ANALYSING CREDIT RISK IN LARGE LOCAL GOVERNMENTS. AN EMPIRICAL STUDY IN SPAIN

Abstract

In governments throughout the world, bank lending excesses, solvency issues and worsening credit ratings have all contributed to raising risk premiums and impeding access to credit, thus provoking a major financial problem in the public sector. Accordingly, tax authorities and regulators need to analyse the causes of public sector bank debt, doing so through the joint study of idiosyncratic and systematic variables, an area that has been neglected in previous research. This paper examines idiosyncratic and systematic factors that may influence local government credit risk, through an empirical study of the performance of 148 large Spanish municipalities during 2006-2011. We identify individual factors relevant to the probability of local government default (such as dependent population, per capita income and debt composition) and also determinants associated with macroeconomic developments, such as GDP and the risk premium.

Keywords

Credit risk, default, local governments, idiosyncratic and systematic factors, Basel II.

1. Introduction

In many countries, the economic recession that began in 2008 gave rise to high levels of bank debt and budget deficit, leading to solvency problems, hampering access to credit markets and jeopardising the sustainability of public services. In countries such as Portugal, Greece, Italy, Ireland and Spain, the difficult situation of government finances attracted the attention of diverse international organisations (IMF, 2014; Worldwide Bank Group, 2015; FASAB, 2014; EU, 2015).

The debt crisis and its impact on governments' credit risk aroused special concern among politicians, financial regulators, tax authorities and researchers, who concurred on the need to study the causes of high levels of default in order to design corrective and preventive policies to straighten out government finances and thus enable debt and deficit targets to be met (IMF, 2014; Worldwide Bank Group, 2015; EU, 2015; EC, 2012; FASAB, 2014; Navarro et al., 2015; Balaguer et al., 2015; Bastida et al., 2014; Bailey et al., 2014).

Taking into account that financial institutions are the main creditors of local governments (henceforth, LGs), previous studies have examined four types of variables that influence levels of bank debt and public sector solvency, all of which are related to the specific characteristics of each municipality (idiosyncratic factors): a) demographic variables, such as population size, immigrant population and dependent population (Wang and Hou, 2012; Guillamón et al., 2011); b) socio-economic variables, such as unemployment rate, income per capita and level of tourism (Balaguer et al., 2015; Cabaleiro et al., 2013; Benito et al., 2010; Zafra et al., 2009); c) financial variables, such as financial autonomy, deficit and investments (Navarro et al., 2015; Balaguer et al., 2015; Cabaleiro et al., 2013); d) political variables, such as absolute majority, political orientation and political fragmentation (Rodríguez et al., 2016; Balaguer et al.,

2015; Elgin and Uras, 2013, Geys and Revelli, 2011).

However, despite the useful conclusions drawn from the above research, numerous organisations in the field of public finance have argued that a proper analysis of local government credit risk should also take into account systematic factors, due to the vulnerability of public institutions to macroeconomic changes (EU, 2015; IMF, 2014; FASAB, 2014; Worldwide Bank Group, 2015; US Department of Treasury, 2013).

In the private sector, numerous analyses of credit risk have already considered both idiosyncratic and systematic factors (Castro, 2013; Mileris, 2012). Idiosyncratic factors are those which are specific to the characteristics of the borrower, while systematic factors are of a macroeconomic, political-electoral and monetary-budgetary nature (Bailey et al., 2014; Schularick and Taylor, 2012; Agnello et al., 2011).

In the LG sector, numerous studies have examined the influence of idiosyncratic variables (Navarro et al., 2015; Benito et al., 2015; Balaguer et al., 2015; Arbatti and Escolano, 2015; Cabaleiro et al., 2013) and of systematic variables such as the economic cycle, gross domestic product, unemployment rate or the electoral cycle (Navarro et al., 2015; Benito et al., 2015; Balaguer et al., 2015). In this respect, too, Gaillard (2009) identified a relationship between the credit ratings of local and regional governments on the one hand, and the sovereign rating on the other, as both ratings depend on the country's default history and on its GDP. However, to date no studies have specifically addressed the joint effect of idiosyncratic and systematic factors on LG credit risk, despite the recommendations in this respect made by international organisations and researchers (EU, 2015; IMF, 2014; Worldwide Bank Group, 2015; Elgin and Uras, 2013; Castro, 2013; Schularick and Taylor, 2012).

