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DISSERTATION

DETERMINANTS OF NONPERFORMING LOANS IN PORTUGAL

EDUARDO ANTÓNIO CARVALHO SOARES

SEPTEMBER - 2017

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ORIENTATION:

ANA REGINA NUNES PEREIRA

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RESUMO

A consequência imediata do crescimento de empréstimos em incumprimento (NPLs na sigla Inglesa) no sistema bancário pode ser a sua falha o que se traduz numa ameaça para a estabilidade financeira. Neste contexto, uma das principais lições da crise financeira global é que os reguladores precisam de saber quais são os determinantes que influenciam o aumento de NPLs e monitorizá-los. Esta tese pretende ajudar as instituições financeiras e as autoridades microprudencial e macroprudencial a reconhecer os indicadores que contribuíram para a evolução do rácio de NPLs (empréstimos em incumprimento a dividir pelo total de empréstimos) no período de Dezembro de 1999 a Março de 2016. Com esta finalidade, será testado o impacto de vários indicadores financeiros no rácio de NPLs, e será dada especial atenção aos indicadores financeiros que foram considerados relevantes para explicar o rácio de NPLs noutros países ou que indicam a acumulação de risco sistémico.

Palavras-chave: estabilidade financeira, sistema bancário, rácio de NPLs.

ABSTRACT

The immediate consequence of the rising nonperforming loans (NPLs) in the banking system can be its failure what translates into a threat for financial stability. Against this background, one of the key lessons of the global financial crisis is that policymakers need to recognize the determinants that influence the buildup of NPLs and monitor them. This thesis intends to assist financial institutions and the macroprudential and microprudential authorities in the recognition of the indicators that contributed to the evolution of the NPLs ratio (NPLs divided by total gross loans) in the period between December 1999 and March 2016. In furtherance of this objective, the impact of several financial indicators on NPLs will be tested and special attention will be given to the financial indicators considered as relevant to explain the NPL ratio in other countries or that indicate the build-up of system-wide risk.

Keywords: financial stability, banking system, NPLs ratio.

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1. INTRODUCTION

Prior to the recent global financial crisis, the average bank asset quality across most countries in the world remained relatively stable. During this period, in the United States of America (US), along with the euphoria of the economic growth there was an expansion of the credit market with less focus on the quality of loans and banks moved away from their traditional function and took riskier positions (Beck et al., 2013). When problems in the United States sub-prime mortgage sector started to materialize in 2007, nonperforming loans (NPLs) began to increase sharply as shown in figure 1.

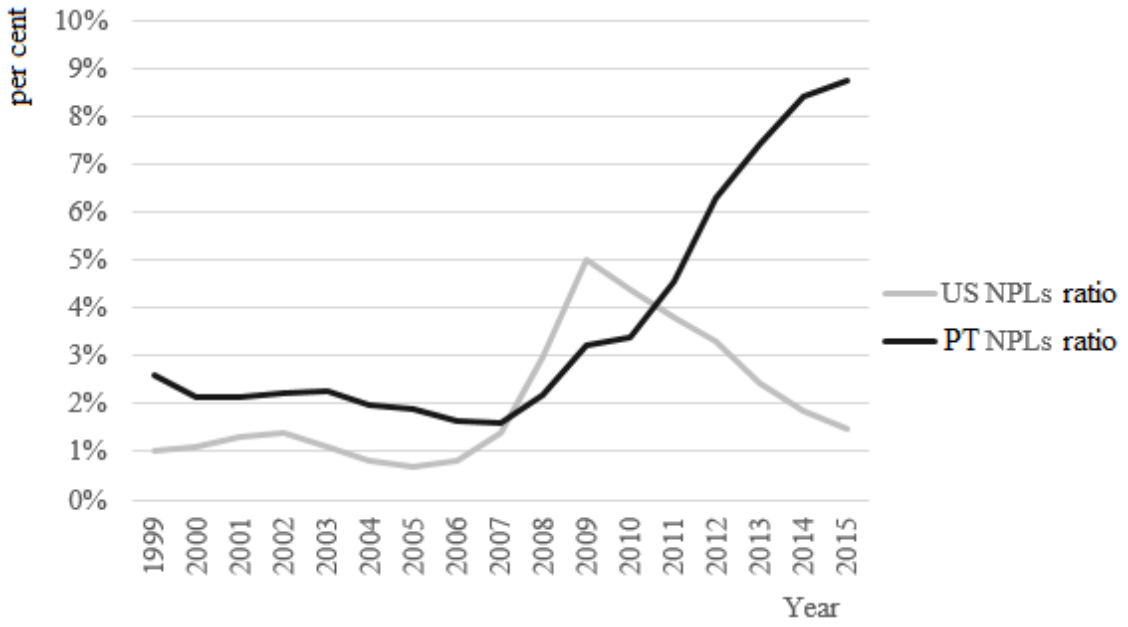

Figure 1 –NPLs to Total Gross Loans ratio (NPL ratio) in Portugal and US (Source: World Bank, Banco de Portugal).

The overall percentage of US NPLs kept rising until 2009. While the US domestic economy largely recovered, there has been a continuous decrease in NPLs (Kossof, 2014). In contrast, NPL ratio in Portugal kept increasing in the years subsequent to 2009. With the euro area integration, increased demand for funding from households and non-financial corporations was met by Portuguese banks leading to an alarming hike in debt.

(Banco de Portugal, 2014). The unfavorable internal factors coupled with the global financial crisis and subsequent economic recession fostered a rapid materialization of high NPL levels in Portugal, especially among non-financial corporations, as shown in figure 2.

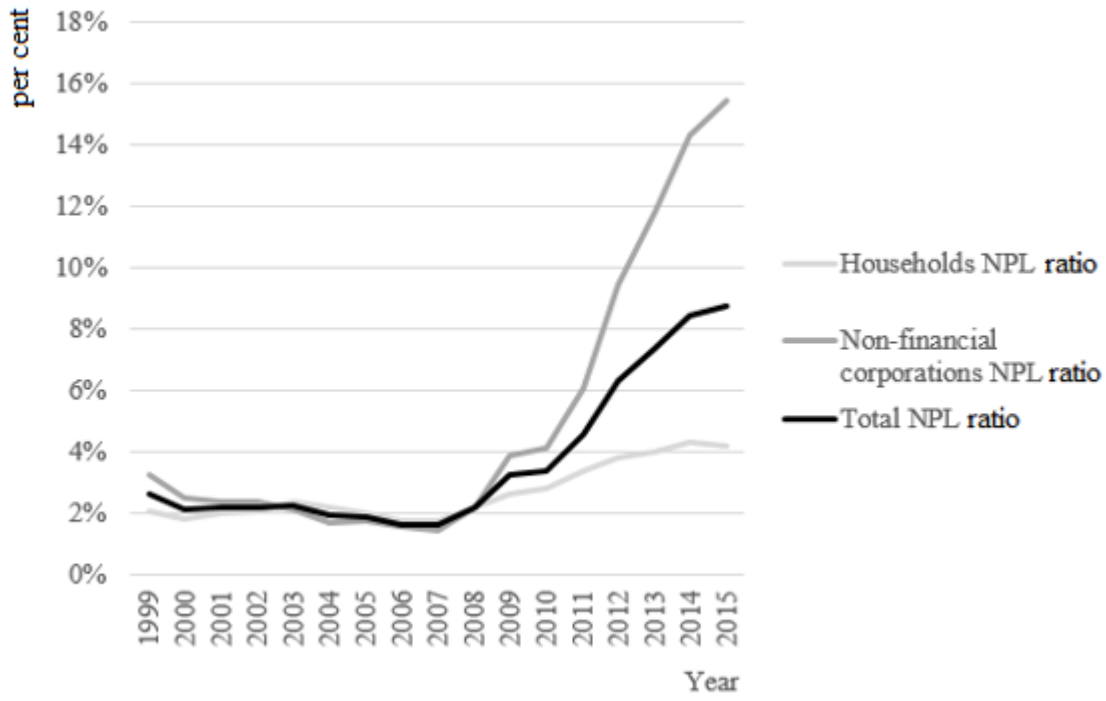

Figure 2 – NPL ratio in Portugal for Households, Non-financial Corporations and Total (Source: Banco de Portugal)

The deterioration of the default rates in Portugal persisted after 2009, boosted by the lower disposable income and high unemployment rate perceived with the economic and financial assistance program in 2011 (Pina, 2013). For a number of European countries, the recent financial crisis and consecutive economic downturn emerged in a framework of an overleveraged non-financial private sector, promoting high levels of NPLs and Portugal was one of the most vulnerable countries to this increase (Banco de Portugal, 2015).

