Differential Effect on the Determinants of the Late Payments According to the Economic Cycle

Salvador Climent-Serrano[1], Elisabeth Bustos-Contell[2] & Gregorio Labatut-Serer[2]

[1] Department of Financial and Actuarial Economics. Faculty of Economics. University of Valencia. Campus Els Tarongers s/n, 46022 Valencia – Spain.

[2] Department of Accounting, University of Valencia, Av. dels Tarongers s/n, 46022 Valencia – Spain. Elisabeth.Bustos@uv.es

Correspondence: Salvador Climent-Serrano, Department of Financial and Actuarial Economics. Faculty of Economics. University of Valencia. Campus Els Tarongers s/n, 46022 Valencia – Spain. E-mail: Salvador.climent@uv.es

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Abstract

From 2004 to 2007, the Spanish financial system grew at a very rapid rate. However, from 2008 to 2012 impairment losses amounted equivalent to 25% of Spanish GDP.

The objective of this paper is investigate how have affected the main problems that have suffered the Spanish economy on the late payments on Spanish credit institutions. And to check whether the effect of these problems is different on stages of growth with respect to the stages of crisis.

The main results, according the test Chow, confirmed that there is a structural break in the model in 2007. Also the increase in unemployment increases the late payments and this increase is greater in the stages of growth compared to the stages of recession. The decrease in the price of housing increases the late payments. The increase in equity decreases the late payments, in these two variables decrease is greater in the recession stages compared to the growth stages.

Keywords: loan default, banks, unemployment, leverage, housing prices

JEL classification: G21, M41

1. Introduction

From 2004 to 2008, the Spanish financial system grew at a very rapid rate and enjoyed important benefits. However, from 2008 to 2012 impairment losses amounted to 240.483 million euros, equivalent to 25% of Spanish GDP (BDE, 2013a). This situation forced the Spanish authorities to request financial assistance from the European Commission of up to 100,000 million euros (European Commission, 2012).

State aid requested by Spanish banks exceeds 60,000 million euros (Climent, 2013), of which 25,000 million is considered irrecoverable. Traditional savings banks have disappeared because they have been absorbed, nationalized or merged and all have been converted to commercial banks (Climent & Pavia, 2014, 2015b). Therefore, many cities with small populations have been left without financial services.

In terms of Human Resources, between 2010 and 2012 9,760 branches closed, 21.14% of the total that existed in 2008 (BdEc, 2013). Some 41,798 jobs have been lost since then (BdEc, 2013), aggravating even more the problem of unemployment in the Spanish economy.

One of the main causes of the events described in the preceding paragraphs is the high non-performing loans (NPLs) of Spanish credit institutions. NPLs in this period were the highest recorded by the Bank of Spain, with a maximum of 13.53% in January 2014. However, these same banks in 2004 to 2007 enjoyed the lowest late payment rates registered, less than 1% (BDE, 2014). This big difference and the events discussed above are sufficiently important reasons to study the relatively short periods from 2004 to 2007 and from 2008 to 2012.

The factors that determine NPLs are used to predict future events, especially after the widespread use of stress tests in the banking sector. Therefore, it is important to know how these determinants affect late payment in each of the

two periods, because if there are differences between results obtained in stages of growth compared with recession, these differences should be applied to the estimates.

This work has two objectives:

1. to investigate how they have affected the main problems that have suffered the Spanish economy as, the impact on unemployment, GDP growth, interest rates, the price of housing, leverage and the type of business on the late payments on Spanish credit institutions.
2. to check whether the effect of these problems is different on stages of growth with respect to the stages of crisis.

New contributions to the literature are made in relation to these two objectives. First, the effects of the main problems suffered by the Spanish economy, and the consequences for NPLs, are estimated. Furthermore, two stages are studied independently, investigating whether a structural break took place. The effect and strength of each of these factors in each of the periods as a determinant of late payment are studied.

With these two new contributions, techniques that serve to predict late payment, in times of both growth and crisis, will be achieved.. To do this, an econometric model with a sample for 2004-2012 and two more models with samples from 2004 to 2007 and 2008 to 2012 are estimated.

Their use will improve the techniques used in the stress test, based on different types of scenarios, because for each type of scenario the impact of economic factors (explanatory variables) will be different, not only because the value of the variable changes, but also the force that affects the dependent variable changes in this case the NPLs.

The main results obtained in the investigation indicate that the behaviour of the determinants is different in times of economic growth compared with recessions. Therefore, an increase in the unemployment rate of the same amount does not have the same effect on NPLs when the economy is growing as it does when it is in recession. The same goes for the price of housing, equity capital of credit institutions and leverage.

1.1 Justification for Choice of Spain, and Overview of Late Payments in Europe

In the early years of the twenty-first century the NPLs in most credit institutions around the world remained stable. However, the global financial crisis of 2007 to 2008 affected the quality of credits, but in different ways in each geographical area or country. In the case of Spain, according to Ontiveros & Berges (2010) the impact was delayed by more than a year compared with other countries.

The same factors can affect each country differently. For example, Beck, Jakubik, & Piloiu (2013) argue that factors such as the depreciation of the exchange rate produced an increase in NPLs in countries with a high number of foreign currency loans. For example, the depreciation of local currencies in central, east and south-east Europe against the Swiss franc and, to a lesser extent, the Euro negatively affected the quality of assets in Poland, Hungary and Croatia. They also claim that a decrease in share price more negatively affected the quality of bank assets in countries with large stock markets. Finally, they also indicate that the effect of the same variable, GDP, for late payments is different in different European countries: the effect of GDP on NPLs in the Baltic countries like Latvia, for example, is much greater compared with countries like Germany.

Legislation on mortgage loans also affects different countries differently. For example, a fall in the value of collateral for housing loans will affect NPLs differently. In countries where mortgage loans allow by law dation in payment, late payment will be greater, as in countries such as Spain, where mortgage guarantees extend to all property and personal rights of the holders of the mortgage.

Another factor is how monetary policy is implemented. In the case of Spain, the expansionary monetary policy conducted by the ECB in the early years of the twenty-first century, was counterproductive in the overheated economy. This situation further stimulated the housing bubble. This housing bubble was one of the determinants of the Spanish crisis. However, in other countries one of the main problems was the assets of sub-prime mortgages, by which Spain was not affected.

