THE IMPACT OF POPULATION SIZE ON THE RISK OF LOCAL GOVERNMENT DEFAULT

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Abstract

Since the outbreak of the international economic crisis in 2008, governments' fiscal policies have been strongly influenced by high levels of public debt and default. Studies of the causes of debt problems for large local governments have emphasised the interest and timeliness of identifying factors that may influence the probability of municipal default, and have concluded that fiscal policies should be defined according to population size. The present empirical study was conducted on a sample of 1,476 local governments, with data for the period 2009-2014, to determine the influence of financial, socioeconomic and population factors on default risk in three types of municipality (small, medium-sized and large). The variables analysed were those considered relevant to the design of fiscal policies for these local governments. The results obtained show that the factors that influence the risk of default vary according to the size of the municipality, although some are common to all or most cases, such as real estate taxes, vehicle taxes, financial autonomy and per capita income. The main elements found to vary according to municipal size are overall immigration, female immigration, female unemployment and proximity to the next elections. Our findings show that the financial risk of local governments is affected not only by population size but also by financial and socioeconomic variables. These results can help policy-makers to design fiscal policies appropriate for the size of each municipality, thus contributing to avoiding bankruptcy, cuts in public spending and tax increases. Our study findings may be of interest to politicians, managers, fiscal authorities, central governments, supervisory bodies, financial institutions, banks, voters, taxpayers and users of public services.

Key words

Default risk, local government, population size effect, Basel Regulation.

JEL codes

C33; H72; H74.

1 Introduction

Academic researchers and international organisations concur that the economic crisis provoked a worrying increase in bank debt in European countries such as Italy, Greece, Ireland, Portugal and Spain, and significantly influenced subsequent fiscal policies. In all these countries, local governments (LGs) were severely affected by problems of solvency, reduced sustainability of public services, financial insufficiency, budget deficits and cuts in spending on essential services. These constraints severely limited governments' decision-making options and hampered fiscal policies, regarding both income and expenditure (Cohen et al., 2017b; EU, 2015; FASAB, 2014; Greer, 2016; IMF, 2014; Kluza, 2017; Moody's, 2013; Navarro-Galera et al., 2017; Padovani et al., 2018; Worldwide Bank Group, 2015).

The same financial restrictions persist today, and the long-term maturity of bank loans taken out is making some governments highly vulnerable to interest rate rises and/or reductions in revenues that would prevent them from meeting their financial obligations. For this reason, various studies (Alaminos et al., 2018; Bailey et al., 2014; Balaguer-Coll et al., 2015; Benito et al., 2015; Lara-Rubio et al., 2017) have been undertaken to discover the causes of excessive LG bank debt, seeking to clarify this question for managers, politicians, tax authorities, financial institutions, investors, creditors, users of public services, the general public and academics.

Previous research has obtained interesting findings about the causes of bank debt volume, identifying influential factors in this respect, including demographic variables (Guillamón et al., 2011; Wang and Hou, 2012), socioeconomic variables (Balaguer-Coll et al., 2015; Cabaleiro et al., 2013) and financial variables (Benito et al., 2015; Navarro-Galera et al., 2015).

In line with the recommendations of international organisations interested in governmental finances (EU, 2015; IMF, 2014; Moody's Investors Service, 2013; Worldwide Bank Group, 2015), we believe it necessary to achieve a better understanding of the causes of LG default, so that policymakers and managers can incorporate preventive or corrective action into their fiscal policies to address possible insolvency.

Some recent studies have identified explanatory variables of LG default as a key element for fiscal policies. Thus, Cohen et al. (2017a), Gardini and Grossi (2018), Greer (2016), Lara-Rubio et al. (2017) and Navarro-Galera (2017) have all concluded that the

determinants of default risk often depend on the size of the municipality, obtaining empirical evidence in this respect. These papers highlight the effectiveness and consistency of the Basel regulations (BCBS, 2006; 2011; 2017) as a basis for analysing LG default risk.

Although some authors have used empirical observations of municipalities of different sizes to examine the explanatory variables of bank debt volume (Balaguer-Coll et al., 2015; Benito et al., 2015; Guillamón et al., 2011), the few studies that have been conducted specifically to analyse the default risk of LGs have focused exclusively on large municipalities (population >50,000). However, the effectiveness of fiscal policies to reduce or eliminate the risk of LG default could depend on the population size of the municipality (Alam et al., 2019; Gardini and Grossi, 2018; Navarro-Galera et al., 2017; Padovani et al., 2018).

In this respect, previous research has highlighted the need to examine the explanatory variables of default risk not only in large municipalities but also in smaller ones. The latter provide fewer services, but they have fewer financial resources, too, which makes them especially vulnerable to default risk, and this danger shapes the fiscal options that are available.

This type of research is highly relevant for the fiscal policies applied in the European Union, which has 120,305 municipalities, of which 97.72% have fewer than 20,000 inhabitants (EU, 2011). These smaller LGs have received very little research attention with respect to variables affecting their risk of default. In Spain, where many LGs have been hard hit by the debt crisis, population sizes are diverse, but over 98% of the 8,117 municipalities in the country are small to medium-sized (Balaguer-Coll et al., 2015; Cabaleiro and Buch, 2011; IMF, 2014; Rodríguez-Bolívar et al., 2018).

Taking into account the above considerations, the aim of this study is to extend our understanding of default risk in European LGs to help define fiscal policies based on population size. The focus on LG size is expected to generate useful findings for policy-makers, tax authorities, managers, supervisory bodies, financial institutions, taxpayers, users of public services and other stakeholders. To this end, we examine factors relevant to the default risk of large, medium-sized and small LGs.