Portuguese banks face significant challenges from their high levels of impaired

assets. Aiyar et al (2015) and Bending et al (2014) suggest that high NPL levels affect bank lending in terms of profitability, capital and funding costs. NPLs generate lower effective return and thus lower profitability. They are also related to higher capital requirements, given their association with greater risks. Finally, given that NPLs generate expectations of lower profitability and increased risk among investors, it may result in higher funding costs.

In recent times, we saw the rising of divergences in Europe. One of the factors among many more that point to the divergence in Europe is the European banking system's solvency situation. The European banking system, especially the Italian and the Portuguese one, have a problem of NPLs in their balance sheets. The NPL ratio has been steadily rising for the last years and the international regulatory framework[1] is exacerbating the adverse effects associated with NPLs maintenance on balance sheets, making them increasingly difficult to bear (Paim, 2013).

Therefore, the factors determining NPLs deserve a lot of interest in order to restore the health of the European banking system solvency and supporting credit growth in Europe.

This study aims to reveal what are the main drivers behind the levels of the NPL ratio in Portugal in the period between December 1999 and March 2016. A considerable amount of financial indicators were tested, and special attention will be given to the financial indicators considered as relevant to explain the NPL ratio in other countries or that indicate the build-up of system-wide risk.

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[1] BCBS, J. (2011). Basel III: A global regulatory framework for more resilient banks and banking systems. *Bank for International Settlements*.

This thesis contributes to academic research by providing an extensive dataset and evidence not yet been presented in the Portuguese market for the period analyzed, which may engage further academic debate and shape financial and economic policies.

This analysis was conducted for Portugal considering that this country has one of the largest amounts of bad loans in Europe, as well as deteriorated financial indicators during recent years.

The study is organized in the following way. Firstly, the literature review discusses in chronological order the main studies that tried to explain the determinants of NPLs and the financial indicators that contribute to systemic-wide risk. Secondly, the data and methodology section is divided into three subsections: dependent variable, explanatory variables and empirical methodology. In the first subsection, it is presented the most know definition of NPLs and a brief analysis of NPLs in Portugal from 1999 until 2016. In the second subsection, the financial indicators used in this analysis were presented bearing in mind the literature before mentioned and in the third subsection we explain and justify the methodology used considering the previous studies in this field using similar methodology, proving its aptness for use in this paper. Lastly, the econometric tests for Portugal are carefully analyzed, and conclusions regarding the determinants of the NPLs ratio and suggestions for future research are presented.

2. LITERATURE REVIEW

In Portugal, the relationship between macroeconomic conditions and the banking system has been widely investigated by Banco de Portugal. However, these investigations were mainly oriented to the identification of indicators with early warning signaling properties for banking crises and there is no evidence that these indicators are related with the development of the NPL ratio. Notwithstanding the number of studies that are made

at a global level to investigate the determinants of the NPL ratio, there is a lack of country specific erudition for Portugal on this matter. The empirical model will rely on some indicators proposed by the studies mentioned in this literature review as potential early warning indicators of rising NPL ratio, especially in advanced economies with high levels of NPLs as in Italy and Spain, given their similarity with Portugal on this matter. As a matter of fact, the countries mentioned in the literature review, despite their geographical proximity, show a number of differences, including, for instance, the quality of institutions, repayment culture and market standards. It follows that the variables can be considered reliable to explain the NPL ratio in one country and less reliable for other countries. The time period under analysis is also different from study to study, meaning that the explanatory variables, even the ones considered previously as not statistically significant, can turn out to be significant when employing an updated and extended time series. For these reasons, even variables that were considered as non-significant to explain the NPL ratio in other countries, were included in the initial model for Portugal. Due to the lack of available data for Portugal on some of the variables discussed below, it was not possible to test all the variables used in similar studies for other countries.

Bonilla (2011) studied the impact of credit growth on the NPLs ratio in Spain and Italy over January 2004 and March 2012, considering that these countries have one of the largest amounts of bad loans in Europe. Credit growth turned out to be not statistically significant for both countries. Salas & Saurina (2002) found evidence that credit growth is useful for explaining the increase in NPLs. This finding infers that after the debt crisis in Europe, the new NPLs in the economy could be more affected by the existing loans than by new loans. This belief is supported by the more stringent credit policies adopted

by the banks after the debt crisis, which have affected the credit markets.

Furthermore, the study of Bonilla (2011) also suggests that inflation is not relevant from a statistical point of view to explain the NPL ratio, neither in Spain nor in Italy, over the period from January 2004 to March 2012. In this thesis, inflation was represented by the consumer price index quarter on quarter growth rate. The consumer price index is an indicator that examines the evolution of the weighted average of prices of a basket of consumer goods and services, such as transportation, food and medical care.

Lastly, Bonilla (2011) argues that unemployment is a very relevant variable with a positive relationship with the NPL ratio in Spain and Italy for the time period of January 2004 to March 2012, since an increase in unemployment may affect the quantity of borrowers not able to fulfill their commitments. The unemployment rate is defined as the percentage of the total labor force that is unemployed but actively seeking employment and willing to work.

Beck et al (2013), after studying NPLs across 75 countries between 2002 and 2012, concluded that an increase of the interest rate increases the NPLs. Loans get more expensive and in return there are less payment capabilities. In contrast, Baholli et al (2015) argued that the interest rate has a negative impact on NPL fluctuations.

In addition, Beck et al (2013) suggest that exchange rate depreciations lead to an increase of NPLs in countries with a high degree of lending in foreign currencies to unhedged borrowers. This is visible in net importing countries, as national currency depreciates making imports more expensive. In the same line of reasoning, Baholli et al (2015) argues that the exchange rate depreciation has a statistically significant and positive relationship with NPLs.

Beck et al (2013) also mentions the real GDP growth as the main driver of NPLs. Therefore, a drop in global economic activity would remain the most important risk for bank asset quality. This is an inflation-adjusted measure that reflects the growth in the value of all goods and services produced by an economy in a given year. According to Bonilla (2011), the GDP is a significant variable with a negative correlation in the model for Spain and a positive correlation in the model for Italy. From these results it is difficult to determine a general relationship of GDP with NPLs. However, Bonilla's (2011) study was made on an annual basis and it is advisable to analyze this variable on a quarterly basis in order to avoid interpolations and possible skewness of the data (Bonilla, 2011). In this thesis, GDP is analyzed on a quarterly basis and we use a year over year comparison.

Finally, Beck et al (2013) found that a decrease in stock prices can negatively affect bank asset quality, particularly in countries with broad stock markets relative to GDP. Shares, while rarely used directly as collateral, might be correlated with other risky assets which serve as collateral for loans, thus a drop in the collateral for loans could be a proxy indicator that negatively affects bank asset quality.

In June 2014, the European Systemic Risk Board issued a recommendation which intended to guide macroprudential authorities on the implementation of a countercyclical capital buffer. In this recommendation, the European Systemic Risk Board (2014) suggests that the variables which indicate the build-up of system-wide risk should include, among others, measures of: a) models that combine the credit to GDP gap and a selection of the above measures; b) potential overvaluation of property prices (e.g. price to income ratio); c) external imbalances (e.g. current account balances as a ratio to GDP);

d) the strength of bank's balance sheets (e.g. loans to deposits ratio); e) private sector debt burden (e.g. debt service to income ratio).

As a result, according to the European Systemic Risk Board (2014), the credit-to-GDP gap is the best single indicator for the Union as a whole for signaling the build-up of financial vulnerabilities associated with banking crises and several studies interpret it as an important measure of excessive credit growth. The credit-to-GDP gap is defined as the difference between the credit-to-GDP ratio and its long-run trend.

With reference to the measures of potential overvaluation of property prices, one of the variables suggested by the European Systemic Risk Board (2014) is the price-to-income ratio. There is no evidence that the price to income ratio has an impact on NPLs. In this thesis, we test its impact on the NPLs ratio in Portugal. The price to income ratio consists on the nominal house prices divided by the nominal disposable income.