Another of the peculiarities of the Spanish financial system is the incorporation of generic provisions in 2002. The impairment of loans depends on various factors, in addition to NPLs.

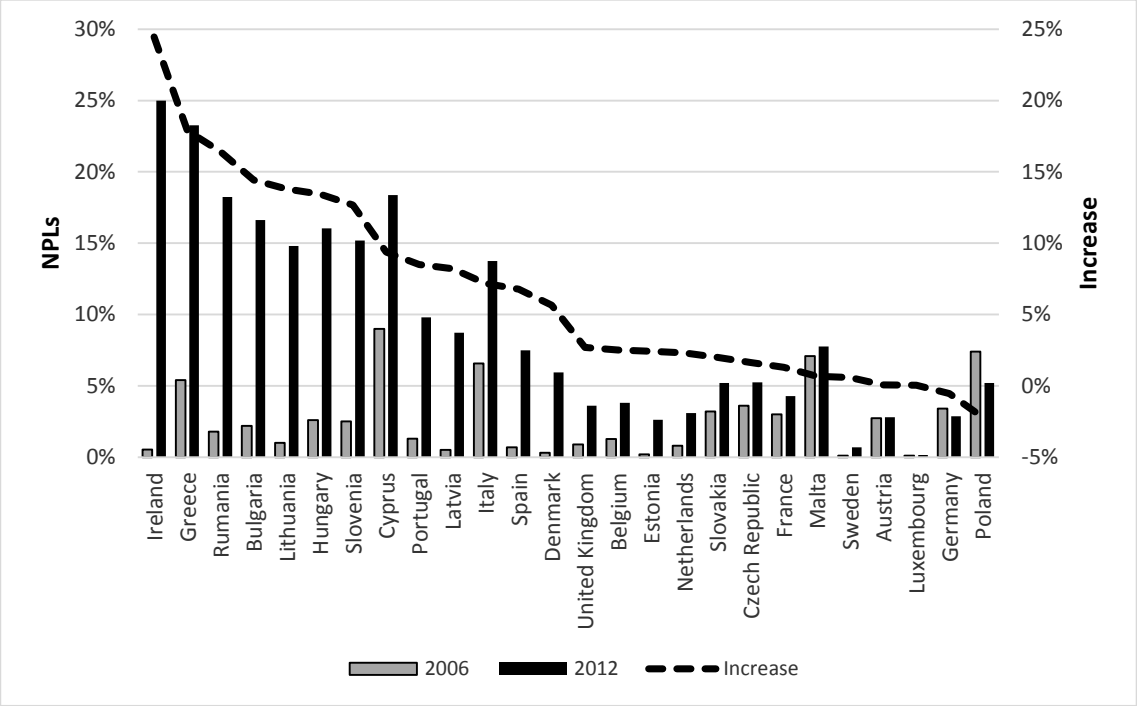

Figure 1. NPLs of EU countries

Source: compiled from data from the World Bank-2016

Figure 1 shows the evolution of late payments in 2006 and 2012 and the disparity in the evolution of the same in EU countries, of which a great majority belong to the Euro area with a common monetary policy.

The rest of the paper is organized as follows. Section 2 describes the background to late payments, the selection of variables and the objectives of the research. Section 3 describes the methodology. Section 4 presents the results obtained and Section 5 discusses the findings. Section 6 concludes.

2. Background

Late payment and its determinants are a subject that has been widely studied in the empirical literature. Very common in these studies are the relationships of variables with economic growth, such as GDP or unemployment rate and asset quality. The study of NPLs increased in importance thanks to Demirguc-Kunt (1989), Whalen (1991) and Barr & Siems (1994) by whom bank failures were associated with increases in delinquency.

One of the seminal works on Spain is that by Freixas, et al (1994), in which the authors study how economic cycles affect NPLs by increasing the volume of loans. They use the aggregate data of bank default offered by the Bank of Spain, and estimate an econometric model adapted from corporate bankruptcies. They conclude that economic growth, inflation expectations of economic activity, level of debt, monetary policy, wage growth and real interest rates are macroeconomic variables that explain late payments.

Salas & Saurina (2002) use the Arellano-Bond estimator for dynamic models of panel data to compare the determinants of problem loans of Spanish commercial and savings banks in the period 1985 to 1997, taking into account both macroeconomic and individual bank level variables. The GDP growth rate, firms, and family indebtedness, rapid past credit or branch expansion, inefficiency, portfolio composition, size, net interest margin, capital ratio, and market power are variables that explain credit risk.

Other authors who have studied the determinants of NPLs in Spain are: Fernández de Lis et al (2000), Delgado & Saurina (2004), González & Díez (2010), Jiménez, et al (2013), Climent (2013), and Climent & Pavía (2015a).

Looking at European countries, Podpiera & Weill (2008) study the question of the causality between non-performing loans and cost efficiency in order to examine whether either of these factors is a serious determinant of bank failures. They extend the Granger causality model developed by Berger, & DeYoung (1997) by applying GMM dynamic panel estimators to a panel of Czech banks between 1994 and 2005. Their results support the bad management hypothesis, according to which deteriorations in cost efficiency precede increases in non-performing loans. Foos,

Norden & Weber (2010) investigate whether loan growth affected the riskiness of individual banks of Canada, Japan, and 13 European countries between 1997 and 2007. They test three hypotheses on the relation between abnormal loan growth and asset risk, bank profitability, and bank solvency. Their results show that loan growth leads to an increase in loan loss provisions during the subsequent three years, a decrease in relative interest income, and lower capital ratios. Festić et al (2011) use the regression method with panel data on fixed effects and random effects to explore why rapid credit growth has been one of the most pervasive developments in recent years in central and eastern Europe. Their findings support the hypothesis that the growth of credit and the amount of available finance may harm banking performance and deteriorate non-performing loan (NPL) dynamics, probably because of the overheating of economies in the five new member states of central and eastern Europe. Magri & Pico (2011) assess through a regression to OLS the extent to which mortgage rates in Italy were priced according to credit risk as proxies by the probability of household mortgage NPLs for mortgages granted between 2000 and 2007. They find that a one percentage point increase in the probability of default is associated with a 21 basis point rise in mortgage interest rates. Louzis, Vouldis & Metaxas (2012) using the dynamic panel data method show that, for all loan categories, NPLs in the Greek banking system can be explained mainly by macroeconomic variables (GDP, unemployment, interest rates, public debt) and management quality. Differences in the quantitative impact of macroeconomic factors among loan categories are evident, with non-performing mortgages being the least responsive to changes in macroeconomic conditions. Vallascas & Keasey (2012) use an empirical approach-based distance-to-default model and an extensive sample of listed European banks to estimate how the risk of bank failure changes because of systemic shocks. The results show that restrictions on a bank's leverage ratio and the imposition of liquidity requirements, as in the Basel III Accord, may improve the resilience of a bank to systemic events. They also demonstrate that bank size, share of non-interest income and asset growth are key determinants of a bank's risk exposure. Finally, they show that the strengthening of individual bank stability obtained via size restrictions is accompanied by a reduction in the contribution to systemic risk for banks which are relatively large compared with the domestic economy.