The aim of this paper is to conduct a detailed analysis of the factors influencing

LG credit risk, examining the joint effect of idiosyncratic and systematic factors on the probability of default (PD), calculated according to the Basel II rules (BCBS, 2006), for 148 Spanish local governments, during the period 2006-2011. We considered a study period ranging from three years before the onset of the crisis until three years after this time, following the approach adopted by Navarro et al. (2015), Cohen et al. (2012) and Benito et al. (2016). To narrow the focus of the study, we followed the criteria of the Spanish Local Government Modernisation Act, No. 57/2003 and selected 148 municipalities, each with more than 75,000 inhabitants, together with those which have fewer inhabitants but are provincial capitals. Our sample, thus, consists of 148 Spanish municipalities, of which 146 have a population of over 75,000 inhabitants and 2 have fewer than 75,000 inhabitants but are provincial capitals. This study is particularly timely and relevant in a country like Spain because the bank debt of Spanish local and regional governments is very large and the public deficit is worryingly large and rising (EU, 2012; IMF, 2014), as a result of the increasing range of functions being undertaken and the expanding role of the public sector in economic activity (Banco de España, 2008).

We conclude that default risk is affected not only by idiosyncratic factors (population density, dependent population and composition of the debt), but also by systematic ones such as GDP and the country risk premium.

2. Estimating local government credit risk taking into account idiosyncratic and systematic variables

According to the EU (2015), IMF (2014), Worldwide Bank Group (2015) and US Department of the Treasury (2013), analysing the joint effect of idiosyncratic and systematic factors could further our knowledge of the causes and consequences of LG

default and point the way to possible solutions.

Accordingly, this paper analyses the probability of LG default, as an indicator of credit risk, based on the Basel II definition of default proposed by the Basel Committee on Banking Supervision (2006), and in line with previous studies in this field (Bluhm and Overbeck, 2003; Gordy, 2003). The higher the PD, the greater the expected loss, and hence the higher the capital requirements and the higher the price charged for loans.

Because Basel II defines various scenarios of default, the analysis presented in this paper takes into account a dependent variable that reflects all of these scenarios, through the concept of *Ability-to-Pay Process* (APP), which measures a LG's ability to meet its credit liabilities (Bluhm and Overbeck, 2003). The APP depends on the quality of assets and financial resources held. It is a random latent variable, which is not directly observable, and so must be estimated by nonlinear models of discrete choice, such as probit or logit data panel (this approach is commonly adopted in empirical studies of credit risk). Such models are very appropriate to examine the factors underlying the probability of loan default (Bonfim, 2009; Hwang et al., 2013).

According to Gordy (2000) a LG_i is in default if its capacity to pay at a given time APP_{it} is below a given level of credit liability (c_{it}). In this framework, the default event of LGs_i in period t is a random variable Y_{it} of a dichotomous nature such that:

$$Y_{it} = \begin{cases} 1 \ \text{if the LG defaults at time } t \text{ or } APP_{it} \leq c_{it} \\ 0 \ \text{if the LG does not default at time } t \text{ or } APP_{it} > c_{it} \end{cases} \qquad (1)$$

where the PD of LGi at time t is:

$$PD_{it} = P(Y_{it} = 1) = P(APP_{it} \leq c_{it}) \qquad (2)$$

Following the methods used in previous research into private-sector credit risk (Castro, 2013; Mileris, 2012; Schularick and Taylor, 2012), in this paper we assume that the credit risk factors that also influence PD in LGs can be of two types: idiosyncratic and systematic. The former (Z_{it}) correspond to LG-specific factors such as socioeconomic, demographic, financial situation and political variables. Systematic credit risk factors (X_t), on the other hand, relate to the macroeconomic cycle, fiscal policy and the electoral cycle. Accordingly, we assume: (1) that LGs form a homogeneous segment within the public sector; (2) that the systematic factors X_t influencing credit risk affect all borrowers equally at time t ($t=1, ..., T$); (3) that the idiosyncratic factors Zit ($i=1,..., Nt$, $t=1,...,T$) that influence credit risk affect each LG (Lgi) individually; (4) that the idiosyncratic factors are not entirely independent of the systematic effects, an aspect that is especially significant in an economic recession (Bonfim, 2009). Given these considerations, the variable APP_{it} of the i-th LG at time t is a function of systematic and idiosyncratic variables according to the following expression:

$$APP_{it} = \alpha + \beta_j X_t + \delta_k Z_{it} + u_{it} \qquad (3)$$

where β_j and δ_k are the parameter vectors estimated using a linear panel data model, and where u_{it} is the error term.