Regarding the measures of external imbalances, the debt to GDP is used to measure the financial leverage of an economy. However, there is no evidence that this ratio has an impact on NPLs. We test its impact on the NPLs ratio in Portugal in this thesis. Debt to GDP ratio is expressed as the ratio between a country's government debt and its gross domestic product.

Considering the measures of the strength of banks' balance sheets recommended by the European Systemic Risk Board, the loans to deposits ratio is used to assess a bank's liquidity and is obtained by dividing the bank's total loans by its total deposits. It is a measure of the strength of a bank's balance sheet and there is evidence of a strong rise in this ratio during the four years preceding the recent financial crisis and the same behavior is found in many other countries before major banking crises (Banco de Portugal, 2015). Given its banking crisis signaling properties, Banco de Portugal uses the loans to deposits

ratio to support its countercyclical capital buffer rate decisions. However, there is no evidence that this ratio affects the NPLs ratio. Therefore, in this paper, we will seek to scrutinize the relationship and its impact on the NPLs ratio in Portugal.

Lastly, with reference to the measures of private sector debt burden, the European Systemic Risk Board (2014) suggests the debt service to income ratio as a reliable early warning indicator for systemic banking crises. The debt service ratio is defined as the ratio of interest payments plus amortizations to income. In this thesis this ratio is studied for the private non-financial sector. This ratio measures the proportion of income used to repay debt and meet interest payments. If the debt level of the private non-financial sector grows faster than disposable income then economic agents need to spend more of their income in the future to repay their loans. An adverse shock to income increases the probability of default (Banco de Portugal, 2015). Considering this, we expect this variable to have a positive relationship with the NPL ratio given that unfavorable developments in the repayment capacity of the private non-financial sector might make households and corporations default on their commitments.

Baholli et al (2015) studied the impact of the credit to economy (the ratio of total credit to GDP) on the NPLs ratio in Albania given that its economy is recently having low growth with the banking system suffering from the increase of NPLs. The model indicated that when lending increases the probability of an increase in the NPL ratio is higher. This is explained by the fact that when an economy has a high level of credit to economy, an economic crisis will make businesses suffer liquidity problems due to stricter access to credit. Along the same line of reasoning, Jakubík & Reininger (2013) empirically assessed the impact of the private credit to GDP ratio in the quality of banks'

assets in the CESEE countries (their study covers the following nine CESEE countries: Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, Russia, Slovakia and Ukraine) and their model suggested this variable to be statistically significant.

3. DATA AND METHODOLOGY

In this thesis we estimate a regression in which the dependent variable is the NPL ratio. Several financial indicators and their impact on the NPL ratio in Portugal will be tested: the financial indicators considered as relevant to explain the NPL ratio in other countries and the financial indicators that indicate the build-up of system-wide risk.

3.1. Dependent Variable

Asset quality in banks' balance sheet can be determined using distinct concepts, based on prudential, accounting or supervisory reporting benchmarks. Nonperforming exposures (NPEs), of which NPLs are the main component, are the principal concepts at European level for assessing bank's credit quality. Therefore, it is important to have a clear perception of their definition and scope, as well as how they compare and relate with national concepts. Currently, some international institutions, such as the European Banking Authority and the European Central Bank use NPE/NPL based indicators to perform international analysis and comparisons on credit quality. However, there is a high level of subjectivity in regard to these concepts and insufficient harmonization across countries, and even across institutions of the same country (Banco de Portugal, 2016).

In this thesis, the NPL ratio is defined as total NPLs over total gross loans. The data regarding NPLs is collected from Banco de Portugal and covers the period between December 1999 and March 2016. In this paper it is adopted the definition proposed by the International Monetary Fund Staff (2008) in the Financial Soundness Indicators Guide

that is the definition more generally accepted, including by Banco de Portugal. To improve the cross-country comparability of data, the Financial Soundness Indicators Guide recommends that loans (and other assets) should be classified as NPL when:

1. Payments of principal and interest are past due by three months (90 days) or more;
2. Interest payments equal to three months (90 days) interest or more have been capitalized (reinvested into the principal amount), refinanced, or rolled over (that is, the payment has been delayed by agreement).
3. Loans with payments less than 90 days past due that are recognized as nonperforming under national supervisory guidance (when evidence exists to classify a loan as nonperforming even in the absence of a 90-day past due payment, such as when the debtor files for bankruptcy).

According to figure 1, from 1998 until 2000, the NPL ratio decreased continuously in Portugal. The decline up to 2000 was consistent with the economic growth and development observed in Portugal after 1986. This period was characterized by high GDP growth rates, low unemployment, falling interest rates and a low level of NPLs for households and non-financial corporations.

From 2000 until 2008, the NPLs ratio remained relatively stable. With the euro area integration, increased demand for funding from households, firms and the public sector was met through lending by Portuguese banks which, in turn, borrowed on the international financial markets (Banco de Portugal, 2014). Portuguese households' debt trajectories diverged sharply from the euro area average as well as the financing structure of Portuguese firms, having one of the highest debt to capital ratios in the euro area as a whole (Banco de Portugal, 2014). In 2006, Portuguese GDP growth at 1.3 percent, was

the lowest in Europe. According to The Economist (2007), the European Commission is of the view that Portugal's error was the excessive increase in public spending. When interest rates dropped and led to a surge of growth in the late 1990s, Portugal opted for an expansionary fiscal policy instead of softening its deficit. These unfavorable internal factors coupled with the global financial crisis and subsequent economic recession emerged Portugal in a framework of an overleveraged non-financial private sector, which fostered a rapid materialization of high NPL levels among non-financial corporations (Pina, 2013). NPLs among households were more subdued and remained at modest levels, according to figure 2. This is explained by the fact that households loans are mostly obtained for the purchase of permanent dwellings, which act as collateral and, therefore, default tends to be lower. In turn, there was a significant materialization of credit risk in bank loans to households for consumption and other purposes due to the lower disposable income and high unemployment rate following the economic slowdown and the financial assistance program in 2011, according to figure 3.

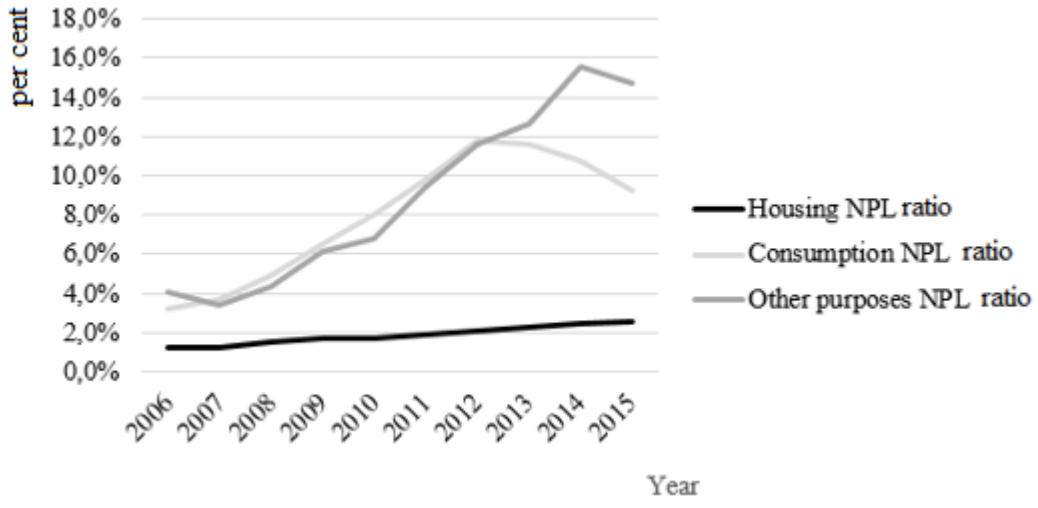

Figure 3 — NPL ratio in Portugal for Households Separated by Purposes: Housing Loans, Consumption Loans and Other Purposes (Source: Banco de Portugal)

The deterioration of the non-financial corporations NPLs was transversal by size of company and branch of activity since the beginning of the economic and financial assistance, as can be seen in figure 4.