At the international level Berger & DeYoung (1997) employ Granger causality techniques to test whether cost efficiency in banks pre-dates loan quality, whether loan quality pre-dates cost efficiency, or both, using pooled cross section-time series data on MPLs, operating cost efficiency, equity capital ratios, and other variables for US commercial banks between 1985 and 1994. Brent et al (2011) use panel data with a fixed effects model to examine data on mortgage late payment rates in the USA for 2004 to 2009. Demyanyk & Van Hemert (2011) use loan-level panel data for the USA to analyse the quality of subprime mortgage loans by adjusting their performance for differences in borrower characteristics, loan characteristics, and macroeconomic conditions. They find that the quality of loans deteriorated for six consecutive years before the crisis and that securities were, to some extent, aware of it. They provide evidence that the rise and fall of the subprime mortgage market follows a classic lending boom-bust scenario, in which unsustainable growth leads to the collapse of the market. and say problems were masked by high house price appreciation between 2003 and 2005.

Other works include for countries around the world: Ghosh (2005) on Indian banks, Asmild & Matthews (2012) on China, Dell'Ariccia, Igan & Leaven (2012), Crook & Banasik (2012), Ramcharan & Crowe (2013) and Sarmiento (2012) on the USA.

As seen in the literature review the diversity of variables used to determine NPLs is wide, comprising macroeconomic and microeconomic variables, internal variables, assets, equity and balance sheet management. However, as stated above, the main objective of this study is not to determine the factors which cause late payments but to research how they have affected the NPLs and the main problems suffered by the Spanish economy, and especially if this behaviour is the same in times of stages of crisis as in growth stages. To do this the most important factors that have influenced the Spanish economy and its impact on the late payment will be assessed for the period 2004 to 2012. There was a period of great economic growth in 2004 to 2008 and a crisis from 2008 to 2012.

The study focuses on seven explanatory variables. Four external variables, three macroeconomic, unemployment, GDP and interest rates and a micro, the price of housing. Three internal variables, two asset management, leverage, and the type of business and other equity. The choice of these variables is motivated by the great problems that have affected the Spanish economy. The high rate of unemployment, the housing bubble, the excessive credit growth of commercial and savings banks, and lack of self-financing have necessitated an injection of public funds in major Spanish banks.

The variables that are used by authors in this research are described variously in the literature review as below.

The **leverage** is a determinant of NPLS in the studies of Fernández de Lis et al (2000), Salas & Saurina (2002), Ghosh (2005), Foos, et al (2010) and Louzis, ey al, (2012). All authors confirm that increased leverage increases NPLs.

The **unemployment rate** as a determinant of NPLs is studied by Magri & Pico (2011), Demyanyk & Van Hemert (2011), Crook & Banasik (2012), Sarmiento (2012), Louzis, Vouldis & Metaxas, (2012), Ramcharan & Crowe (2013) and Brent et al (2011). All these authors agree that there is a positive correlation between unemployment rate and NPLs, although in the work of the last two authors cited the variable is not statistically significant. Moreover, in the study by Dell'Ariccia, Igan & Leaven (2012) the sign and statistical significance vary depending on the various models with different types of borrowers and different kinds of loans.

The increase in **equity** as a ratio of assets or risk-weighted assets is a determining factor contributing to the decline in NPLs in Berger and DeYoung (1997), Fernández de Lis et al (2000), Salas & Saurina (2002), Ghosh (2005), Foos, et al (2010) and Vallascas & Keasey (2012). All authors agree this variable is also statistically significant.

However, in the **price of property** there are contradictory results in terms of how it affects NPLs. Whereas in the studies of Demyanyk & Van Hemert (2011), Brent et al (2011), Crook & Banasik (2012), Dell'Ariccia, et al (2012) and Sarmiento (2012), the increases in the price of housing contribute to lower NPLs, in the articles of Stephen and Estrada (2013) and Ramcharan & Crowe (2013) the increased price of houses increases NPLs.

According to Freixas, et al (1994), Fernández de Lis et al (2000), Salas & Saurina (2002), Delgado & Saurina (2004), Ghosh (2005), Podpiera & Weill (2008), Festić et al (2011), Jimenez, et al (2013) and Ramcharan & Crowe (2013), increases in the rate of growth of **GDP** favour the decrease of NPLs. However, in the work of Vallascas & Keasey (2012), the effect is the opposite; an increase in GDP increased NPLs.

According to Freixas, et al (1994), Delgado & Saurina (2004), Podpiera & Weill (2008), Jiménez, et al (2013) and Ramcharan & Crowe (2013), an increase in the **interest rates** contributes to an increase in NPLs. However, for Crook & Banasik (2012), the effect depends on how the variable is included in the model: NPLs will increase if the variable is taken of this year, but if the interest rate is taken with a delay of one year, the effect is the opposite, decreasing NPLs. Finally, Dell'Ariccia, et al (2012) conclude that reductions in interest rates increase NPLs as a result of relaxing the conditions for granting loans.

Finally, as regards the **type of business,** in the case of Spain it is taken as differentiation that is bank or savings bank. According to Delgado & Saurina (2004) banks are more efficient than savings banks. This result is in agreement with Salas & Saurina (2002), Delgado & Saurina (2004), De los Rios et al (2012), Climent (2013) and Climent & Pavia (2014).

3. Methodology and Data

Table 1 shows the descriptive statistics of the variables studied.