Specifically, we examine the financial behaviour of 1,476 Spanish local governments (129 of which are large, 982 medium-sized and 365 small) during the period 2009-2014, assessing the default probability in each case according to the Basel

Committee standards (BCBS, 2006; 2011; 2017), to determine the influence of population, socioeconomic and financial variables. The results obtained represent an advance on those of previous research, in which the study of default risk was restricted to large LGs.

2 Using the Basel Committee standards to assess default risk

At present, the banks are still the major creditors of governments in the Eurozone countries (Balaguer-Coll et al., 2016; IMF, 2014; Navarro-Galera et al., 2017), and therefore our analysis of the causes of LG default on bank debt is both interesting and timely.

In line with recent investigation in this field (Cohen et al., 2017a; Gardini and Grossi, 2018; Greer, 2016; Lara-Rubio et al., 2017; Navarro-Galera et al., 2017), we believe that understanding the risks assigned by financial entities to the credits issued to LGs is of great importance in facilitating decision making by politicians and government managers, for diverse reasons. First, the identification of factors related to bank risk helps LGs negotiate their loan conditions, such as maturity and interest rate. Second, knowledge of these same risk factors can help policymakers adopt preventive and corrective measures to ensure the adequate control of non-payment situations. Third, a more complete knowledge of the risk factors involved would facilitate the design of financial viability and sustainability plans for governments faced by debt repayment problems.

In order to measure these risks, the standards issued by the Basel Committee on Banking Supervision (BCBS) are considered the main benchmark in the international financial system (EU, 2015; IMF, 2014; Navarro-Galera et al., 2017; Padovani et al., 2018). These regulations make it possible to assess the financial risks associated with the institutions to which banks lend money – not only private companies, but also central, regional and local governments (Article 58, BCBS, 2006).

The Basel regulations, with the corresponding updates Basel II (2006) and Basel III, (2011; 2017), recommend that credit risk should be measured by quantifying the probability of default, using an internal ratings-based approach (IRB). Thus, the credit risk loss is calculated as the sum of expected loss (EL) and unexpected loss (UL), or capital requirements.

The following parameters are normally used to calculate the credit risk loss: exposure at default (EAD), probability of default (PD), conditional probability of default (CPD), correlation of the asset value with the state of the economy (ρ) and loss given default (LGD). Because BCBS (2006; 2010; 2017) defines various default scenarios, we follow previous research approaches in this respect (Gardini and Grossi, 2018; Lara-Rubio et al., 2017; Navarro-Galera et al., 2017; Padovani et al., 2018; Rodríguez Bolívar et al., 2016) and select a dependent variable that incorporates and unifies the above scenarios via the concept of ability-to-pay process (APP), i.e. the capacity of LGs to repay their credit liabilities.

Some researchers in this area have identified factors that influence the probability of default by large LGs, but these studies did not analyse the causes of default among smaller ones. Nevertheless, knowledge of this latter aspect of the question could be very useful for managers and policymakers in small and medium-sized municipalities (Gardini and Grossi, 2018; Greer, 2016; Lara-Rubio et al., 2017; Navarro-Galera et al., 2017; Padovani et al., 2018). The justification for addressing these LGs is that the risk factors of default, and therefore the preventive and corrective measures that should be taken in this respect, may vary considerably according to the size of the LG considered. Furthermore, 97.72% of European municipalities have fewer than 20,000 inhabitants (EU, 2011).

3 Research methodology

3.1 Sample selection

The present empirical study focuses on LGs in Spain. The study of this country in particular is of interest for two reasons. First, international organisations (EU, 2015; FASAB, 2014; IMF, 2014) and previous research (Balaguer-Coll et al., 2016; Benito et al., 2015; Cabaleiro et al., 2013; Lara-Rubio et al., 2017; Navarro-Galera et al., 2017) agree that the bank debt of Spanish LGs is excessive and is causing problems of sustainability. Second, LGs in Spain suffered intensely from the economic crisis. Moreover, there is a great diversity of population sizes and a large number of small and medium-sized municipalities (Balaguer-Coll et al., 2015; Narbón-Perpiñá et al, 2019; Rodríguez Bolívar et al., 2016; Rodríguez-Bolívar et al., 2018;).

The study sample is composed of 1,476 Spanish LGs (see Table 1), with data for the period 2009-2014, which includes the first six years following the start of the

economic crisis, which provoked major problems of default for these municipalities. The data were obtained from the annual accounts that LGs are obliged to submit to the Supreme Audit Institution of the Government of Spain (www.tcu.es) and from the records provided by this body.

The sample was structured into four areas, by population size, following the criteria adopted in previous research on local government finance (Balaguer-Coll et al., 2015; Benito et al., 2015; Cabases et al., 2007; Sole-Olle and Bosch, 2005), and taking into account the distinction made in Act 7/1985, on Local Government, and Act 27/2003, on the Rationalisation and Sustainability of Local Governments, whereby certain competences regarding the provision of public services were assigned to larger municipalities but not to smaller ones.

This sample and the segmentation applied enabled us to obtain findings that may also be of interest to other European countries; the European Union has 120,305 municipalities, of which 97.72% have fewer than 20,000 inhabitants (EU, 2011).