According to Banco de Portugal (2016), in June 2016, the NPLs ratio granted by the resident financial sector to non-financial corporations stood at 16.5 percent (5.2 percent in March 2011). The credit granted by the financial sector continued to be channeled to the most profitable sectors and well capitalized companies, resulting in a reduction in the relative weight of the construction and real estate activities sectors and in the increase of the relative importance of the manufacturing and trade sectors. Manufacturing and trade have profitability ratios that are on average more favorable than the total of private firms. Construction, real estate and trade continued to record an increase in the NPL ratio, while this ratio remained unchanged in manufacturing and declined considerably in hotels and restaurants.

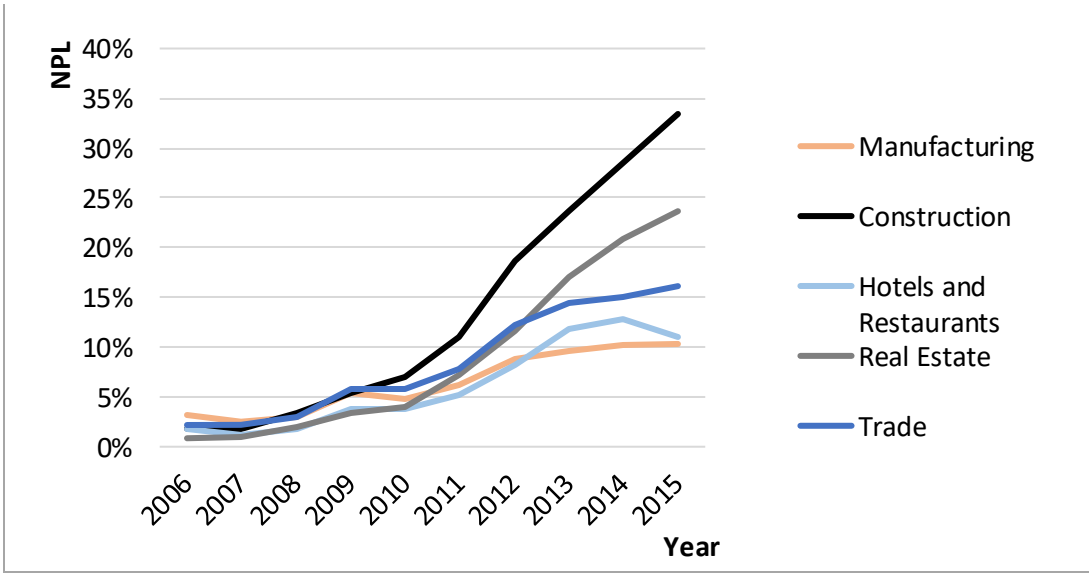

Figure 4 –NPL ratio Across Economic Activities in Portugal (Source: Banco de Portugal).

3.2. Explanatory Variables

Table I presents the explanatory variables that were tested to describe the NPL ratio in Portugal in the time period of December 1999 to March 2016 along with their respective initials and source. The explanatory variables chosen were the financial indicators already discussed in the literature review for which there is data for Portugal in the time period between December 1999 and March 2016 and one more variable which is not commonly test, the spread between the PT and DE 10 year bonds. This variable consists on the interest rate differential between the two government bonds. Bond spreads reflect the relative risks of the bonds being compared. The larger the spread, the higher the risk usually is.

Table I

Explanatory variables

Explanatory Variable	Initials	Source
Credit growth	CREDITGROWTH	Banco de Portugal, Statistical Bulletin
Credit to GDP gap (Bank credit to nonfinancial private sector)	GAPBANKPRIVATE	Author's calculation
Credit to GDP gap (Total credit to households)	GAPHH	Author's calculation
Credit to GDP gap (Total credit to nonfinancial corporations)	GAPNFC	Author's calculation
Credit to GDP gap (Total credit to nonfinancial private sector)	GAPPRIVATE	Author's calculation
Debt service ratio	DEBTSERVICE	Bank for International Settlements, Statistics Warehouse
Government debt to GDP ratio	DEBTGDP	European Central Bank, Statistical Data Warehouse
Inflation	INFLATION	Organisation for Economic Co-Operation and Development, Statistics
Loans-to-deposit ratio	LOANSDEPOSITS	European Central Bank, Statistical Data Warehouse
Price to income ratio	PRICEINCOME	Organisation for Economic Co-Operation and Development, Statistics
Real GDP growth	RGDPGROWTH	Organisation for Economic Co-Operation and Development, Statistics
Spread between PT and DE 10 year bonds	SPREAD	Author's calculation
Unemployment rate	UNEMPLO	Banco de Portugal, Statistical Bulletin

Table II below presents the descriptive statistics for each variable under the scope of this thesis. A broader set of descriptive statistics for the same variables is presented in the appendix in table VI.

Table II

Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum
NPL	3,8%	2,4%	9,3%	1,6%
CREDITGROWTH	5,9%	5,0%	27,6%	-4,5%
DEBTGDP	83,8%	69,1%	132,8%	50,1%
DEBTSERVICE	19,2%	19,0%	22,4%	14,9%
GAPBANKPRIVATE	620 bps	1100 bps	3490 bps	-3860 bps
GAPHH	80 bps	350 bps	1510 bps	-2110 bps
GAPNFC	1190 bps	1190 bps	3430 bps	-1970 bps
GAPPRIVATE	1270 bps	1550 bps	4430 bps	-4080 bps
INFLATION	2,1%	2,5%	4,8%	-1,5%
LOANSDEPOSITS	144,7%	146,7%	167,8%	107,5%
PRICEINCOME	110,1%	106,8%	132,0%	90,4%
RGDPGROWTH	0,5%	1,1%	4,4%	-4,5%
SPREAD	196 bps	39 bps	1139 bps	0 bps
UNEMPLO	10,1%	9,2%	17,3%	4,8%

The credit growth in Portugal was obtained from the statistical bulletin of Banco de Portugal and averaged 5,8 percent from December 1999 until March 2016, reaching an upper limit of 27,5 percent in March of 2000 in line with the economic growth and development observed in Portugal at the time and a record low of -4,5 percent in March of 2013 reflecting the financial crisis and subsequent economic recession.

The credit to GDP gap was separated into different categorie as follows: (i) total credit to non-financial private sector to GDP gap; (ii) bank credit to non-financial private sector to GDP gap, (iii) total credit to households to GDP gap and (iv) total credit

to non-financial corporations to GDP gap. All types of credit to GDP gap were calculated by the author.

The government debt to GDP ratio in Portugal averaged 83 percent over the period under analysis, reaching a peak of 132,7 percent in March of 2014, being one of the highest government debt to GDP ratios recorded in Europe, only behind Greece and Italy. This variable had a record low of 50,1 percent in March of 2001.

The inflation in Portugal averaged 2,1 percent between December 1999 and March 2016, reaching a peak of 4.8 percent in March of 2001 and a minimum of -1,5 percent in September of 2009, remaining low in Portugal and in the euro area in the subsequent years.

The price to income ratio in Portugal averaged 110 percent from December 1999 until March 2016, reaching a maximum of 131,9 percent in March of 2001 and a minimum of 90,4 percent in March 2013, amidst deteriorating economic conditions.

The real GDP growth in Portugal averaged 0,5 percent from December 1999 until March 2016, achieving a peak of 4,4 percent in the first quarter of 2000, consistent with the economic growth and development observed in Portugal in this period and with a low point of -4,5 percent in the last quarter of 2012 due to the financial crisis and subsequent economic recession.

3.3. Empirical Methodology

The model used to describe the NPLs ratio in the time period of December 1999 to March 2016 was a linear regression estimated by ordinary least squares (OLS). We specified the following regression, which has all the variables under the scope of this thesis:

$$(1)\quad \mathrm{D1(NPLTOTAL)}_t = \alpha + \beta_1 \mathrm{D1(CREDITGROWTH)}_{t-8} + \beta_2 \mathrm{D1(GAPBANKPRIVATE)}_{t-4}, + \beta_3 D1(\mathrm{GAPHH})_{t-4} + \beta_4 \mathrm{D1(GAPNFC)}_{t-6} + \beta_5 \mathrm{D1(GAPPRIVATE)}_{t-6}, + \beta_6 \mathrm{D1(DEBTGDP)}_{t-9} + \beta_7 \mathrm{D1(DEBTSERVICE)}_{t-5} + \beta_8 \mathrm{D1(INFLATION)}_{t-4} + \beta_9 \mathrm{D1(PRICEINCOME)}_{t-4} + \beta_{10} \mathrm{D1(PRICEINCOME)}_{t-6} + \beta_{11} 0 D1(\mathrm{RGDPGROWTH})_{t-4} + \beta_{12} \mathrm{D1(SPREAD)}_{t-7} + \beta_{13} \mathrm{D1(UNEMPLO)}_{t-1} + \epsilon$$

where *D1* stands for the first difference, α is the constant, ϵ is the residual term of the regression and β_i *i=1,…,13* represents the coefficient of each variable.