Table 1. Descriptive Statistics

	NPLs	Variation in the unemployment rate	House prices	Solvency	Leverage	Interest rate	GDP
Mean	0.033	0.027	1.149	0.117	18.624	0.012	0.060
Median	0.015	0.028	1.055	0.069	18.923	0.031	0.057
Maximum	0.373	0.048	2.977	0.546	20.855	0.041	0.167
Minimum	0.001	0.005	0.688	-0.152	15.312	-0.031	-0.059
Std. dev.	0.040	0.012	0.314	0.214	1.683	0.027	0.024

Prepared by author

3.1 Data

The database used for NPLs, equity, and leverage has been built using data from the consolidated financial statements and annual management reports of the 47 savings banks that existed in 2004, 14 banks more representative and new entities that have emerged from mergers and takeovers in the Spanish financial system in the period from 2004 to 2012. Credit institutions in the database account for 99% of all banks and Spanish savings banks.

The variables used are as below.

NPL: is the dependent variable and is built by the ratio of NPLs of customers with respect to the total loans granted to customers.

The explanatory variables in the model are as below.

Leverage: ratio formed by loans to customers divided by customer deposits.

Type of business: differentiated between savings banks and commercial banks, whereby a dummy variable is included that takes the value one for the banks and zero for the savings banks.

Solvency: equity ratio respect to assets.

Unemployment rate: rate of annual change in the unemployment rate. Data obtained from the Labour Force Survey, published by The National Statistics Institute

Evolution of GDP. Annual growth rate of GDP published by the INE.

Interest rate: 12-month Euribor published by the Bank of Spain.

Housing prices: price per square metre of private housing published by the Ministerio de Fomento in hundreds of euros.

Expected behaviour of the explanatory variables

Internal variables

According to Fernández de Lis et al (2000), Salas & Saurina (2002), Ghosh (2005), Foos, et al (2010) and Louzis, et al (2012), **leveraging** is expected to be a positive sign. The lending growth can increase risk as a result of relaxing the conditions for granting loans (Dell'Ariccia, et al, 2012).

For the **type of business**, according to the work of Chambers & Saurina (2002), Delgado & Saurina (2004), De los Rios et al (2012), Climent (2013) and Climent & Pavia (2014) expected negative sign, especially after the events that led to the virtual disappearance of the savings banks.

As regards **solvency,** according to Berger & DeYoung (1997), Fernández de Lis et al (2000), Salas & Saurina (2002), Ghosh (2005), Foos, Norden & Weber (2010) and Vallascas & Keasey (2012) the expected sign of the coefficient is negative. Institutions with fewer NPLs will obtain greater benefits and further increase equity.

External variables

The increase in **rate of change of unemployment** directly affects the wealth of families negatively. The ratio is expected to be positive.

GDP growth will translate into greater wealth for families, so in this case the expected sign is negative.

An increase in **interest rates** hinders the payment of loans and credits and increases NPLs, so in this case a positive sign is expected for this variable.

Finally, the higher the **price of housing** the greater the possibility of selling with gains housing; in this way, paying loan instalments will be encouraged to avoid defaults. The sign of the coefficient is expected to be negative.

Table 2 shows the correlations between the variables.

Table 2. Correlations between variables

	NPLs	Variation in the unemployment rate	House prices	Solvency	Leverage	Interest rate	GDP
NPLs	1						
Unemployment rate	0.285***	1					
House prices	-0.310***	0.351***	1				
Solvency	-0.341***	-0.096**	-0.053	1			
Leverage	-0.044	0.028	0.131***	-0.209***	1		
Interest rate	-0.565***	-0.193***	0.709***	0.033	0.106**	1	
GDP	-0.574***	-0.810***	0.086*	0.110**	0.016	0.671***	1

Source: Authors

There is a high correlation between GDP, variation in the unemployment rate and interest rate, and also between interest rate and house prices.

3.2 Presentation of Results

First, a descriptive analysis of the variables that were statistically significant in the econometric model is shown. Graphs show the evolution of these explanatory variables with respect to the dependent variable.

For the econometric analysis a model with the seven explanatory variables was estimated. Subsequently econometric analysis with the variables that resulted as statistically significant in the previous model was performed. The purpose of this estimation was to detect structural change. To that end, three regression models were estimated; one for all years from 2004 to 2012 and two each of the two sub-samples for 2004 to 2007 and 2008 to 2012. A structural stability comparison of the two periods was performed by means of the Chow test and a contrast difference coefficient.

3.3 Selection of the Econometric Model

According to the relatively short time series and similarities between the analysed credits institutions are used panel data techniques to analyse and quantify the impact of the macroeconomic and financial variables. This allows us to capture the specific effects and the unobservable differences between credit institutions. Using a panel data approach, one can control for the biases generated by potential heterogeneity and omitted variable problems that are persistent over time. Moreover, including the lags of regressors means one may alleviate measurement errors and endogeneity bias.

Analysing the regression with panel data the test of homogeneity indicates that the fixed effects model is better than the data pool. With the fixed effects model we proceeded to estimate the model considering both individual fixed effects, the intragroup estimator, as random fixed effects, the random effects estimator. The Hausman test results support the consistency and efficiency of the individual fixed effects estimator. We found autocorrelation problems of residues, evident from the Durbin Watson statistics (see Table 1) and the graphic analysis.

To correct this problem has been estimated with AR1 model system, ensuring that disappears the auto-correlation of the residuals. So there is inertia on the dependent variable. This residual autocorrelation disappears when the two sub-samples are studied separately; see Durbin Watson in Table 1. Therefore, the models of the two sub-periods without the AR1 system obtain better results.

In Table 3 the results of the nine patterns are shown. To control heteroscedasticity, all regression models were estimated with White's robust standard error method. There is no multicollinearity between the explanatory variables. Variance inflation factor (VIF) is 1,118 in the leverage variable; 5,061 in the unemployment rate; 4,725 in the price of housing and 1,211 in equity and there is no correlation between them.

We made regressions of the residues with each of the explanatory variables and all are statistically non-significant. The Hausman test for endogeneity indicates that it does not exist. In addition, to check the

robustness of the model regression with instrumental variables the MGG method of Arellano and Bold (1991) was performed. The results are very similar to the model AR (1), confirming the robustness of the model.