Table 1 Number of municipalities by population size

Population (inhabitants)	Total (a)	Sample (b)	% Sample / Total (b/a) x 100
≤5,000	6,813	365	5.76%
5,001-20,000	905	758	83.76%
20,001-50,000	254	224	88.19%
≥50,001	145	129	88.97%
TOTAL	8,117	1,476	18.18%

3.2 Dependent variable

In this paper, the dependent variable incorporates and unifies the scenarios defined in the Basel banking regulations, according to the APP concept. According to previous research in this field (Cohen et al., 2017a; Gardini and Grossi, 2018; Gordy, 2000; Lara-Rubio et al., 2017; Navarro-Galera et al., 2017; Padovani et al., 2018), a local government LG_i is assumed to be in default if its payment capacity at time APP_{it} is below its credit liability (c_{it}). In this framework, the default event of LGs_i in period t is a random dichotomous variable Y_{it} such that:

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

where the probability of default by LG_i at time t is expressed as:

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

Therefore, the dependent variable is the Y_{it} of the LGs in the study sample, calculated according to the BCBS definition of default (BCBS, 2006, 2010, 2017), based on four financial indicators which determine when APP_{it} is less than the credit liability. A loan to a LG is considered to be in default when there is reasonable doubt that this government can meet its financial obligations. 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.

Following the criteria used in previous research papers on the financial analysis of LGs (Benito et al., 2015; Cabaleiro et al., 2013; Cohen et al., 2012; Lara-Rubio et al., 2017; Moody's Investors Service, 2013; Navarro-Galera et al., 2015; Rodríguez Bolívar et al., 2016), we assume that APP_i is less than credit liability and therefore that a LG is in default when it meets at least one of the following conditions, or financial indicators:

- First indicator of default: $D_{it}(d_1) \in \{0,1\}$. If *cash surplus from general expenses* < 0, then $D_{it}(d_1) = 1$, which indicates reduced LG solvency (otherwise, $D_{it}(d_1) = 0$; according to Art. 193 of the Regulatory Act and according to the BCBS (2006), Arts. 452 and 453. Cash surplus is the sum of liquid funds and rights pending collection minus outstanding obligations; the latter concept reflects the authority's capacity or need for short-term funding to cover general expenses.
- Second indicator of default:$D_{it}(d_1) \in \{0,1\}$. If the *legal borrowing limit* > 110% of current income, this indicates reduced LG solvency (otherwise, $D_{it}(d_2) = 0$) according to Art. 53.2 of the Regulatory Act. From the use of the concept of legal borrowing limit by Kluza (2017) and Padovani et al. (2018) and according to Spanish legislation on local government budgets (Ministry of Finance, 2004; 2008), current revenue (taxes plus transfers from central and regional governments) is a

long-term source of funds, and constitutes a guarantee for the repayment of bank loans. These regulations also state that there is a risk of default when the outstanding debt exceeds 110% of current income, because the latter, even if it is not subject to great uncertainty, is insufficient to repay all bank loans, and so the LG in question must rely on other forms of income that are subject to greater uncertainty and volatility, such as taxes on the construction of new homes. So, from a financial perspective, the choice of this indicator is motivated by the projection and long-term guarantee of current revenues (which include participation in state taxes and taxes based on the properties of citizens) that are resources subject to little volatility and uncertainty, thus assuring the repayment of loans.

- Third indicator of default: $D_{it}(d_3) \in \{0,1\}$. If *gross budget savings* (current revenue less current spending) < 0, this is a situation of reduced LG solvency and $D_{it}(d_3) = 1$ (otherwise, $D_{it}(d_3) = 0$) according to Art. 53.1 of the Local Finance Regulatory Act and the BCBS (2006), Art. 453.
- Fourth indicator of default: $D_{it}(d_4) \in \{0,1\}$. If *solvency* (the ratio of current assets to current liabilities) <1, then the APP_{it} is reduced and $D_{it}(d_4) = 1$ (otherwise, $D_{it}(d_4) = 0$). Current assets consist of those available for sale, plus stocks, accounts receivable, short-term financial investments and treasury balance. Current liabilities include creditors, short-term bank liabilities, non-budget obligations and non-budgetary rights. This concept reflects the LG's capacity to meet its short-term liabilities at term, and is traditionally used for the financial analysis that is implicit in the BCBS (2006), Arts. 452 and 453. It describes both liquidity and solvency, by highlighting liquidity shortfalls that may give rise to insolvency.

The reasons for assuming that the presence of any of the above indicators would imply a risk of LG default are set out in the Local Government Finance Act (Arts. 53.1, 53.2 and 193) and in the corresponding LG accounting regulations (Ministry of Finance and Public Administration, 2013), and the existence of these indicators would be taken into account by any bank approached for finance.

In view of these considerations, the dependent variable that we use as an indicator of LG default is $D_{it}(d_1, d_2, d_3, d_4) \in \{0,1\}$, where 0 indicates solvency and 1 indicates default, as summarised in (4).

$$D_{it}(d_1, d_2, d_3, d_4) = max\{0, max(d_1, d_2, d_3, d_4)\} \quad (4)$$

Therefore, our dependent variable is the default probability of the LG in question, calculated using the BCBS (2006; 2011; 2017) according to these four financial indicators.

3.3 Independent variables

To identify factors associated with default by LGs of different population sizes, three types of explanatory variable (population, socioeconomic and financial) were examined, based on previous studies of large LGs (see Table 2) which analysed the basic causes of default (Cohen et al., 2017a; Gardini and Grossi, 2018; Lara-Rubio et al., 2017; Navarro-Galera et al., 2017; Padovani et al., 2018) and the factors influencing the volume of debt (Balaguer-Coll et al., 2015; Benito et al., 2015; Guillamón et al., 2011) and the level of financial sustainability (Navarro-Galera et al., 2016; Rodríguez Bolívar et al., 2016). Although these studies did not examine small and medium-sized municipalities, their findings for large ones justify the selection of explanatory variables used in the present work. In any case, as in the private sector, an increase in the volume of debt is considered, in itself, a risk factor for default (Abdou, 2009; West, 2000).