In order to evaluate the presence of a unit root, it is used the Augmented Dickey-Fuller test. Considering that the variables under the scope of this thesis are non-stationary, we apply transformations to estimate an appropriate model with stationary time series, respecting the statistical properties of the OLS estimators. It is not possible to apply the logarithm to any variable, since they are expressed in percentage. To stationarize the time series, it is applied the first differences:

$$(2)\quad \Delta X_t = X_t - X_{t-1}$$

where X denotes the variable and t the time period

Given that this regression equation is used to predict current values of a dependent variable based on lagged (past) values of explanatory variables, we included lags in the equation. The number of lags selected for each variable was chosen through multiple trials and graphical analysis by checking how much quarters (lags) it takes for a movement in the explanatory variable to have an impact on the NPLs ratio.

The precision or robustness of an OLS estimation is given by its standard error. To access the viability of the model, the residuals were analyzed by performing a series of tests. A normality test was performed to the residuals to determine if they are normally distributed. The presence of serial correlation in the model was tested by the Breusch-Godfrey Serial Correlation LM Test. The null hypothesis assumes no serial correlation of any order up to p, where p is the order of autocorrelation being tested. If the null hypothesis is rejected, there is evidence of serial correlation and standard inference is no longer valid. In order to test for the presence of heteroskedasticity, two different tests were used: the Breusch Pagan-Godfrey and the White's test. If heteroscedasticity is present, the error term does not have a constant variance, invalidating all the standard inference.

The RESET test tests whether non-linear combinations of the explanatory variables help explain the dependent variable. This procedure aims to test if there are omitted variables and incorrect functional form.

Further considerations regarding the empirical methodology and results interpretation are addressed in section 4.

4. Analysis of Results

All the following results were obtained using Eviews (Econometric Views).

With reference to the correlation matrix (table VII in the appendix), there is a high correlation between some regressors. For instance, the correlation between the government debt to GDP ratio and unemployment rate is about 0.93 or, for the price to income ratio and unemployment is about -0.93.

Regarding the Augmented Dickey-Fuller test (Table V in the appendix) which assesses the presence of a unit root, after applying first differences to all variables, the null hypothesis is rejected for all variables under scope, meaning there are no unit roots at a 5 percent significance level, the series are stationary.

Table III below shows the OLS regression output when considering all the variables under the scope of this research.

Since the p value for $\mathrm{LOANSDEPOSITSD1}_{t-4}$, is higher than the 10 percent significance level, this is not statistically significant, meaning it will not be considered in this research since it has no explanatory power of the variance of the independent variable at this significance level.

Table III

OLS Regression With All Variables

Dependent Variable: NPLD1
Method: Least Squares

Sample (adjusted): 11 66
Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CREDITGROWTHD1(-8...	-0.026610	0.010692	-2.488723	0.0169
DEBTGDPD1(-9)	0.022710	0.010469	2.169189	0.0358
DEBTSERVICED1(-5)	0.105056	0.053454	1.965350	0.0560
GAPBANKPRIVATED1(-...	0.055478	0.017354	3.196854	0.0026
GAPHHD1(-4)	-0.314444	0.050149	-6.270184	0.0000
GAPNFCD1(-6)	0.241776	0.053633	4.507943	0.0001
GAPPRIVATED1(-6)	-0.243583	0.052393	-4.649175	0.0000
INFLATIOND1(-4)	-0.000627	0.000329	-1.905755	0.0635
LOANSDEPOSITS(-4)	-0.000664	0.001898	-0.349845	0.7282
PRICEINCOMED1(-6)	-0.035774	0.014561	-2.456818	0.0182
RGDPGROWTHD1(-4)	0.044333	0.021417	2.070018	0.0446
SPREADD1(-7)	0.075191	0.032037	2.347002	0.0237
UNEMPLOD1(-1)	0.120695	0.053776	2.244402	0.0301
C	-0.001276	0.002868	-0.444945	0.6586

R-squared	0.755410	Mean dependent var	0.001209
Adjusted R-squared	0.679703	S.D. dependent var	0.002374
S.E. of regression	0.001344	Akaike info criterion	-10.17474
Sum squared resid	7.58E-05	Schwarz criterion	-9.668405
Log likelihood	298.8928	Hannan-Quinn criter.	-9.978437
F-statistic	9.978123	Durbin-Watson stat	1.965033
Prob(F-statistic)	0.000000		

After dropping from equation 1 the non-statistically significant variables, the final OLS regression for the period under consideration is the following.

$$(3)\quad \mathrm{D1(NPLTOTAL)}_t = \alpha + \beta_1 \mathrm{D1(CREDITGROWTH)}_{t-8} + \beta_2 \mathrm{D1(GAPBANKPRIVATE)}_{t-4}, + \beta_3 D1(\mathrm{GAPHH})_{t-4} + \beta_4 \mathrm{D1(GAPNFC)}_{t-6} + \beta_5 \mathrm{D1(GAPPRIVATE)}_{t-6}, + \beta_6 \mathrm{D1(DEBTGDP)}_{t-9} + \beta_7 \mathrm{D1(DEBTSERVICE)}_{t-5} + \beta_8 \mathrm{D1(INFLATION)}_{t-4} + \beta_9 \mathrm{D1(PRICEINCOME)}_{t-6} + \beta_{10} \mathrm{D1(RGDPGROWTH)}_{t-4} + \beta_{11} \mathrm{D1(SPREAD)}_{t-7} + \beta_{12} \mathrm{D1(UNEMPLO)}_{t-1} + \epsilon$$

The results shown in table IV below are in line with expectations. The high R-squared value (about 0.75) demonstrates that the model fits the data well. The model explains a high share of the variability in the dependent variable.

Table IV

New OLS Regression

Dependent Variable: NPLD1
Method: Least Squares

Sample (adjusted): 11 66
Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CREDITGROWTHD1(-8...	-0.027090	0.010495	-2.581143	0.0133
DEBTGDPD1(-9)	0.022304	0.010298	2.165845	0.0359
DEBTSERVICED1(-5)	0.108953	0.051744	2.105601	0.0411
GAPBANKPRIVATED1(-...	0.052111	0.014293	3.645916	0.0007
GAPHHD1(-4)	-0.309706	0.047790	-6.480536	0.0000
GAPNFCD1(-6)	0.241150	0.053054	4.545395	0.0000
GAPPRIVATED1(-6)	-0.243119	0.051839	-4.689913	0.0000
INFLATIOND1(-4)	-0.000635	0.000325	-1.954555	0.0572
PRICEINCOMED1(-6)	-0.034434	0.013905	-2.476466	0.0173
RGDPGROWTHD1(-4)	0.043581	0.021090	2.066417	0.0448
SPREADD1(-7)	0.072782	0.030968	2.350274	0.0234
UNEMPLOD1(-1)	0.116769	0.052052	2.243295	0.0301
C	-0.002269	0.000412	-5.504944	0.0000

R-squared	0.754697	Mean dependent var	0.001209
Adjusted R-squared	0.686240	S.D. dependent var	0.002374
S.E. of regression	0.001330	Akaike info criterion	-10.20755
Sum squared resid	7.60E-05	Schwarz criterion	-9.737376
Log likelihood	298.8113	Hannan-Quinn criter.	-10.02526
F-statistic	11.02444	Durbin-Watson stat	1.960900
Prob(F-statistic)	0.000000		

In accordance with section 3, to access the robustness and the viability of the model, the OLS residuals were tested.