The model tested in the overall sample is as follows:

$$\text{NPLs} = \propto_i + \beta_1 Unemployment\ rate_{it} + \beta_2 House\ prices_{it} + \beta_3 Leverage_{it} + \beta_4 Solvency_{it} + \beta_5\ GDP_{it} + \beta_6\ Rate\ of\ interest_{it} + \beta_7 Type\ of\ business_{it} + \omega_{it}$$

As there is a high correlation between GDP and unemployment, and also between interest rates and housing prices, these two variable models are removed, along with the type of business that has not been statistically significant.

The model to be tested, after exclusion of non-statistically significant variables in the overall sample and in each of the two sub-samples, is:

$$\text{NPLs} = \propto_i + \beta_1 Unemployment\ rate_{it} + \beta_2 House\ prices_{it} + \beta_3 Leverage_{it} + \beta_4 Solvency_{it} + \omega_{it}$$

For the fixed effects model, the intragroup estimator model is applied by OLS the model transformed to obtain consistent estimates of β, where $\propto_i$ is the constant that reflects the heterogeneity in the behaviour of the sample cross-sectional units. The fixed effects model is also estimated as a model with an AR1 system and thus reflects the effect of non-performing loans last year in the current year. In this way the problem of autocorrelation of the residues detected is corrected and confirms the inertia of NPLs.

Structural stability analysis is performed according to the method of Chow in the fixed effects model and AR 1 to check in 2007 for structural change in the trend model. By detecting this structural change the differences between the results obtained in each of the regressions in the two sub-samples are analyzed. Finally, a test of difference coefficients will take place between the regressors of the two sub-samples.

4. Results

4.1 Descriptive Analysis

Figures 2, 3 and 4 show that the average of the three explanatory variables is statistically significant concerning the dependent variable.

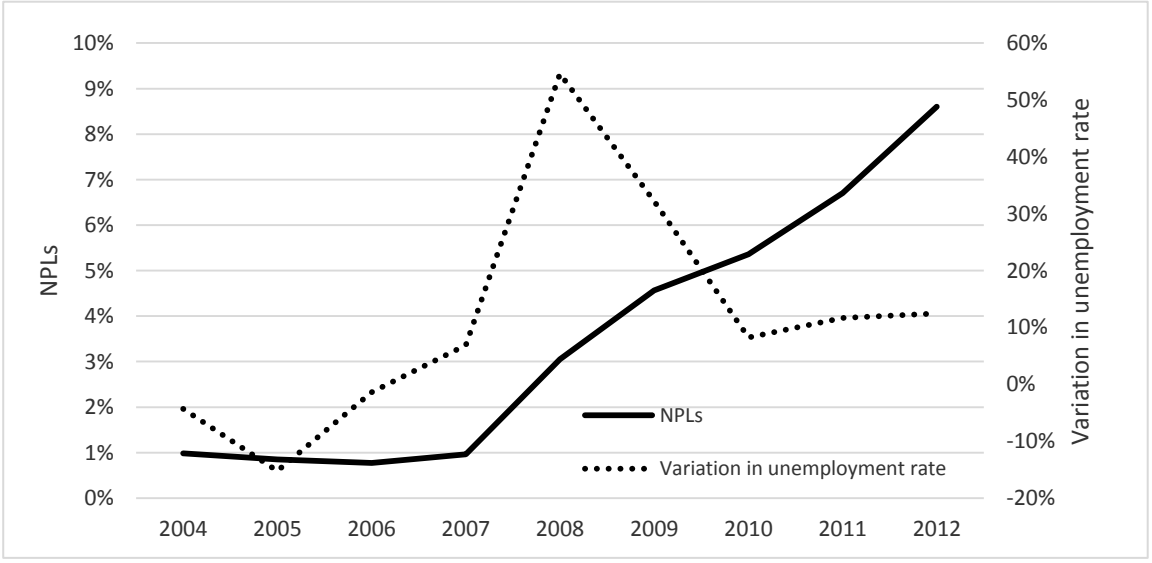

Figure 2. NPLs vs. change in unemployment rate

Source: Authors

The NPLs remain at very low levels; below 1% until 2007, when they begin to grow steadily until January 2014. The variation of the unemployment rate is negative from 2004 to 2007, coinciding with periods when the NPL is low, constant and at its lowest. From 2007 to 2009 the rate of variation in unemployment grew strongly, coinciding with

the period of greatest increase in NPLs. The last two years comprising the study, 2010 and 2011, show the rate of variation in unemployment is still growing but more moderately, at around 10%, while NPLs are still rising.

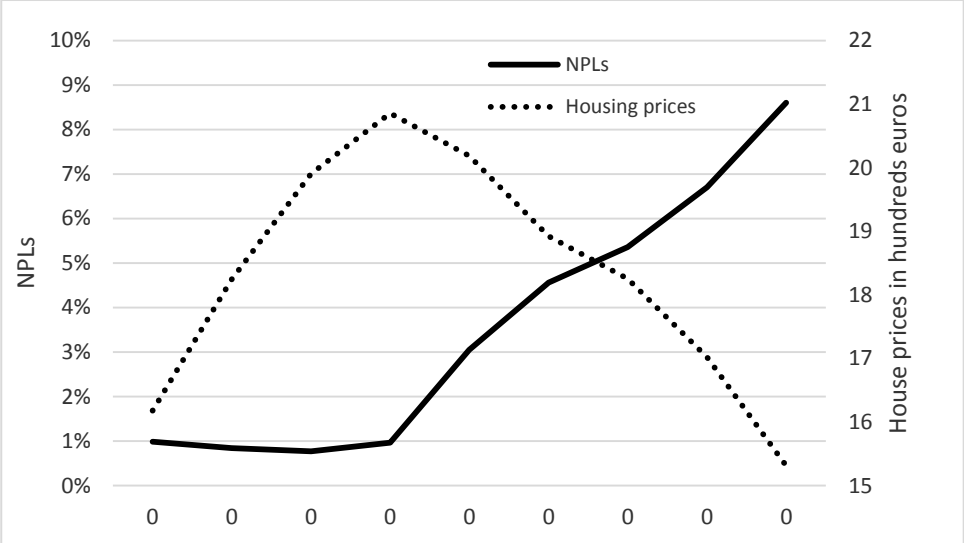

Figure 3. NPLs vs. house prices

Source: Authors

The price of housing grew at a very rapid rate in the early years of the research. In 2004 the price per square metre was 1,618 euros and in 2007 the price was 2,085 euros. This period coincides with the NPLs at historic lows. After 2009 the price of houses reversed the trend and a process of sharp decline happened, which has lasted until today. This caused a decrease in price per square metre from the 2,085 of 2007 to 1,531 in 2012, a value lower than that registered in 2004. Figure 3 shows that when the price of housing increases the NPL rate remains constant; however, when the price of housing decreases the NPL ratio increases. Thus an inverse relationship between the two variables is evident.