Table 2 shows the definition and expected sign of the proposed explanatory factors (independent variables) of the probability of default (dependent variable). A positive sign means that an increase in the independent variable is associated with a corresponding increase in the probability of default. A negative sign means that an increase in the independent variable may produce a decrease in the probability of default.

The descriptive statistics obtained (Appendix 1) show that the distribution of local governments in terms of their political ideology is evenly balanced (50% progressive and 50% conservative), and that only 40% govern with an absolute majority. Therefore, and in line with previous research, we consider it interesting to analyse the influence of this variable on the probability of LG default.

On average, each municipality has 632 inhabitants per km2 of territory and a population of 25,270 inhabitants. Of these, 33.59% are considered dependent, 10.55% are immigrants and 9% are unemployed. Women represent 52.29% of the dependent

population, 47.5% of the immigrant population and almost 49% of the unemployed population.

The average monthly income per inhabitant is €1,122. The income derived from property taxes, especially real estate tax (IBI), accounts for 45% of payment obligations, which provides these LGs with considerable financial autonomy. Debt finance is almost 60% of equity finance, commercial debt is more than double that of a financial nature and its enforceability is primarily short term.

The Comp_Debt and Fin_Struct variables present the largest standard deviations. On the other hand, the study data vary little in terms of the proportion of the dependent population, the overall size of the immigrant population, the rate of unemployment and the male/female distribution of the population.

Table 2 Financial, socioeconomic and population variables

Variable	Description	Expected sign (β)
	Financial variables	
Fin_Aut	Financial autonomy: Municipal revenues (less transfers and grants) / total municipal revenues. Numerical variable. Source: Ministry of Finance and Public Administration.	-
Fin_Struct	General financing structure: Debt finance / Equity finance. Numerical variable. Source: Court of Auditors.	+
Comp_Debt	Debt composition and maturity: Short-term debt / Long-term debt. Numerical variable. Source: Court of Auditors.	+
Source_Debt	Origin and nature of the debt: Financial debt / Commercial debt. Numerical variable. Source: Court of Auditors.	+
Urban_IBI/Liabilities_due	Capacity of the income derived from the tax on real estate (IBI), in annual terms, to repay liabilities due.	-
VT/Liabilities_due	Proportion of vehicle tax income to liabilities due.	-
	Socioeconomic variables	
Unemployment	Rate of unemployment: No. of unemployed / Total population. Numerical variable. Source: Ministry of Employment and Social Security and INE.	+
Female_Unempt	Rate of female unemployment: No. of women unemployed / Total population unemployed. Numerical variable. Source: Ministry of Employment and Social Security and INE.	+
Elec_Cycle	State of the electoral cycle. Dummy variable: (0) Observation in a year when no election campaign took place (2009 and 2012-2013); (1) Observation in year when an election campaign took place (2010-2011 and 2014). Source: The authors.	+
Political_Sign	Political sign. Dummy variable: (0) Conservative; (1) Progressive. Source: Ministry of Finance and Public Administration.	+
Absol_Maj	Absolute majority. Dummy variable: (0) Absolute majority, (1) No absolute majority. Source: Ministry of the Interior.	+
IPC	Income per capita: Budgeted liquid revenue (€'000) / Municipal population. Numerical variable. Source: Ministry of Finance and Public Administration and INE.	-
	Population variables	
Pop_Size	Population size (millions). Numerical variable. Source: Spanish Institute of Statistics (INE).	+
Pop_Dens	Population density: No. of inhabitants (thousands)/ Surface area of municipalities (km^2). Numerical variable. Source: INE and La Caixa Yearbook.	-
Total_Depend_Pop	Proportion of dependent population: No. of inhabitants aged <16 and>65 years / Total population. Numerical variable. Source: INE.	+
Female_Depend_Pop	Proportion of dependent female population: No. of women aged <16 and >65 years / Total dependent population. Numerical variable. Source: INE.	+
Total_Immigr_Pop	Proportion of immigrant population: No. of immigrants / Total population. Numerical variable. Source: INE.	+
Female_Immigr_Pop	Proportion of female immigrant population: No. of immigrant women / Total immigrant population. Numerical variable. Source: INE.	+

Financial variables. Balaguer-Coll et al. (2015) and Cabaleiro et al. (2013) concluded that financial autonomy contributes to improving the financial health of LGs, thus reducing the probability of default. We expect this variable to have a negative sign.

Furthermore, assuming that an increase in the debt/capital ratio is associated with a greater probability of company default (Mossman et al., 1998), Navarro-Galera et al. (2017) and Lara-Rubio et al. (2017) concluded that this ratio is positively associated with the probability of default in large LGs. However, they did not study this relationship with respect to small and medium-sized municipalities. We expect the financial structure variable to have a positive sign.

With respect to large LGs, Lara-Rubio et al. (2017) and Navarro-Galera et al. (2015) concluded that short-term debt and banking debt aggravate problems of insolvency. In this paper, we examine the variables *Composition of the debt* and *Source of the debt*, and expect both to have a positive sign.

Finally, another aspect that to our knowledge has not been previously examined is that of the ratio between tax revenues and debt liabilities (*Urban property taxes/Liabilities due* and *Vehicle taxes/Liabilities due*). Following previous research (Alam et al., 2019; Balaguer-Coll et al., 2016; Benito et al., 2016), we expect to find an inverse relation between these variables, although the former has a structural nature while the latter is more transient, being dependent on the useful lives of the housing stock and of the vehicles registered in the municipality, respectively.