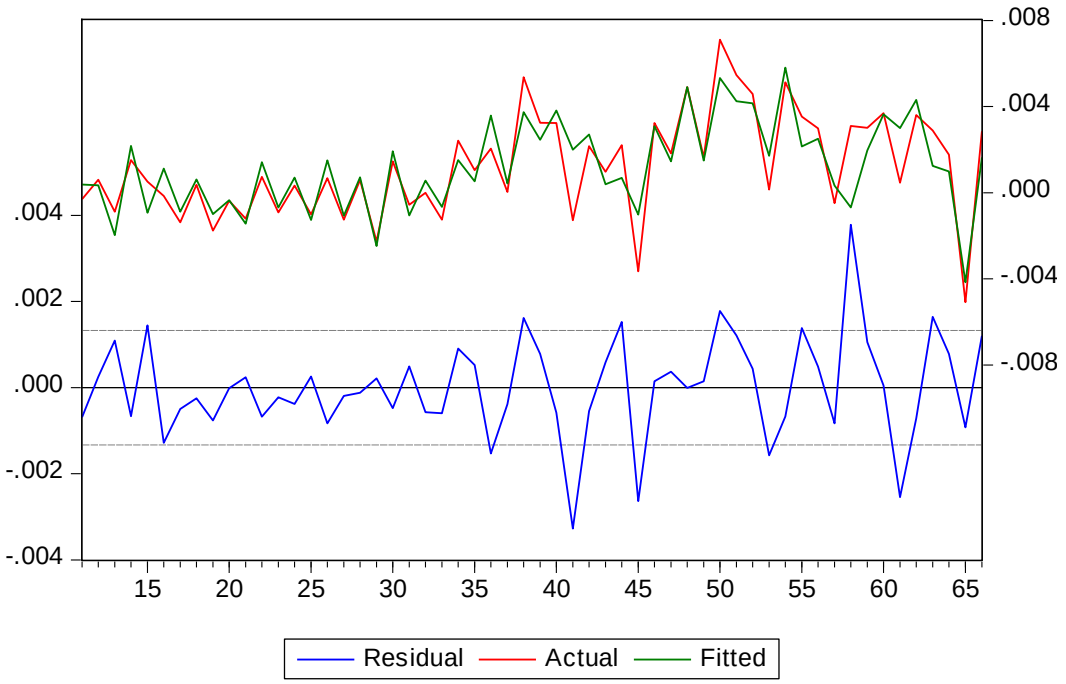

Figure 5 – OLS residuals plot

The high variability of the residuals in the last part of our sample, especially during unstable market periods, might indicate the possible violation of the hypothesis of constant variance of the error term. Also, in the presence of high variability, as can be seen in figure 5, the normality hypothesis might also be violated.

As figure 6 in the appendix shows, it is not rejected that the OLS residuals are normally distributed at a 5% significance level as the Kurtosis is approximately 3 and the Skewness equal to 0.

The Breusch-Godfrey Serial Correlation LM Test with 1 lag (table IX in the appendix) shows that the null hypothesis is not rejected, the p-value is higher than the 5 percent significance level, meaning that there is no serial correlation. This test allows to infer that, in principle, the coefficient estimates are not biased.

Table X in the appendix shows the Breusch-Pagan-Godfrey Heteroskedasticity test on the OLS residuals. Due to a high p-value (0.32) the null hypothesis of

homoscedasticity is not rejected. In other words, the variance of the errors seems to be constant. The same reasoning is corroborated by the White test (table XI in the appendix). Since the p-value is higher than 5 percent, the null hypothesis is not rejected at a 5 percent significance level. If heteroskedasticity was present, the standard errors could infer inappropriate results and further considerations could also be misleading. However, as in both tests we reject heteroskedasticity, there is no need for further corrections in the model.

The RESET test (table XII in the appendix) tests the possibility of misspecification of the functional form. Once more, due to the high p-value (about 0.26) the linearity is not rejected.

The following results only concern Portugal in the time period between December 1999 and March 2016.

1. Credit growth: the variable credit growth had a negative and statistically significant impact on the NPLs ratio in Portugal at a 95 percent confidence level. This finding allows to infer that the new NPLs in the economy could be more affected by the existing loans than by new loans.

2. Credit to GDP gap: the bank credit to non-financial private sector to GDP gap and total credit to non-financial corporations to GDP gap had a positive and statistically significant impact on the NPLs ratio in Portugal at a 99 percent confidence level. Total credit to nonfinancial private sector to GDP gap and total credit to households to GDP gap had a negative and statistically significant impact on the NPL ratio in Portugal at a 99 percent confidence

level.

3. Government debt to GDP ratio: this ratio had a positive and statistically significant impact on the NPLs ratio in Portugal at a 95 percent confidence level. Therefore, the model suggests that as the government debt increases, the NPL ratio increases as well.

4. Inflation: this variable had a negative and statistically significant impact on the NPLs ratio in Portugal at a 90 percent confidence level. The model suggests that an increase in inflation may decrease the NPL ratio, possibly due to higher agents' income.

5. Price to income ratio: this ratio had a negative and statistically significant impact on the NPLs ratio in Portugal at a 95 percent confidence level. This is explained by the fact that an increase in house prices has a positive impact on agents' net wealth reducing the level of NPLs. Therefore, in addition to having signaling properties for banking crises (European Systemic Risk Board, 2014), the model suggests that the price to income ratio affected the NPLs ratio in Portugal during the studied period.

6. Real GDP growth: is a positive and statistically significant variable at a 95 percent confidence level, so it is suggested that an increase in economic activity might have been a risk for bank asset quality in Portugal.

7. Unemployment rate: the model suggests the unemployment rate has positive and statistically significant impact at a 90 percent confidence level. The model suggests that an increase in unemployment would affect the number of borrowers not fulfilling their commitments.

8. Debt service to income ratio: the debt service to income ratio had a positive and statistically significant impact on the NPLs ratio in Portugal at a 95 percent confidence level. Therefore, this finding is consistent with the other studies reviewed in the literature review section. Unfavorable developments in the repayment capacity of the private non-financial sector contribute to the buildup of NPLs in Portugal, given that households and corporations might default on their commitments (Banco de Portugal, 2015).

9. Spread between PT and DE 10 year bonds: the interest rate differential between PT and DE 10 year bonds had a positive and statistically significant impact on the NPLs ratio in Portugal at a 90 percent confidence level. Therefore, the model suggests that the higher the interest differentials between PT and DE government bonds, the higher the risk, which might have affected the NPL ratio in Portugal.

10. Loans to deposits ratio: the loans to deposits ratio had not a statistically significant impact on the NPLs ratio in Portugal. Despite having early warning signaling properties for banking crises (Banco de Portugal, 2015), the model suggests that the loans to deposits ratio did not affect NPLs in Portugal during the studied period.

5. CONCLUSIONS AND FUTURE RESEARCH

The results of this research show new empirical evidence on the impact of several variables on the NPL ratio in Portugal in the time period between December 1999 and March 2016.

Overall, the results of the research were satisfactory given the adequacy of the model in the explanation of the NPL ratio. The robustness tests provided statistical proof that results were not spurious as the majority of the OLS regression assumptions were verified.

For further research on this topic, with more available data, is worth analyzing potential determinants of the NPLs ratio such as lending rates, exchange rates, stock prices and indicators of bank's capital adequacy (e.g. regulatory tier 1 capital to risk weighted assets), profitability (e.g. return on assets and return on equity), liquidity (e.g. liquid assets to short term liabilities) and leverage (e.g. capital to assets).

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7. APPENDIX

Table V

Augmented Dickey Fuller test

Variable	ADF test	t-statistic	Transformation	ADF test	t-statistic
NPL	I(1)	2.77	First differences	I(0)	-6.24
CREDITGROWTH	I(1)	-2.67	First differences	I(0)	-6.24
DEBTGDP	I(1)	0.58	First differences	I(0)	-6.70
DEBTSERVICE	I(1)	-2.47	First differences	I(0)	-3.72
GAPBANKPRIVATE	I(1)	2.81	First differences	I(0)	-5.02
GAPHH	I(1)	3.79	First differences	I(0)	-5.89
GAPNFC	I(1)	0.76	First differences	I(0)	-7.83
GAPPRIVATE	I(1)	1.82	First differences	I(0)	-7.34
INFLATION	I(1)	-1.47	First differences	I(0)	-5.31
LOANSDEPOSITS	I(1)	-1.23	First differences	I(0)	-6.25
PRICEINCOME	I(1)	-0.82	First differences	I(0)	-6.49
RGDPGROWTH	I(1)	-2.25	First differences	I(0)	-6.20
SPREAD	I(1)	-1.08	First differences	I(0)	-3.49
UNEMPLO	I(1)	-1.29	First differences	I(0)	-4.48