Although APP_{it} is a latent variable, which is not directly observable, the explanatory variables and the systematic and idiosyncratic factors, X_t and Z_{it}, together with the independent binary variable, Y_{it}, the indicator of default, are directly observable from the sample data. Accordingly, the relationship between the dependent variable and

the risk factors can be established by a probit or logit data panel model, which estimates the PD of the borrower *LGi* at time *t* as a function of systematic and idiosyncratic factors. In the present study, we opted for a logit data panel model, as this presents a lower log likelihood ratio than the corresponding probit data panel, and is therefore a more appropriate instrument for measuring LG credit risk. Given the linear data panel model defined in (4), the PD is obtained as follows:

$$\begin{aligned} &PD\left(Y_{it}=1 \mid X_t, Z_{it}\right)=PD\left(APP_{it} \leq c_{it} \mid X_t, Z_{it}\right)= \\ &=PD\left(\alpha+\beta_j X_t+\delta_k Z_{it}+u_{it} \leq c_{it} \mid X_t, Z_{it}\right)= \\ &=PD\left(u_{it} \leq \hat{\alpha}+\hat{\beta}_j X_t+\hat{\delta}_k Z_{it} \mid X_t, Z_{it}\right)= \\ &=F\left(\hat{\alpha}+\hat{\beta}_j X_t+\hat{\delta}_k Z_{it}\right) \end{aligned} \tag{4}$$

where *F(.)* represents the standard normal distribution of the error term u_{it}, c_{it} is the normalised threshold (*LGsi credit liability*), $\hat{\alpha}=c_{it}-\alpha$, $\widehat{\beta_j} X_t=-\beta_j X_t$ and $\widehat{\delta_k} Z_{it}=-\delta_k Z_{it}$.

3. Research methodology

3.1. Methodology

In this paper, the PD of LG*i* at time *t* can be calculated from a logit data panel, as follows (Train, 2003):

$$PD_{it}\left(APP_{it} \leq c_{it} \mid X_t, Z_{it}\right)=\frac{e^{(\hat{\alpha}+\hat{\beta}_j X_t+\hat{\delta}_k Z_{it})}}{1+e^{(\hat{\alpha}+\hat{\beta}_j X_t+\hat{\delta}_k Z_{it})}} \tag{5}$$

The LG credit risk model proposed in this paper, based on calculating the corresponding PD, was chosen for several reasons. First, discrete choice models are appropriate when

the study goal is to analyse the determinants of the probability of an individual economic agent (Huyghebaert et al., 2014; Hwang et al., 2013). Second, because this approach meets the statistical requirements established in the Basel II regulations for the calculation of the PD. Third, the IMF (2014) and Worldwide Bank Group (2015) have both highlighted the need to study the joint effect of idiosyncratic and systematic variables in measuring credit risk.

To measure the PD of LG, we assigned a value of 1 to a LG if it is in default, and a value of 0 otherwise, analysing data from a sample of 148 Spanish municipalities. These data were comprised of the values corresponding to the dependent variable (PD as an indicator of credit risk) and to our 23 independent variables, reflecting both idiosyncratic factors (population, socioeconomic, financial and political variables) and systematic factors (macroeconomic, political election cycle and fiscal policy variables).

Logit panel data can be used to establish the correlation between unobserved factors over time, and to eliminate the bias arising from the existence of unobservable and time-invariant heterogeneity among individuals (Train, 2003). These characteristics are relevant for our purposes, as they closely fit the characteristics of our sample.

In the present study, the dependent variable is binary, and we have a data panel for the period 2006-2011. Therefore, a conditional random-effects logit data panel regression can be used for the study sample. In this analysis, we used the random effects logistic regression procedure available in the software package Stata 12.0. The random intercept logit model was chosen for two reasons. First, to control and model the unobserved heterogeneity in our data. For instance, the model also provides intra-class correlation, i.e., a percentage of the variance of the dependent variable that is due to individual unobserved characteristics. Second, it allows for subject-specific interpretations and inferences. Finally, and in accordance with Antão and Lacerda

(2011) and Shih-Chen, L. and Chien-Ting, (2012), Table 2, we applied two statistical models: a) *Model 1*, in which the independent variables are idiosyncratic (population, socioeconomic, financial and political); b) *Model 2*, where the independent variables included are the idiosyncratic ones from Model 1 plus systematic variables (macroeconomic, election cycle and fiscal policy).

3.2. Sample selection and variables.

3.2.1. Sample selection

Our empirical study focuses on large LGs in Spain. This country was selected for analysis because institutions (EU, 2012; IMF, 2014) and previous research papers (Balaguer et al., 2015; Benito et al., 2015; Navarro et al., 2015; Cabaleiro et al., 2013; Guillamón et al., 2011) have concluded that the bank debt of Spanish local and regional governments is very large and that there is a worrying gap between income and expenditure.