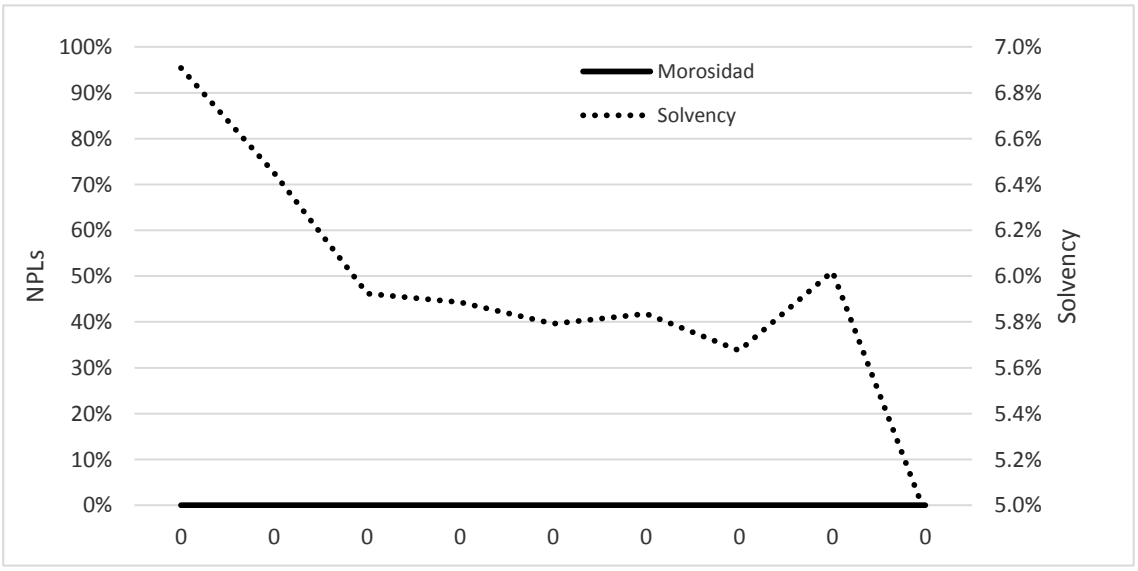

Figure 4. NPLs vs. solvency

Source: Authors

The last variable studied is solvency. Figure 4 shows the relationship between NPLs and equity. The trend of the ratio of equity is always decreasing, so that the relationship is inverse, although the NPLs in the early years are stable.

4.2 Econometric Results

4.2.1 Full Sample

In the OLS model with the full sample, covering 2004 to 2012, it seems that there is autocorrelation in the residuals; the Durbin-Watson statistic is 1,398, so a positive autocorrelation is clear. By analysing the residuals we found that this autocorrelation was of the first order. Therefore, the model was estimated using the model with the scheme AR (1), so the effects of the inertia of the dependent variable were collected. With the new model disappears the autocorrelation detected, the Durbin-Watson statistic is 2,026. The two econometric models are shown in Table 3.

The effect of NPLs last year on the current late payment was found, as AR1 coefficients in the fixed effects model have been significant and with high coefficients, as in GMM model. So, the model commentating on, will be the AR1.

In the first model, with seven explanatory variables, there was no significance shown by leverage, interest rates, GDP and type of business, so for structural analysis and to avoid problems of multicollinearity we eliminated these variables. GDP was removed because of its strong correlation with the unemployment rate. The interest rate, by its correlation with house prices, while leverage is not removed, because it has no correlation with the others explanatory variables and is statistically significant at one of the periods.

Arellano and Bond's method gave results very similar to AR1, which reinforces the robustness of the results. The model on which the analysis focuses is AR (1) with fixed effects.

Unemployment, as in Macri & Pico (2011), Demyanyk & Van Hemert (2011), Crook & Banasik (2012) and Sarmiento (2012), was significant with the expected sign. The positive sign indicates that an increase in unemployment will cause an increase of late payments. Depending on elasticity an increase of 10% in the unemployment rate will mean an increase in NPLs of 50%.

The price of housing is also as expected. As in Demyansk & Van Hemert (2011), Brent et al (2011), Crook & Banasik (2012), Dell'Ariccia, et al (2012) and Sarmiento (2012), the negative sign indicates the rising price of housing will result in a decrease of late payments and vice versa. The elasticity is very high; a decrease of 1% in the price of housing will mean a higher than 6% increase in defaults. In this case the results of this work do not agree with those of Stephen & Estrada (2013) or Ramcharan & Crowe (2013).

The institutions with highest equity have fewer NPLs, evidenced by the negative sign of the coefficient of this variable and its significance level. The elasticity indicates that a 1% increase in equity decreases NPLs by the same proportion. In this case the results obtained are consistent with those of Berger & DeYoung (1997), Fernández de Lis et al (2000), Saurina & Salas (2002), Ghosh (2005), Foos, et al (2010) and Vallascas & Keasey (2012). Finally, in agreement with Berger & DeYoung (1997), and Louis, et al (2012), some positive inertia of the dependent variable was detected, since the coefficient of the parameter AR (1) was significant with a value of 0.731, very similar to that obtained by the GMM method, 0.873.

Table 3. Econometric models.