Table VI

Descriptive Statistics

	NPL	CREDITGR(	DEBTGDP	DEBTSERV	GAPBANKI	GAPHH	GAPNFC	GAPPRIVA	INFLATION	LOANSDEP	PRICEINCC	RGDPGROV	SPREAD	UNEMPLO
Mean	0,04	0,06	0,84	0,19	0,06	0,01	0,12	0,13	0,02	1,45	1,10	0,00	0,02	0,10
Median	0,02	0,05	0,69	0,19	0,11	0,04	0,12	0,16	0,02	1,47	1,07	0,01	0,00	0,09
Maximum	0,09	0,28	1,33	0,22	0,35	0,15	0,34	0,44	0,05	1,68	1,32	0,04	0,11	0,17
Minimum	0,02	-0,05	0,50	0,15	-0,39	-0,21	-0,20	-0,41	-0,02	1,07	0,90	-0,04	0,00	0,05
Std. Dev.	0,02	0,08	0,30	0,02	0,20	0,11	0,12	0,22	0,02	0,17	0,13	0,02	0,03	0,04
Skewness	1,11	0,61	0,56	-0,18	-0,69	-0,51	-0,90	-0,80	-0,01	-0,46	0,20	-0,74	1,84	0,30
Kurtosis	2,68	2,85	1,69	2,84	2,67	2,01	3,44	2,80	0,02	2,17	1,48	2,67	5,58	2,11
Jarque-Bera	13,75	4,19	8,22	0,43	5,61	5,57	9,54	7,14	4,37	4,18	6,80	6,32	55,55	3,16
Probability	0,00	0,12	0,02	0,81	0,06	0,06	0,01	0,03	0,11	0,12	0,03	0,04	0,00	0,21
Sum	2,51	3,89	55,29	12,69	4,10	0,52	7,86	8,38	1,40	95,52	72,69	0,32	1,30	6,67
Sum Sq. Dev	0,04	0,43	5,87	0,02	2,70	0,80	0,96	3,28	1,52	1,92	1,15	0,03	0,05	0,08
Observations	66,00	66,00	66,00	66,00	66,00	66,00	66,00	66,00	66,00	66,00	66,00	66,00	66,00	66,00

Table VII

Correlation matrix

	NPL	CREDITGROW	DEBTGDP	DEBTSERVICE	GAPBANKPRI	GAPHH	GAPNFC	GAPPRIVATE	INFLATION	LOANSDEPOS	PRICEINCOM	RGDPGROWT	SPREAD	UNEMPLO
NPL	1,00	-0,74	0,93	0,13	-0,91	-0,92	-0,83	-0,90	-0,59	-0,41	-0,72	-0,23	0,51	0,75
CREDITGROW	-0,74	1,00	-0,84	-0,59	0,82	0,84	0,54	0,71	0,54	-0,16	0,82	0,57	-0,59	-0,85
DEBTGDP	0,93	-0,84	1,00	0,41	-0,94	-0,98	-0,81	-0,92	-0,57	-0,09	-0,89	-0,40	0,70	0,93
DEBTSERVICE	0,13	-0,59	0,41	1,00	-0,29	-0,41	-0,09	-0,25	-0,17	0,71	-0,68	-0,67	0,53	0,60
GAPBANKPRI	-0,91	0,82	-0,94	-0,29	1,00	0,97	0,90	0,96	0,61	0,14	0,83	0,24	-0,48	-0,82
GAPHH	-0,92	0,84	-0,98	-0,41	0,97	1,00	0,88	0,97	0,62	0,06	0,91	0,33	-0,59	-0,88
GAPNFC	-0,83	0,54	-0,81	-0,09	0,90	0,88	1,00	0,97	0,54	0,23	0,70	-0,02	-0,31	-0,63
GAPPRIVATE	-0,90	0,71	-0,92	-0,25	0,96	0,97	0,97	1,00	0,59	0,16	0,83	0,15	-0,46	-0,77
INFLATION	-0,59	0,54	-0,57	-0,17	0,61	0,62	0,54	0,59	1,00	0,01	0,62	0,15	-0,04	-0,54
LOANSDEPOS	-0,41	-0,16	-0,09	0,71	0,14	0,06	0,23	0,16	0,01	1,00	-0,27	-0,38	0,09	0,20
PRICEINCOM	-0,72	0,82	-0,89	-0,68	0,83	0,91	0,70	0,83	0,62	-0,27	1,00	0,49	-0,65	-0,93
RGDPGROWT	-0,23	0,57	-0,40	-0,67	0,24	0,33	-0,02	0,15	0,15	-0,38	0,49	1,00	-0,61	-0,57
SPREAD	0,51	-0,59	0,70	0,53	-0,48	-0,59	-0,31	-0,46	-0,04	0,09	-0,65	-0,61	1,00	0,75
UNEMPLO	0,75	-0,85	0,93	0,60	-0,82	-0,88	-0,63	-0,77	-0,54	0,20	-0,93	-0,57	0,75	1,00

Table VIII

OLS and new OLS results

Variable	p-value	p-value
CREDITGROWTHD1(-8)	0.0169*	0.0133*
DEBTGDPD1(-9)	0.0358**	0.0359**
DEBTSERVICED1(-5)	0.0560**	0.0411**
GAPBANKPRIVATED1(-4)	0.0026*	0.0007*
GAPHHD1(-4)	0.0000*	0.0000*
GAPNFCD1(-6)	0.0001*	0.0000*
GAPPRIVATED1(-6)	0.0000*	0.0000*
INFLATIOND1(-4)	0.0635***	0.0572**
LOANSDEPOSITSD1(-4)	0.7282	
PRICEINCOMED1(-6)	0.0182*	0.0173*
RGDPGROWTHD1(-4)	0.0446**	0.0448**
SPREADD1(-7)	0.0237**	0.0234**
UNEMPLOD1(-1)	0.0301**	0.0301**
C	0.6586	0.0000*

**** 10 percent significance level, **5 percent significance level, *1 percent significance level*

Table IX

Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.002490	Prob. F(1,42)	0.9604
Obs*R-squared	0.003320	Prob. Chi-Square(1)	0.9540

Test Equation:
Dependent Variable: RESID
Method: Least Squares

Sample: 11 66
Included observations: 56
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CREDITGROWTHD1(-8...	2.49E-05	0.010631	0.002340	0.9981
DEBTGDPD1(-9)	-0.000124	0.010714	-0.011607	0.9908
DEBTSERVICED1(-5)	-0.000257	0.052608	-0.004886	0.9961
GAPBANKPRIVATED1(-...	2.76E-05	0.014472	0.001910	0.9985
GAPHHD1(-4)	-0.000179	0.048488	-0.003699	0.9971
GAPNFCD1(-6)	-3.58E-05	0.053685	-0.000666	0.9995
GAPPRIVATED1(-6)	-3.35E-05	0.052455	-0.000638	0.9995
INFLATIOND1(-4)	-3.04E-06	0.000334	-0.009076	0.9928
PRICEINCOMED1(-6)	-2.97E-05	0.014081	-0.002108	0.9983
RGDPGROWTHD1(-4)	-2.80E-05	0.021346	-0.001313	0.9990
SPREADD1(-7)	0.000319	0.031979	0.009981	0.9921
UNEMPLOD1(-1)	2.22E-05	0.052669	0.000422	0.9997
C	3.01E-07	0.000417	0.000722	0.9994
RESID(-1)	0.008571	0.171749	0.049904	0.9604

R-squared	0.000059	Mean dependent var	3.14E-19
Adjusted R-squared	-0.309446	S.D. dependent var	0.001176
S.E. of regression	0.001345	Akaike info criterion	-10.17189
Sum squared resid	7.60E-05	Schwarz criterion	-9.665554
Log likelihood	298.8130	Hannan-Quinn criter.	-9.975586
F-statistic	0.000192	Durbin-Watson stat	1.971696
Prob(F-statistic)	1.000000		

Table X

Heterokedasticity Test: Breusch-Pagan-Godfrey

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.183878	Prob. F(12,43)	0.3247
Obs*R-squared	13.90691	Prob. Chi-Square(12)	0.3067
Scaled explained SS	14.70337	Prob. Chi-Square(12)	0.2581