Socioeconomic variables. Palumbo and Zaporowski (2012) and Kloha et al. (2005) concluded that an increase in unemployment is associated with a greater volume of public debt in large LGs. However, they did not study smaller municipalities or the effect of the female unemployed population, in this respect. In this paper, we analyse the effect of both variables, and expect to observe a positive relation.

The electoral cycle has been identified as a factor that may influence the solvency and probability of default of large LGs (Benito et al., 2015; Lara-Rubio et al., 2017; Navarro-Galera et al., 2015). This conclusion motivates our interest in analysing the effect of the electoral cycle in smaller municipalities. We expect a positive sign for this variable.

According to Guillamón et al. (2011) and Benito et al. (2015), LGs where the governing party has a progressive ideology are likely to have a greater volume of public debt than those with a conservative government, and this can increase the probability of default in large LGs, as concluded by Navarro-Galera et al. (2017). Therefore, we expect to obtain a positive relationship for the variable *Political sign*.

Benito et al., (2010) and Solé-Ollé (2006) concluded that when the governing party has an absolute majority, in large LGs, this is associated with a greater capacity to generate income and, therefore, there is a lower level of public debt. Accordingly, we expect to find a positive sign for the variable *Absolute majority*.

Finally, previous research (Lara-Rubio et al., 2017; Navarro-Galera et al., 2017; Padovani et al., 2018) has reported that an increase in per capita income is associated with a lower probability of default in large LGs. However, these studies did not analyse the effect in municipalities with a smaller population. We analyse the relationship for small and medium-sized municipalities, and expect to obtain a negative sign.

***Population variables*.** With respect to population size, larger populations are expected to generate greater expenditure, which may imply higher volumes of government debt, thus increasing the probability of default (Gonçalves-Veiga and Veiga, 2007; Greer, 2016; Solé-Ollé, 2006; Wang and Hou, 2012). Therefore, we expect this estimator to have a positive sign.

Moreover, population density contributes to increasing the volume of debt (Guillamón et al., 2011; Wang and Hou, 2012), although in this respect, Navarro-Galera et al. (2017) and Lara-Rubio et al. (2017) found that a reduction in this variable was associated with a greater risk of default risk by large LGs. These authors did not study smaller municipalities. We expect to obtain a negative sign for the estimator of this variable.

According to previous studies, in large municipalities the proportion of dependent population is associated with an increased volume of debt, a higher default risk and less sustainability (Benito et al., 2015; Guillamón et al., 2011; Lara-Rubio et al., 2017; Navarro-Galera et al., 2017; Rodríguez Bolívar et al., 2016). This consideration justifies our interest in studying the effect of this variable on small and medium-sized municipalities. We expect it to have a positive sign. A novel aspect of the present study is the incorporation of the variable *Proportion of women in the dependent population*. This variable was included in order to determine whether the gender of the dependent population is related to the probability of default, since this question has not been considered previously, despite the importance of women as taxpayers and users of public services.

Finally, we analysed the impact on the probability of default of the total immigrant population and of the proportion of women in the total immigrant population. Some studies have reported that the size of the immigrant population is positively associated with government debt. However, these earlier papers did not examine the case of immigrant women, despite their importance as taxpayers and users of public services (Choi et al., 2010; Guillamón et al., 2011).

3.4 Hypotheses tested

Taking into account the variables analysed, as described in sections 3.2 and 3.3, we propose the following study hypotheses, which are tested by empirical analysis.

Financial variables

H1: Population size may affect the influence of financial autonomy on the default risk of LGs.

H2: Population size may affect the influence of the general financing structure on the default risk of LGs.

H3: Population size may affect the influence of debt composition and maturity on the default risk of LGs.

H4: Population size may affect the influence of the origin and nature of municipal debt on the default risk of LGs.

H5: Population size may affect the influence of municipal revenue from real estate taxes on the default risk of LGs.

H6: Population size may affect the influence of municipal revenue from vehicle taxes on the default risk of LGs.

Socioeconomic variables

H7: Population size may affect the influence of unemployment on the default risk of LGs.

H8: Population size may affect the influence of female unemployment on the default risk of LGs.

H9: Population size may affect the influence of the electoral cycle on the default risk of LGs.

H10: Population size may affect the influence of the political sign of the governing party on the default risk of LGs.
H11: Population size may affect the influence of municipal government by absolute majority on the default risk of LGs.
H12: Population size may affect the influence of income per capita on the default risk of LGs.

Population variables

H13: Population size may affect the influence of population density on the default risk of LGs.
H14: Population size may affect the influence of the size of the dependent population on the default risk of LGs.
H15: Population size may affect the influence of the size of the female dependent population on the default risk of LGs.
H16: Population size may affect the influence of the size of the immigrant population on the default risk of LGs.
H17: Population size may affect the influence of the size of the female immigrant population on the default risk of LGs.

3.5 Statistical methodology

The fundamental aim of our analysis is to determine the statistical relationship between the independent or explanatory variables (see Table 2) and the probability of municipal default (explained or dependent variable), by studying the financial behaviour of 1,476 small and medium-sized LGs during the period 2009-2014.

To measure the probability of default by a LG, as defined in Eq. (2), we assign a value of 1 to a LG that met one or more of the conditions for default during the study period, as specified in section 3.2, and a value of 0 otherwise. The data considered are the values corresponding to the dependent variable (probability of default) and to the 18 independent variables, reflecting population, socioeconomic and financial factors.

In line with recent studies (Cohen et al., 2017a; Gardini and Grossi, 2018; Kluza, 2017; Lara-Rubio et al., 2017; Navarro-Galera et al., 2017; Rodríguez Bolívar et al., 2016), we use logit panel data 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, 2009). These characteristics are relevant for our purposes, as they closely fit the characteristics of the sample.