		2004 -2012					2004-2007		2008-2012		Differences	
Variable		F.E.	**F.E. AR1**	F.E.	**F.E. AR1**	**GMM**	**F.E.**	F.E. AR1	**F.E.**	F.E. AR1	**F.E.**	AR1
C	Coefficient	0.149***	**0.283*** **	0.228***	**0.307*** **		**0.019*** **	-0.4830	**0.334*** **	0.284***	**0.315**	0.767
	Standard errors	-0.029	**(0.040)**	(0.0259	**(0.022)**		**(0.004)**	(0.458)	**(0.039)**	(0.053)		
Variation in the	Coefficient	-0.066***	**0.014** **	0.071***	**0.014*** **	0.043***	**0.013*** **	-0.093**	**0.001**	0.004	**-0.012**	0.097
unemployment	Standard errors	-0.011	**(0.006)**	(0.004)	**(0.003)**	-0.002	**(0.002)**	(0.043)	**(0.013)**	(0.011)	**-0.9411*** **	**-1.0415*** **
rate	Elasticity			0.252	**0.052**		**-0.053**	0.386	**0.003**	0.015	**Relative gap**	**Relative gap**
	Coefficient	-0.004***	**-0.010*** **	-0.009***	**-0.011*** **	-0.004***	**-0.001*** **	0.023	**-0.013*** **	-0.011***	**0.013*** **	**-0.034*** **
House prices	Standard errors	(0.001)	**(0.002)**	(0.001)	**(0.001)**	(0.002)	**(0.000)**	(0.021)	**(0.002)**	(0.003)	**164.131**	**-148.26**
	Elasticity			-4.933	**-6.421**		**-1.697**	51.46	**-3.958**	-3.326	**Relative gap**	**Relative gap**
	Coefficient	-0.603***	**-0.570*** **	-0.7434***	**-0.574*** **	-0.662***	**-0.048***	0.022	**-0.547*** **	-0.595**	**-0.499*** **	**-0.617**
Solvency	Standard errors	(0.213)	**(0.207)**	(0.0215)	**(0.185)**	(0.073)	**(0.029)**	(0.031)	**(0.181)**	(0.245)	**10.41**	**2.96**
	Elasticity			-0.136	**-1.052**		**-0.356**	0.163	**-0.518**	-0.564	**Relative gap**	**Relative gap**
	Coefficient	0.004	**0.008**	0.004	**0.006**	0.003	**0.006*** **	0.004***	**0.002**	0.016*	**-0.0042*** **	**0.012*** **
Leverage	Standard errors	(0.007)	**(0.006)**	(0.010)	**(0.006)**	-0.004	**(0.001)**	(0.001)	**(0.007)**	(0.008)	**-0.6802**	**2.9972**
	Elasticity			0.166	**0.243**		**0.975**	0.614	**0.041**	0.325	**Relative gap**	**Relative gap**
Interest Rate	Coefficient	0.603*	**-0.161**									
	Standard errors	-0.305	**(0.202)**									
GDP	Coefficient	-1.301***	**0.013**									
	Standard errors	-0.17	**(0.105)**									
Type of business	Coefficient	0.023***	**0.002**									
	Standard errors	(0.006)	**(0.008)**									
AR 1 in F.E	Coefficient		**0.748*** **		**0.731*** **	**0.873*** **		0.442***		0.416**		**-0.026***
/NPLs-1 in GMM	Standard errors		**(0.086)**		**(0.061)**	**-0.039**		(0.132)		(0.172)		**-5.95%**
					Significance: ***1%; **5%; *10%							
N		449	**374**	449	**374**		**238**	177	**211**	197		
R2 adjusted		0.853	**0.900**	0.722	**0.874**		**0.733**	0.803	**0.825**	0.794		
Durbin-Watson		1.398	**2.026**	1.236	**1.993**		**1.911**	2.619	**1.99**	2.417		
F statistic structural contrast				212.52	**28.44**							

Source: Authors

4.2.2 Structural Analysis

The structural stability of the model was studied by means of Chow's test (1960). The breakthrough year is fixed at 2007, with a sample comprising the years 2004 to 2007 and again from 2008 to 2012. The statistical F obtained is 28.44 in the AR1 model scheme so that the null hypothesis is rejected and it is confirmed that there is a structural break in the model parameters between the two sub-samples studied. The test of difference coefficients, shown in the last column of Table 3, confirms the results obtained with the Chow test, since differences are statistically significant explanatory variables of the four models.

4.2.3 Analysis of the Two Periods

Models of the two sub-periods with the AR1 scheme and fixed effects without AR1 were estimated. In both sub-periods the result indicates that there is no autocorrelation of the first order. So the best model is that with fixed effects (see Table 3).

2004-2007. Growth stage

This stage is characterized by a stable rate of unemployment over 10%, with a slight downward trend, so the change in unemployment rates is negative. A sharp increase in house prices occurs, but with a downward trend; the price per square metre in 2004 was 1,618 euros and 2,085 in 2007, a 30% increase. A very sharp increase in leverage occurred; in 2004 it was 119.56% and 143.62% in 2007. In addition, overall economic growth occurred.

The four explanatory variables are significant in the model with fixed effects without the AR1 scheme. The coefficient on the unemployment variable is positive. So the decrease in the unemployment rate which occurred during this period contributed to the decline in NPLs, although moderately, with elasticity of less than unity.

The price of housing in this period supports a large increase. Therefore, in view of the negative sign of the coefficient of this variable, it can be said that the increase in price of homes produced from 2004 to 2007 contributed to the reduction in late payments, in this case significantly because elasticity, as in the full model, is greater than unity.

As in the work of Fernández de Lis et al (2000), Salas & Saurina (2002), Ghosh (2005), Foos, et al (2010) and Louzis, et al (2012) the increase in credit contributed to the increase in defaults.

As can be deduced the sign of the leverage ratio is positive. Therefore, increasing the leverage that occurs in this period contributes to increasing NPLs. The elasticity is less than unity. Entities in this growth stage further reinforce solvency, they mean fewer late payments, since the negative sign indicates that the increase in equity reduces delinquency.

2008-2012 financial crisis

This stage is characterized by a very strong growth in the unemployment rate, with changing rates of unemployment increase during the first year to 50% in 2008. Later they continue to grow, but with less intensity, stabilizing at 10%. House prices fall significantly, compensating for all the increases since 2004, reaching prices below those for that year. A strong deleveraging, as hard as in the previous period, occurred, but in reverse, in a period of economic crisis both nationally and internationally.