Our study sample is comprised of large LGs, in line with previous studies of municipal finance (Rodríguez et al., 2016; Benito et al., 2015; Wang and Hou, 2012; Guillamón et al., 2011). Following the criteria of the Spanish Local Government Modernisation Act, No. 57/2003, we selected 148 municipalities, each with more than 75,000 inhabitants or provincial capitals, taking data for the period 2006-2011, using observations from three years before the onset of the crisis until three years after this point, following the criteria used in comparable previous research (Benito et al., 2016; Navarro et al., 2015; Cohen et al., 2012). This Act defines large cities as municipalities with over 75,000 inhabitants or which are provincial capitals even if they have a smaller population. Thus, our sample contains 146 LGs with more than 75,000 inhabitants and two LGs with a smaller population, but which are provincial capitals.

This sample is appropriate for our research goal, for the following reasons: a) the EU (2012) and credit rating agencies such as Moody's (2013) have observed that the financial situation of large LGs in Spain is among the most worrying in the Eurozone; b) the introduction to the Local Government Rationalisation and Sustainability Act, No. 27/2013, states that large LGs face significant problems of insolvency and shortcomings in their financial management; c) these governments have a considerable volume of bank debt (Bailey et al., 2014; Benito et al., 2015, Navarro et al., 2015); d) these governments account for over 38.7% of all local spending and represent about 56% of the Spanish population, providing a wide range of services including public transport, sewage treatment, waste disposal and sports facilities (IGAE, 2014; Fundación La Caixa, 2014); e) the accounting system used by large LGs in Spain is considered to be more revealing and complete than that employed by smaller municipalities, which contributes to the representativeness and consistency of the financial data considered (Ministry of Finance and Public Administration, 2013).

3.2.2. Variables.

The dependent variable

Our analysis of credit risk was conducted taking into account the perspective of financial institutions, which are the largest creditors of LGs, and the solvency rules applied to LGs in Spain. Specifically, we used the definition of default as set out in the provisions of the "International Convergence of Capital Measurement and Capital Standards" (Basel II) issued in 2006, and the Revised Text of the Spanish Local Government Finance Act.

In this paper, our dependent variable is the Y_{it} of the LGs analysed, according to four financial indicators which determine when APP_i is less than the credit liability. A

loan to a LG is considered to be in default when there is reasonable doubt that its financial obligations can be met. Among other circumstances, worsening solvency is revealed by an inadequate economic or financial structure, negative equity, continuing losses, generalised late payments, insufficient cash flow to pay debts, inability to obtain additional financing or a situation of official receivership. Therefore, following the criteria set out in previous research papers on the financial analysis of LGs (Moody's, 2013; Benito et al., 2015; Rodríguez-Bolivar et al., 2016; Navarro et al., 2015; Bailey and Asenova, 2011) and in the Basel II provisions, we consider that APP_i is less than credit liability and therefore that a LG is in default when at least one of the following variables or financial indicators is observed. According to the Basel II regulations and also the Revised Text of the Spanish Local Government Finance Act, when a LG meets a single indicator, this is sufficient to constitute a situation of default; i.e. it is not necessary for two or more indicators to be met.

- *Variable Default 1:* $Y_{it}(k_1)\epsilon\{0,1\}$. Cash surplus for overheads (Index of cash surplus). Addressed in Article 193 of the Revised Text of the Spanish Local Government Finance Act. When this indicator is negative, it indicates a deterioration in the creditworthiness of the debtor, in this case the LG, as described in the first point of Article 452 and the second one of Article 453 of the Basel II regulations. For this condition, if Cash surplus for overheads > 0, $Y_{it}(k_1) = 0$; otherwise, $Y_{it}(k_1) = 1$. For information on this item, we consulted various sources, in the following order of preference: (a) the Court of Auditors, through its accountability website; (b) the external audit body for the autonomous community to which the municipality belongs; (c) the local authority's own website.