The dependent variable is binary, and thus we can obtain a data panel for the period 2009-2014. Therefore, a conditional fixed-effects logit data panel regression is applied to the study sample, and the 1476 LGs are divided into four strata, or segments, according to the population sizes described in Section 3.1 (see Table 1) .For this purpose, we use the fixed effects logistic regression procedure provided by the software package Stata 15.1.

Five statistical models were designed, one for each segment determined in Table 1, together with a further model for the total accumulated sample. As shown by Train (2009), and taking into account Eq. (2), this can be computed as follows:

$$\text{Prob}(Y_{it} = 1) = \frac{\exp(\alpha_i + X_{it}\beta_i + \varepsilon_{it})}{1 + \exp(\alpha_i + X_{it}\beta_i + \varepsilon_{it})} \qquad (3)$$

As explained by Greene (2000), unlike the probit model, the logit data panel model is appropriate for dealing with fixed effects. The test specification designed by Hausman (1978) contrasts two regressions, one in which the problem of correlation (fixed effects) is corrected and one (random effects) in which it is not. If the differences between the two are not significant, this could mean that no correlation correction need be performed. On the other hand, if the differences are very large, correlation problems must be addressed and fixed effects should be used (Gujarati, 2004).

4 Analysis of results

Of the 8,846 observations obtained, in 5,305 (59.97%) there was a loan default and in 3,541 (40.03%) there was no default. As shown in Table 3, the estimated coefficients were transformed into odds ratios (OR) or Exp (β) for the fixed-effects logistic regression models, which is why the number of observations was reduced. However, very few cases were ignored.

In general, the odds ratios obtained show that the most solvent municipalities are those with greatest financial autonomy and that this ratio is stronger for smaller municipalities. The same pattern was observed in the relationships between financial

solvency and the variables ‘municipal revenues from property taxes’ and ‘municipal revenues from vehicle taxes’.

Our results also indicate that increases in female unemployment and in per capita income are both associated with a lower probability of default, especially in smaller LGs.

According to the odds ratios observed, municipal default is more likely during electoral periods, especially in smaller municipalities, which are 43.56% more likely to incur default in an electoral period than at other times.

Analysis of the odds ratios also shows that the greater the per capita income among the municipal population, the lower the probability of LG default, and that this association is stronger in larger municipalities. Finally, in this respect, the larger the municipal population, the higher the probability of LG default.

These findings represent an advance on previous research (Benito et al., 2015; Greer, 2016; Navarro-Galera et al., 2015; Palumbo and Zaporowski, 2012; Wang and Hou, 2012), in which analyses have been made of the effects of socioeconomic and financial variables on the volume of LG debt, but not of their impact on the probability of default. In particular, our study takes into account two variables whose impact on the probability of LG default has not previously been examined: the rate of female unemployment and the availability of tax revenues with which to repay debts. We show that both variables are inversely associated with LG default.

We concur with previous research findings that municipal size is related to the causes of LG default. For this reason, we performed a comparative analysis of the four population segments presented in Table 1. In all cases, the financial variables had a stronger influence on the probability of default than the population and socioeconomic variables. However, in segment 2 (5,001-20,000 inhabitants), the impact of the three types of variables is more balanced than in the other cases. These findings represent an advance on those of previous studies, which highlighted the influence of population size on the determinants of debt volume (Balaguer-Coll et al., 2016), on solvency (Benito et al., 2015) and on financial sustainability (Navarro-Galera et al., 2015; Rodríguez Bolívar et al., 2016), but did not specifically analyse government default with respect to different population sizes.

We obtain empirical evidence of the influence of all the study variables on at least one of the population segments, with the exception of *Absolute majority* and *Financial*

structure, which present no significant relationship. For all segments, the variables exerting greatest influence are population size, per capita income, financial autonomy, property taxes and vehicle taxes.

More specifically, the results presented in Table 3 show that three variables affect only large municipalities (more than 50,000 inhabitants). These variables are total immigrant population, the female immigrant population and governance of the municipality by a party with a left-wing ideology. Each of these variables is inversely associated with the probability of default. Although most previous work in this field suggests that progressive parties are more likely than conservative ones to increase debt and public spending (Balaguer-Coll et al., 2016; Benito et al., 2015), we agree with Ashworth et al. (2005), according to whom left-leaning parties tend to have a lower level of bank borrowing, and hence the probability of default is reduced. Furthermore, in all population segments except the smallest (fewer than 5,000 inhabitants), an increase in per capita income tends to reduce the probability of default, which corroborates the conclusions implicit in previous studies regarding this variable (Lara-Rubio et al., 2017; Navarro-Galera et al., 2017; Padovani et al., 2018).

According to our results, some variables influence the probability of default of small and medium-sized LGs, but not larger ones. These variables are: a) rate of female unemployment, which has a negative effect on population segments 1 (less than 5,000 inhabitants) and 2 (5,001-20,000 inhabitants); b) bank debt, which has a negative effect on segment 2; and c) the proximity of elections, which has a positive effect on segments 1 and 2. The repercussion of these variables on the probability of default seems to disappear when the municipal population exceeds 20,000 inhabitants.

These analyses by population segments represent an advance on previous research approaches, for two reasons. First, although Lara-Rubio et al. (2017) and Navarro-Galera et al. (2017) found no influence of the rate of unemployment on the probability of default by large LGs, our results show that this variable does impact on small and medium-sized municipalities, which also seem to be affected by the rate of female unemployment. The latter finding is particularly striking. Second, previous studies in this area have not considered the impact of LGs' tax-raising capabilities on their probability of default. Our results show very clearly that an increase in tax revenues can reduce LG default, in all population segments.