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares

Sample: 11 66
Included observations: 56

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.16E-06	7.88E-07	1.472834	0.1481
CREDITGROWTHD1(-8...	-8.51E-06	2.01E-05	-0.423926	0.6737
DEBTGDPD1(-9)	-1.54E-05	1.97E-05	-0.781769	0.4386
DEBTSERVICED1(-5)	-3.56E-05	9.90E-05	-0.359708	0.7208
GAPBANKPRIVATED1(-...	2.74E-05	2.73E-05	1.000294	0.3228
GAPHHD1(-4)	-0.000136	9.14E-05	-1.488807	0.1438
GAPNFCD1(-6)	2.75E-05	0.000101	0.271133	0.7876
GAPPRIVATED1(-6)	-2.06E-05	9.92E-05	-0.207478	0.8366
INFLATIOND1(-4)	-1.38E-06	6.22E-07	-2.222011	0.0316
PRICEINCOMED1(-6)	2.83E-05	2.66E-05	1.065486	0.2926
RGDPGROWTHD1(-4)	-2.30E-05	4.03E-05	-0.571244	0.5708
SPREADD1(-7)	-2.84E-05	5.92E-05	-0.479351	0.6341
UNEMPLOD1(-1)	-7.83E-05	9.96E-05	-0.786479	0.4359

R-squared	0.248338	Mean dependent var	1.36E-06
Adjusted R-squared	0.038571	S.D. dependent var	2.59E-06
S.E. of regression	2.54E-06	Akaike info criterion	-22.72558
Sum squared resid	2.78E-10	Schwarz criterion	-22.25541
Log likelihood	649.3164	Hannan-Quinn criter.	-22.54330
F-statistic	1.183878	Durbin-Watson stat	2.320803
Prob(F-statistic)	0.324705		

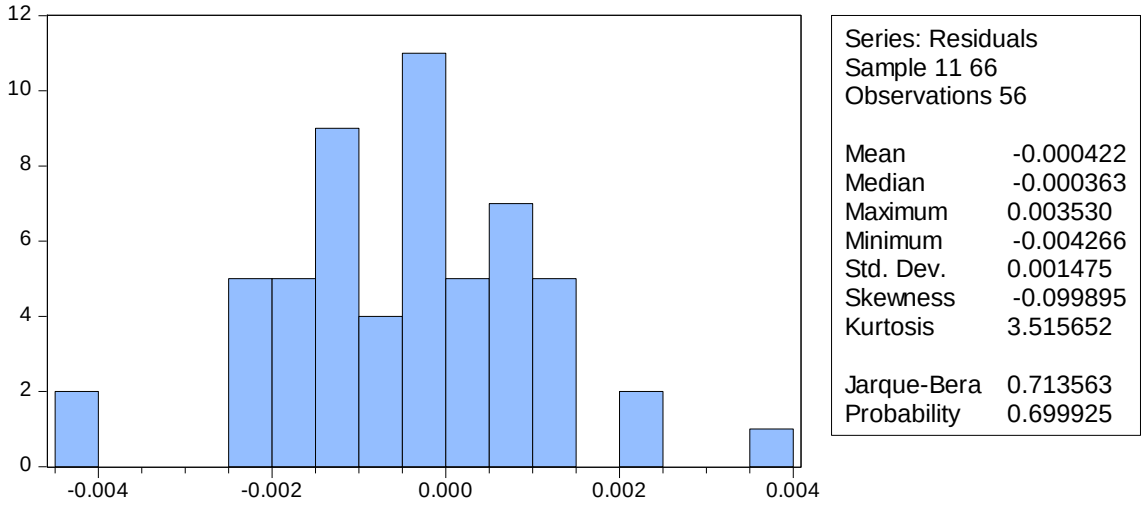

Figure 6 – Normality test of the OLS residuals

Table XI

Heterokedasticity Test: White

Heteroskedasticity Test: White

F-statistic	1.914670	Prob. F(12,43)	0.0595
Obs*R-squared	19.50190	Prob. Chi-Square(12)	0.0771
Scaled explained SS	15.20511	Prob. Chi-Square(12)	0.2304

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares

Sample: 11 66
Included observations: 56

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.12E-06	1.02E-06	2.084091	0.0431
CREDITGROWTHD1(-8)^...	0.000379	0.000597	0.635070	0.5287
DEBTGDPD1(-9)^2	-0.000153	0.000256	-0.599228	0.5522
DEBTSERVICED1(-5)^2	-0.005790	0.024826	-0.233206	0.8167
GAPBANKPRIVATED1(-4)^...	0.000441	0.000974	0.452772	0.6530
GAPHHD1(-4)^2	-0.008367	0.009679	-0.864443	0.3921
GAPNFCD1(-6)^2	5.82E-05	0.000928	0.062771	0.9502
GAPPRIVATED1(-6)^2	-0.000312	0.000911	-0.342680	0.7335
INFLATIOND1(-4)^2	3.05E-06	8.23E-07	3.707033	0.0006
PRICEINCOMED1(-6)^2	-0.001017	0.001234	-0.823986	0.4145
RGDPGROWTHD1(-4)^2	0.000662	0.003051	0.216938	0.8293
SPREADD1(-7)^2	0.001892	0.003909	0.484068	0.6308
UNEMPLOD1(-1)^2	-0.012364	0.015838	-0.780657	0.4393

R-squared	0.348248	Mean dependent var	2.31E-06
Adjusted R-squared	0.166364	S.D. dependent var	3.71E-06
S.E. of regression	3.39E-06	Akaike info criterion	-22.15192
Sum squared resid	4.94E-10	Schwarz criterion	-21.68175
Log likelihood	633.2537	Hannan-Quinn criter.	-21.96963
F-statistic	1.914670	Durbin-Watson stat	2.163319
Prob(F-statistic)	0.059546		

Table XII

RESET Test

Ramsey RESET Test
Equation: UNTITLED
Specification: NPLD1 CREDITGROWTHD1(-8) DEBTGDPD1(-9) DEBTSERVICED1(-5) GAPBANKPRIVATED1(-4) GAPHHD1(-4) GAPNFCD1(-6) GAPPRIVATED1(-6) INFLATIOND1(-4) PRICEINCOMED1(-6) RGDPGROWTHD1(-4) SPREADD1(-7) UNEMPLOD1(-1)
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.140644	43	0.2603
F-statistic	1.301070	(1, 43)	0.2603
Likelihood ratio	1.669288	1	0.1964

F-test summary:

	Sum of Sq...	df	Mean Squares
Test SSR	3.81E-06	1	3.81E-06
Restricted SSR	0.000130	44	2.95E-06
Unrestricted SSR	0.000126	43	2.93E-06
Unrestricted SSR	0.000126	43	2.93E-06

LR test summary:

	Value	df
Restricted LogL	283.8755	44
Unrestricted LogL	284.7102	43

Unrestricted Test Equation:
Dependent Variable: NPLD1
Method: Least Squares

Sample: 11 66
Included observations: 56

Variable	Coefficien...	Std. Error	t-Statistic	Prob.
CREDITGROWTHD1(-8...	-0.006769	0.012589	-0.537682	0.5936
DEBTGDPD1(-9)	0.019843	0.013731	1.445144	0.1557
DEBTSERVICED1(-5)	0.036434	0.066552	0.547450	0.5869
GAPBANKPRIVATED1(-...	0.051787	0.019774	2.618901	0.0121
GAPHHD1(-4)	-0.150933	0.070807	-2.131611	0.0388
GAPNFCD1(-6)	0.083219	0.065142	1.277507	0.2083
GAPPRIVATED1(-6)	-0.081417	0.063968	-1.272777	0.2099
INFLATIOND1(-4)	-0.000200	0.000405	-0.494458	0.6235
PRICEINCOMED1(-6)	-0.013867	0.017186	-0.806877	0.4242
RGDPGROWTHD1(-4)	0.018433	0.026455	0.696787	0.4897
SPREADD1(-7)	0.032888	0.040908	0.803947	0.4258
UNEMPLOD1(-1)	0.041400	0.073947	0.559861	0.5785
FITTED^2	91.63247	80.33395	1.140644	0.2603

R-squared	0.594100	Mean dependent var	0.001209
Adjusted R-squared	0.480825	S.D. dependent var	0.002374
S.E. of regression	0.001710	Akaike info criterion	-9.703935
Sum squared resid	0.000126	Schwarz criterion	-9.233764
Log likelihood	284.7102	Hannan-Quinn criter.	-9.521651
Durbin-Watson stat	1.747242		