- *Variable Default 2*: $Y_{it}(k_2)\epsilon\{0,1\}$. Legal borrowing limit (capital or current debt) exceeding 110% of current revenues, as stipulated in Article 53.2 of the above Act. For this condition, if Legal borrowing limit < 110% of current revenues, $Y_{it}(k_2) = 0$; otherwise, $Y_{it}(k_2) = 1$. For information on this variable, we consulted the virtual office of local authorities, administered by the Ministry of Finance and Public Administration.
- *Variable Default 3*: $Y_{it}(k_3)\epsilon\{0,1\}$. Gross budget savings (current revenue – current expenditure), as considered in Article 53.1 of the above Act. When this indicator is negative, it indicates deteriorating solvency, as described in the first and second points of Article 452 and in the first and second points of Article 453 of the Basel II regulations. For this condition, if Gross budget savings > 0, $k_3 = 0$; otherwise, $Y_{it}(k_3) = 1$. Therefore, $Y_{it}(k_3)\epsilon\{0,1\}$. For information on this variable, we consulted the above-mentioned virtual office for financial coordination with local authorities.
- *Variable Default 4*: $Y_{it}(k_4)\epsilon\{0,1\}$ Solvency (current assets / current liabilities). This indicator of solvency is commonly used in financial analysis and is based on the two national and international sets of regulations cited above. For this indicator, we consulted the same sources of information as for *Variable Defaults* 1, 2 and 3. If it is <1 the LG's solvency is worsening. If Solvency > 1, $Y_{it}(k_4) = 0$; otherwise, $Y_{it}(k_4) = 1$.

Therefore, the dependent variable that is ultimately used as an indicator of LG default is $Y_{it}\left(k_{1,}k_{2,}k_{3,}k_{4,}\right)\epsilon\{0,1\}$, where 0 indicates no default and 1 represents default.

$$Y_{it}(k_1, k_2, k_3, k_4) = \max\{0, \max(k_1, k_2, k_3, k_4)\} \quad (7)$$

Under Basel II, if $Y_{it}(k_m) = 1$ $(para\ m = 1,2,3,4)$ in at least one of the four indicators, the observation is classed as default. However, although the value 1 of any $Y_{it}(k_1, k_2, k_3, k_4)$ is a sufficient condition for default to be declared, our empirical observations show that over half of the LGs in this situation present two or more such indicators (33.04% are in default according to two indicators, 14.51% according to three and 2.46% according to all four).

In accordance with these considerations, in our empirical study, the PD of each of the 148 Spanish LGs was calculated from (5), as described in Section 2.

The Independent variables

Table 1 shows the idiosyncratic and systematic variables used in this study. It also shows the description and expected sign of the relationship between each input variable and the PD. As explained below, these variables were selected taking into account previous research into the level of LG borrowing and the classifications generally used by the credit rating agencies S&P (2009 and 2011) and Moody's (2008).

<<< Insert Table 1 about here >>>

Idiosyncratic variables

POP_SIZE has been used by Carr & Karuppusamy (2010) and Wang and Hou (2012), who concluded that larger populations generate more government spending, which may lead to a greater volume of debt being incurred and to difficulties in meeting it. We would expect a positive sign for this estimate because (as in the business sector) increased debt would increase the PD (Abdou, 2009; West, 2000).

POP_DENS has been used by Gonçalvez and Veiga (2007), Guillamón et al.

(2011) and Wang and Hou (2012). Following these authors, assuming that an increase in population density is positively associated with municipal debt, the indicator sign is expected to be positive.

DEPEND_POP has been used by Zafra et al. (2009) and Benito et al. (2010), who argue that a rising dependent population could increase the budget deficit, as income would be lower and expenses higher, thus provoking greater financial difficulties. Therefore, we expect the sign for this estimate to be positive.

With respect to *IMMIGR*, according to Benito et al. (2010), Guillamón et al. (2011) and Navarro et al. (2015), the higher the proportion of immigrants, the higher the accumulated debt and hence the likelihood of default. We expect the sign for this estimate to be positive.

The income per capita indicator *(IPC)* has been used by Wang et al. (2007) and Zafra et al. (2009), for whom rising incomes are associated with less need to resort to borrowing, and hence a lower volume of debt. Therefore, the sign for this estimate is expected to be negative.

UNEMPLOYMENT has been used by Palumbo and Zaporowski (2012) to construct a credit rating index and by Benito et al. (2010) to study fiscal pressure in LGs. Higher levels of unemployment would lead to LGs having greater need of financial resources, and so becoming more indebted. Accordingly, we expect there to be a positive relationship between the unemployment rate and the probability of loan default.

According to Balaguer et al. (2015) and Cabaleiro et al. (2013), financial autonomy (*FIN_AUT*) contributes to enhancing the financial health of LGs. Thus, the greater the financial autonomy, the lower the PD, and therefore the expected sign for this variable is negative.

On the other hand, studies of default by private companies have shown that as the debt/equity ratio (reflecting the general financial structure) increases, so does the PD and this can lead to problems of insolvency (Mossman et al., 1998). Therefore, we expect the sign for the *FIN_STRUCT* estimate to be positive.