More specifically, our results for segment 4 (large municipalities) extend the findings of Navarro-Galera et al. (2017) and Lara-Rubio et al. (2017). According to the latter authors, three variables (population density, financial structure and debt composition) are related to LG default. However, the findings obtained in our analysis do not support this conclusion, possibly due to the strong impact made by the size of the total immigrant population and that of the female immigrant population; these factors may have counteracted the influence of the first three variables.

Our empirical analysis of the results obtained indicates that the following hypotheses are supported and should be accepted: H3, H4 and H6, H7, H8, H9, H10, H11, H12, H13, H14, H15, H16 and H17. By contrast, no empirical support was found for H1, H2 and H5, which are therefore rejected.

A comparative analysis of the different population segments shows that, without exception, when a variable is influential, the sign of its relation to the probability of default is the same for all segments. Particularly strong effects were observed for per capita income, property tax revenues and vehicle tax revenues, which in every case are inversely associated with the probability of default (i.e., the sign is negative).

To verify the lack of endogeneity problems, we applied the Hausman contrast test (Hausman, 1978), which is commonly used to study this question. As the results in Table 3 reflect, the null hypothesis is accepted for all five models. We conclude, therefore, that there are no problems of endogeneity.

Finally, Table 4 illustrates the reliability and consistency of our results, showing the excellent classification rate obtained for predicted vs. observed cases. These classification rates range from 83.68% for the model of segment 3 (20,001-50,000 inhabitants) to 87.40% for the model of segment 2 (5,001-20,000 inhabitants). Our results, therefore, show that all these models yield useful information for policymakers, managers, financial control organisations, supervisory authorities, creditors, the users of services and citizens in general.

Table 3. Regression results (fixed effects logit).

Variable	Model of total sample (all segments)			Model of Segment 1			Model of Segment 2		
	Coef. (β)	z-value	Exp (β)	Coef. (β)	z-value	Exp (β)	Coef. (β)	z-value	Exp (β)
Pobl-Seg	.6288208 ***	5.3	1.8754						
Fin_Aut	-1.120594 ***	-2.92	0.3261	-2.006664 ***	-3.03	0.1344	-2.155115 ***	-3.73	0.1159
Fin_Struct									
Comp_Debt				-.0119009 ***	-4.69	0.9882			
Source_Debt	-.1630487 **	-2.13	0.8495				-.2942804 **	-2.61	0.7451
Urban_IBI/Required_Liabilities	-4.0185518 ***	-6.2	0.018	-.1129002 **	-1.35	0.8932	-5.19722 ***	-6.98	0.0055
VT/Liabilities_due	-5.634553 ***	-4.9	0.0036				-8.791281 ***	-3.82	0.0002
Unemployment							-5.058347 *	-1.66	0.0064
Female_Unempt	-2.185599 ***	-3.17	0.1124	-1.634926 **	-1.99	0.1950	-2.740601 **	2.10	0.0645
Elec_Cycle	.2962975 ***	4.53	1.3449	.3615511 ***	2.97	1.4356	.2634419 **	2.73	1.3014
Political_Sign									
Absol_Maj									
IPC	-.6313431 ***	-5.32	0.5319				-1.734871 ***	-3.50	0.1764
Pop_Size	.4033631 **	1.85	1.4969	31.32171 ***	3.23	4.00E+13	4.578303 **	1.86	97.3490526
Pop_Dens									
Total_Depend_Pop							-7.183416 **	-2.01	0.0008
Female_Depend_Pop							13.63292 **	2.46	8.33E+05
Total_Immigr_Pop									
Female_Immigr_Pop									
Cons	1.501011 ***	3.48	4.4862	.8059316 **	1.82	2.2388	.8477731 **	0.30	2.3344
Hausman (1978) Test:	9.27: sig.: 0.0992			12.60: sig.: 0.1127			8.11: sig.: 0.0942		
	N = 8,340 n = 1,390			N = 2,034 n = 339			N = 4,374 n = 729		

Note: *** indicates significance at 1, ** at 5% and * at 10%. N = Number of LGs; n = Number of observations.

Table 3. Regression results (fixed effects logit). Continued

Variable	Model of Segment 3			Model of Segment 4		
	Coef. (β)	z-value	Exp (β)	Coef. (β)	z-value	Exp (β)
Pobl-Seg						
Fin_Aut	-5.077821 ***	-2.98	0.0062	-7.393211 ***	-2.94	0.0006
Fin_Struct						
Comp_Debt						
Source_Debt						
Urban_IBI/Required_Liabilities	-7.747294 ***	-5.18	0.0004	-8.302678 ***	-3.51	0.0002
VT/Liabilities_due	-37.7701 ***	-4.53	3.95E-17	-35.06851 **	-2.73	5.89E-16
Unemployment						
Female_Unempt						
Elec_Cycle						
Political_Sign				-.6294593 *	-1.28	0.5329
Absol_Maj						
IPC	-4.154524 ***	-6.49	0.0157	-3.500471 ***	-4.24	0.0302
Pop_Size				.2892974 *	1.40	1.3355
Pop_Dens	.2240981 *	1.73	1.2512			
Total_Depend_Pop						
Female_Depend_Pop						
Total_Immigr_Pop				-5.5844 **	-1.83	0.0038
Female_Immigr_Pop				-24.72 ***	-2.77	1.8376E-11
Cons	8.380164 ***	5.42	4359.7239	18.92176 ***	3.81	1.65E+08
Hausman (1978) Test:	10.88: sig.: 0.1097			9.53: sig.: 0.1002		
	N = 1,248 n = 208			N = 684 n = 114		

Note: *** indicates significance at 1, ** at 5% and * at 10%. N = Number of LGs; n = Number of observations.