In this context, two explanatory variables are statistically significant, and two are not. Unemployment and leverage are no longer very significant, at 0.781 for leverage and 0.954 for unemployment. Despite this result the unemployment rate is a very important factor in the increase in NPLs. These statistical results of the unemployment variable may be owed to the smoothing of the results carried out by the Spanish banks in this period. This, hide late payment, was demonstrated to the be intervened many of Spanish credit institutions by the Spanish banking supervisor and detect a lot of non-performing assets. This led to significantly increased losses from credit institutions intervened and the public aid request of over 60,000 million euros. With respect to other variables, the price of housing remains significant at 1%. It maintains the sign of the negative coefficient, but increases both the coefficient and elasticity, so that the effect in the second period is higher than in the first. The effect of this reduction in housing prices on late payment is very important, because in this period a very sharp decline in house prices occurred.

The importance of the policy of strengthening the quantity and quality of equity in implementing the Basel III rules is confirmed, since the coefficient of equity remains negative with statistical significance of 1%. However, in addition, increases the coefficient since the -0.048 in 2004-2007, until -0.547 to this second period 2008-2012. So the effect of the decline in NPLs in credit institutions that increase equity in times of recession is much higher in the growth stages.

5. Discussion

In the model covering the whole period of 2004 to 2012 there is a certain inertia in NPLs. However, the most important research result obtained is that the magnitude of the impact of variables on late payment is not of the same intensity in periods of growth as it is in periods of recession.

The results obtained, along with the economic situation, explain in part the rescue of Spanish credit institutions, which led to an injection of public funds of more than 60,000 million euros.

At the same time these results can be used to allow policy-makers to prevent or mitigate crises, because, although variables such as unemployment are difficult to control, others such as housing price developments, the increase in credit (leverage) or the regulation of equity of the credit institutions can be regulated by people other than policy-makers.

The impact of the housing bubble, helped by expansionary monetary policy conducted by the ECB in an overheated economy, such as the Spanish one, was one of the main causes of the increase in defaults and consequently the bailout suffered by Spanish credit institutions. This circumstance could have been mitigated by policy-makers, with performances that could have slowed the housing bubble, a bubble which they knew was developing.

A similar situation occurred in equity, since supervision was not diligent. Examples of this were the interventions that occurred and the reformulation of the financial statements with the appearance of a large number of NPLs, especially in Spanish savings banks. In this case policy-makers should have regulated long before to avoid some of the crisis, since they were aware of the bad financial situation.

The impact of unemployment is higher in the full model in the first period, so one could say that the impact in times of recession is higher than in times of growth. Therefore, the policy of strengthening the quantity and quality of equity regarding credit institutions was adequate to support economic recession scenarios.

The regulator and the supervisor together with policy-makers, could also have acted on the growth of credit (leverage) that occurred a very important way. Of this form the impact on the increase in defaults could have been lower.

Finally, the overall results obtained indicate that the effects of variables that determine late payment are greater in times of recession than in growth stages.

This conclusion is very important, because when policy-makers made their forecast this feature was not considered. For example, in the stress test when two or more scenarios projecting the impact of the variables is the same, what changes is the macroeconomic data, microeconomic data or estimates of the assets and liabilities of credit institutions. Hence this feature must be consider and estimate different parameters for different scenarios, thus lessening errors in the results of the stress test. Note that sometimes, the forecast is very different from reality, for example the stress test of the European Banking Authority (EBA) confirming the good solvency of Bankia. Which was published on 20 July 2011, the same day ending the Initial Public Offering subscription (Climent and Pavia, 2015b).

6. Conclusions

The Spanish financial system has undergone profound change. The financial map changed substantially from 2010 to 2013. In just two years the savings banks which had 50% of market share have disappeared or have undergone a profound transformation. All has been motivated in large part by the large endowments to cover NPLs that have reached record highs with figures above 13%. However, in the period 2004 to 2007, the rate of NPLs was extremely low and stable, less than 1% throughout the period.

This great difference between the two periods is very important for the study of the main determinants of NPLs, especially to see if the effect is the same in periods of economic growth and crisis. It is for this reason that this study has researched the effect on NPLs of the main factors of the Spanish crisis, studying the differential effect in two stages, crisis and growth.

For this purpose, an econometric model has been estimated with panel data composed of most of the Spanish credit institutions, representing more than 99% of assets of banks and Spanish savings banks. We have studied the behaviour of the determinants of NPLs and especially if this behaviour is statistically different in times of economic growth compared with times of recession, with the aim of giving the financial system a new tool to predict the effects of the leverage (credit growth) of unemployment, solvency through the evolution of equity and the evolution of housing prices according to the cycle of the economy, i.e. growth or recession.

The main result is that the behaviour of the determinants is different in a recession than in times of growth. In times of recession the magnitude of effect of determinants tested is considerable. The price of housing is a determining element of NPLs. It was confirmed that increase in house prices reduces NPLs, whereas increase in unemployment and leverage increases NPLs. Finally, an increase of capital will cause a decrease in NPLs, so the most solvent credit institutions will have fewer NPLs.

In summary, that the impact on NPLs by the internal and external variables studied, such as leverage, unemployment rate, equity and house prices, is very important in explaining NPLs.

The increase in house prices contributed to the decline in NPLs in important ways because the elasticity of this variable is higher than the unit on all models. Both the regressor coefficient and the elasticity indicate that this effect is much greater in crisis stages than in growth stages, and in addition the difference in the coefficients is statistically significant.

The increase in NPLs equity decreases, but the impact is much greater in times of recession than in growth stages. Therefore, credit institutions are able to increase their solvency in times of recession to control the increase in NPLs that is caused by other external factors.

The increase in unemployment, measured as a variation from the previous period, increases the rate of NPLs, although this increase is different depending on whether the economy is in crisis or recession. The impact of the variation in the unemployment rate is greater in times of recession than in times of economic growth.

The influence of leverage in NPLs is very limited. The coefficients representing the marginal propensity and the elasticity are the smallest of the three variables in the base model.

In conclusion, we can say that the results obtained can be used, among other applications, for stress tests of credit institutions. To differentiate various stages of the economy it is necessary apply different intensity regarding the impacts of the variables affecting NPLs, because the effect on NPLs of these variables is different in times of recession. Not only by the change in the variable data, that it is logical, but also by the intensity in affecting the NPLs. Therefore, the parameters used in the various stages of the stress test must be different.

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