For *COMP_DEBT* and *SOURCE DEBT*, a higher proportion of short-term debt and debt owed to financial institutions means that LGs will have fewer options, due to the greater immediacy and rigour of due dates; thus, it seems reasonable to assume that as these ratios rise, so will the likelihood of default. Therefore, and in accordance with Navarro et al. (2015), we expect a positive sign for these variables.

With respect to political variables, as indicated by Ryan et al. (2005), it may be useful to observe the differences in leadership styles between men and women, and their implications for innovation in local governments. On the other hand, Massolo (1991) and Guillamón et al. (2011) found no evidence of any influence of the mayor's gender on the evolution of municipal debt. However, these studies did not analyse the default risk or other characteristics of the mayor, and so for this empirical study we chose to include two possible explanatory variables with respect to the mayor: level of academic studies (university graduate or otherwise) and academic profile (studies related to economics or otherwise). We expect these variables to be inversely associated with PD.

Some authors (Benito et al., 2015; Benito et al., 2010) have concluded that political competition tends to increase the tax burden, deficit and debt. In contrast, Guillamón et al. (2011) found no evidence of any such relationship with the volume of government debt. We expect a positive sign for the variable *ABS_MAJ*.

Regarding the political ideology (*POLITICAL_SIGN*) of the governing party, Benito et al. (2015) and Balaguer et al. (2015) concluded that left-wing parties are more likely than centrist or right-wing ones to adopt expansionary spending policies, thus

leading to increased borrowing requirements and greater difficulties in meeting repayment obligations. Therefore, we expect a positive effect of this variable.

García et al. (2011) and Guillamón et al. (2011) have concluded that greater political strength is negatively associated with higher levels of debt. To examine whether political strength heightens the default risk, we followed previous research (García et al., 2011; Guillamón et al., 2011) in examining the Herfindahl Index, which is calculated by dividing the number of councillors belonging to the governing party by the total number of councillors. In this respect, Bastida et al. (2015) and Geys and Revelli (2011) concluded that increased political fragmentation can cause budget deficits and aggravate municipal debt. Accordingly, we study the specific influence of this variable on default risk, measuring it as the ratio between the number of parties with seats in the municipal assembly and the total number of councillors.

The findings of Solé-Ollé and Sorribas-Navarro (2008) and Gómez and Herrero (2011) are not conclusive regarding the influence of LG political alignment on levels of debt; some authors have recorded a negative influence, while others have failed to observe any empirical effect. We examined the alignment of the LG with that of the regional government (*LOCAL_REG*) and of the central government (*LOCAL_ST*), and expected to find a negative sign for the relationship.

Systematic variables

As stated above, international bodies and previous studies (EU, 2015; IMF, 2014; Worldwide Bank Group, 2015; Balaguer et al., 2015; Elgin and Uras, 2013; Castro, 2013; Schularick and Taylor, 2012) have recommended incorporating systematic factors in the analysis of LG default risk, together with idiosyncratic factors.

With respect to macroeconomic variables, under Basel II the PD should be a long-term average of default rates (one year), in the view that this long-term perspective represents the economic cycle (Van der Burgt, 2009). Following Ortega and Peñalosa (2012), the present study employs a dichotomous variable (*ECO_CYCLE)*, which approximates periods of expansion or contraction of the economic indicators. Benito et al. (2015) and Balaguer et al. (2015) suggested that this variable could influence the volume of debt and therefore be related to LG insolvency. Therefore, we selected this variable as a possible determinant of PD, expecting its sign to be positive. In addition, Arbatli and Escolano (2015), Navarro et al. (2015) and Balaguer et al. (2015) have suggested that an increased level of economic activity and a higher national unemployment rate may increase LG debt. Accordingly, the variables *GDP* and *UNEMPL-RATE* were included. We expecting the first of these to have a negative effect on PD and the second to have a positive effect.

Based on Benito et al. (2015) and Balaguer et al. (2015) *ELEC_CYCLE* reflects whether the year observed coincides with one in which an election takes place. According to the electoral cycle thesis proposed by Blais and Nadeu (1992), governments will attempt to introduce more ‘‘popular’’ measures, such as increasing expenditure, immediately before an election, and less popular ones, such as raising taxes, after it. For example, in terms of expenditure on policing, an increase in this area would be a ‘‘popular’’ measure before elections, thus providing electoral benefits to the incumbents (Guillamón et al., 2013). Table 1 shows how this variable is measured, and its sign was expected to be positive. Finally, taking into account the pronouncements of the IMF (2014) and the EU (2015) and previous research findings (Palencia, 2011; Mackey, 2014) we included *RISK_PREMIUM*, expecting a negative sign for this variable.

4. Analysis of results

Our empirical results show that a loan default occurred in 486 cases (54.73%) and that in 402 (45.27%) there was no default. Table 2 presents the estimated coefficients transformed into odds ratios (*OR*) or *Exp (β)* of the conditional random-effects logistic regression of Model 1 and of Model 2. The OR information for each variable reflects the influence of the statistically significant variables. The OR is interpreted as a change in the odds of an event (in our case, default) occurring in response to a unit change in the explanatory variable under consideration.

The classification matrix, i.e., the table of estimated versus observed values (Table 3), shows the degree of accuracy of the classification obtained with each model.

<<< Insert Table 2 about here >>>

With Model 2, the inclusion of systematic factors in the analysis of credit risk significantly improved the results obtained (see Table 3), from a correct classification rate of 69.14% with Model 1 to one of 79.73%. This finding confirms the suggestions of previous research and international organisations (EU, 2015; IMF, 2014; Worldwide Bank Group, 2015; Balaguer et al., 2015; Elgin and Uras, 2013; Castro, 2013; Schularick and Taylor, 2012), according to which both systematic and idiosyncratic variables should be included in an analysis of LG credit default.

<<< Insert Table 3 about here >>>

In Figure 1, the ROC curve for Model 2 approaches the upper left corner,

showing that the model discriminates sufficiently well between the two groups of LGs. The goodness of fit, derived from the Wald statistic, leads us to reject the null hypothesis that the coefficients are equal to zero, thus highlighting the joint significance of the model variables.

<<< Insert Figure 1 about here >>>

The correlations among the explanatory variables included in the final model are very small (see Table 4), which confirms that there is no relationship among these variables that would account for the event studied. We conclude, therefore, that the results obtained are robust and reliable.

Model 2 shows that 8 of the 23 variables selected (34.78%) are statistically significant, reflecting the joint and simultaneous effect of the different types of variables on the PD, for each class as follows: populational (2 of 4), socioeconomic (1 of 2), financial (1 of 4), political (2 of 8) and systematic (2 of 5). These results extend the findings of Balaguer et al. (2015), Benito et al. (2015) and Navarro et al. (2015), who reported that LG insolvency may arise both from controllable and from uncontrollable variables, although our results indicate that uncontrollable factors have a stronger influence. In fact, LG risk factors are subject to considerable uncertainty. Although the main explanatory variables of this risk can be identified and measured, their behaviour does not depend on the decisions of LGs or voters, but on the demographic and economic characteristics of the municipality and on the evolution of macroeconomic magnitudes such as GDP and the market risk premium.

<<< Insert Table 4 about here >>>

The coefficients obtained for Model 2 (Table 2) show that five variables have a negative influence and another three have a positive one on the PD. An increase in the PD is associated with the reduced impact of four variables (population density, dependent population, IPC, GDP) and with the ideological alignment between the LG and the national government. In parallel, an increased short-term debt burden, the mayor having an economics-related university degree and a rise in the market risk premium are all associated with increased LG credit risk. Two of these variables are systematic and six are idiosyncratic, which confirms the joint impact of both types on LG default risk.

The individual analysis of the variables shows that *POP_DENS* is significant, but with a negative sign (-0.0735494), when a positive one had been expected. Although previous studies suggested that greater population density heightens the credit risk (Gonçalvez and Veiga, 2007; Guillamón et al., 2011; Wang and Hou (2012), our results show, on the contrary, that such an increase could contribute to avoiding or reducing problems of default. We believe this is because a higher population density reflects the existence of a larger number of users of public services, thus generating a greater volume of financial revenues and enabling the LG to better meet its debt repayment obligations.

The variable *DEPEND_POP* is also significant, but with a negative sign (-0.1305842). This, too, is contrary to previous research findings, according to which an increase in the dependent population will tend to increase the budget deficit (Palumbo and Zaporowski, 2012; Benito et al., 2010). Our results suggest that an increase in the dependent population could mean that LGs are more aware of and place a higher priority on debt repayment.

Regarding *IPC*, we obtained evidence of the specific influence, with a negative

sign (-0.795266), as expected, of this variable on the PD. Thus, an increase in income per capita may reduce the risk of LG default.

For the financial variables, our results show that an increase in the *COMP_DEBT* ratio may raise PD in LG, since the coefficient obtained is +0.0883237. According with Navarro et al. (2015), we suggest that the influence of this variable on PD in LG is similar to that reported for the private business sector.

The *ECO* variable is significant, and its sign is as expected (+ 0.4688818), which corroborates the influence of the mayor's academic profile on the risk of LG default. This finding is an advance on previous studies in this field, which recorded no such association with LG debt.

The variable *LOCAL_ST* has a negative influence (-0.3942798) on the PD, indicating that the absence of ideological alignment between the LG and the central government may increase the risk of default. This finding represents an advance over previous research, which is inconclusive about the relationship between ideological alignment and the volume of debt (Solé-Ollé and Sorribas-Navarro, 2008; Gómez and Herrero, 2011).

Regarding the influence of systematic variables, our results identify two variables that can impact on LG credit risk. This finding represents an advance over previous research and highlights the need to incorporate macroeconomic variables into credit risk models, as suggested by international organisations and previous research, and provides empirical evidence of the effect of uncontrollable factors on government finances (EU, 2015; IMF, 2014; Worldwide Bank Group, 2015; Balaguer et al., 2015; Elgin and Uras, 2013; Castro, 2013; Schularick and Taylor, 2012). The first systematic variable is national GDP, which is significant and has the expected sign (-0.165963), showing that a reduction in national GDP may increase LG credit risk (Gaillard, 2009).

The second significant systematic variable is the national *RISK_PREMIUM* (+0.4207524), which has a positive sign, as expected. This result empirically corroborates previous indications of the IMF (2014), the EU (2015) and previous research (Palencia, 2011; Mackey, 2014), showing that an increase in sovereign risk is translated to PD in LG, given the interrelationship between LGs and central and regional governments via current and capital transfers (Gaillard, 2009).

No empirical evidence was found of any influence of the other variables on the PD. Our results do not support the significance of certain idiosyncratic variables (size, immigrants, unemployment, autonomy, financial structure, origin of the debt, mayor's academic profile, absolute majority, political fragmentation and strength, or ideological alignment with the regional government) or that of some systematic variables (economic cycle, national unemployment and electoral cycle).

5. CONCLUSIONS

The economic recession provoked excessive borrowing by public sector entities, which led to severe insolvency problems that reduced their credit rating, raised the risk premium and hindered access to the credit market, making bank debt one of the main problems affecting government finance. This critical financial situation has led tax authorities, financial regulators, supranational organisations and researchers to examine the causes of government insolvency, and one approach that has been considered is the joint analysis of idiosyncratic and systematic variables.

Using a logit panel data regression model, which includes both types of factors as explanatory variables, we obtained empirical evidence that the PD rises in response to a fall in four variables (population density, dependent population, income per capita and GDP) and with the ideological alignment of the LG with the national government.

In parallel, we found empirical evidence that the PD also increases with short-term borrowing and with increases in the market risk premium, and that it is also heightened when the mayor has an economics-related educational background.

According to our statistical analysis, the factors influencing the PD do not coincide with previously-identified determinants of the volume of bank debt. Thus, unemployment, population size and the electoral cycle are explanatory of the volume of debt, but we found no evidence of their having any impact on the PD in LGs. Moreover, our results show that a growing dependent population and an increasing population density can help reduce default risk, although previous research has concluded that these trends can lead to higher volumes of bank debt.

In view of these considerations, we conclude that the behaviour of LG credit risk is subject to considerable uncertainty, due to the existence of certain variables that are not controlled by the LGs. Although the main explanatory factors of PD have been identified, our results show that it is highly vulnerable to changes in the demographic and economic profile of the local population (idiosyncratic factors) and to the volatility of national macroeconomic indicators, such as GDP and the risk premium (systematic factors). Only the specific weight of short term debt is a controllable factor by LG.

These findings are of great importance to financial analysts of LG credit default. Compliance with solvency conditions, in terms of minimising default risk, requires not only observing the legal limitations on borrowing and electing local leaders who are committed to good financial practice. Therefore, a comprehensive analysis of government solvency on the basis of default risk should include, as well as variables dependent on the decisions of governors and governed (variables such as the debt composition, or the mayor's academic profile), systematic factors whose behaviour is not subject to these circumstances, but which nevertheless should be understood and

taken into account, in order to effectively manage credit risk.

In parallel, LG financial managers, financial regulators and tax authorities can obtain useful information from our conclusions. As our results show, an interannual reduction in GDP and/or a rise in the country's risk premium may worsen the LG credit risk, reflecting its decreased solvency and ability to repay bank loans. Therefore, the trends of these variables should be considered as warning signs, with a potential impact on access to bank credit and on the cost of borrowing.

Moreover, our findings could be very helpful to politicians, as we have identified factors whose evolution may influence both the viability of public services and the effectiveness of measures taken to meet the goals of budgetary stability and financial sustainability that are set annually by central governments in accordance with EU rules on budgetary discipline.

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