Table 4 Classification matrix (%)

MODEL 1-5,000 inhabitants				
Observed		Prediction		
		Y		Correct percentage
		Non-Default	Default	
Y	Non-Default	835	174	82.76
	Default	154	871	84.98
Overall percentage				**83.87**
Optimal cut-off: 0.53. Sens.: 84.47%; Spec.: 83.34%				
MODEL 5,001-20,000 inhabitants				
Observed		Prediction		
		Y		Correct percentage
		Non-Default	Default	
Y	Non-Default	2323	310	88.23
	Default	241	1500	86.16
Overall percentage				**87.40**
Optimal cut-off: 0.49. Sens.: 90.58%; Spec.: 82.88%				
MODEL 20,001-50,000 inhabitants				
Observed		Prediction		
		Y		Correct percentage
		Non-Default	Default	
Y	Non-Default	688	137	83.39
	Default	66	357	84.40
Overall percentage				**83.73**
Optimal cut-off: 0.47. Sens.: 91.13%; Spec.: 72.26%				
MODEL 50,001+ inhabitants				
Observed		Prediction		
		Y		Correct percentage
		Non-Default	Default	
Y	Non-Default	452	75	85.77
	Default	26	131	83.44
Overall percentage				**85.23**
Optimal cut-off: 0.51. Sens.: 94.45%; Spec.: 63.63%				

MODEL total sample				
Observed		Prediction		
		Y		Correct percentage
		Non-Default	Default	
Y	Non-Default	4256	745	85.10
	Default	511	2828	84.70
Overall percentage				**84.94**

Optimal cut-off: 0.49. Sens.: 89.28%; Spec.: 79.15%

5 Conclusions

According to the IMF, the World Bank and the EU, the probability of public debt default is an issue of crucial importance in determining governments' fiscal policies. In this respect, various studies have investigated the causes of debt and insolvency in LGs with large populations. The conclusions presented have identified as an interesting area for further research the analysis of variables associated with financial default by municipalities with other population sizes, in countries affected by the global economic recession.

Based on an empirical study of 1,476 Spanish LGs with data for the period 2009-2014, we show that certain factors have an individual influence on the likelihood of default by small, medium-sized and large municipalities. Population, socioeconomic and financial determinants are identified. Our findings extend those of previous research, showing that the impact of these factors varies according to the size of the municipality, and should be taken into account in order to employ fiscal policies that are appropriate to the population size of each municipality.

Moreover, the above factors do not coincide with the determinants of debt volume. Accordingly, the present study results may be of interest to policymakers, managers and tax authorities interested in designing fiscal policies to prevent or reduce LGs' loan repayment difficulties. The question of municipal size is of particular interest for countries in the European Union, where of 121,305 municipalities, 97.72% have fewer than 20,000 inhabitants.

The results obtained indicate very clearly that the size of the municipality is relevant to the factors underlying the risk of LG default and, therefore, that it may

influence the outcomes of fiscal policies. While some of the factors identified (such as financial autonomy and municipal revenues from property taxes) influence municipalities of all sizes, and others (such as per capita income and vehicle tax revenues) are relevant to those of almost all population sizes, in many cases there are significant differences according to the population size considered. This finding suggests that the fiscal policies applied in determining revenues and expenditure should be tailored according to the size of the municipal population.

In large municipalities, but not in small or medium-sized ones, municipal default is inversely associated with the total size of the immigrant population, the proportion of female immigrants, and municipal government by a party with a left-wing ideology. On the other hand, in the small and medium-sized municipalities, default is influenced by some variables that have no effect on large LGs: thus, the proportion of unemployed women and the volume of bank debt are both inversely associated with LG default, while there is a positive association for the proximity of elections.

From the standpoint of policy-makers and municipal managers, these findings are of great interest for decision-making and represent a considerable advance on previous research outcomes. Specifically, we present new evidence in this field, and show that, regardless of population size, increasing municipal revenues from property and vehicle taxes can reduce the risk of LG default, and therefore fiscal policies should take serious account of this consideration. This increase need not require political decisions to increase fiscal pressure, but could be achieved, for example, by means of fiscal incentives to stimulate house-buying and the purchase of new vehicles.

Two novel aspects of our findings are especially significant for the LGs considered, namely the influence of the rates of female immigration and unemployment on the probability of municipal default. This impact varies according to the size of the municipality in question.

Unlike the case of small and medium-sized municipalities, our results suggest that in large ones a rising immigrant population and the presence of a higher proportion of immigrant women in the municipality are factors that reduce the likelihood of default, enhancing the performance of fiscal policies. This knowledge can be useful to policymakers wishing to design measures to prevent default, taking into account the present situation and future evolution of these variables. In contrast to previous research findings, we show that in large LGs increases in total immigration, in female

immigration and in per capita income can all help reduce the probability of default. However, the favourable effects of rising per capita income might be reduced or eliminated by increases in local unemployment, or by cuts in financial assistance for the unemployed, as reflected in our results on financial autonomy.

In contrast, in small and medium-sized municipalities, our results show that an increase in female unemployment is associated with a lower risk of default. In the smaller municipalities, no significant association is apparent between this risk and total unemployment. The latter finding may be influenced by the negative impact of financial autonomy; our results for this variable show that an increase in financial assistance for the unemployed can mitigate the risk of default. In addition, the effect of female unemployment could be counteracted by the proximity or otherwise of the next elections, as indicated by the positive association obtained for the electoral cycle.

Our findings are also interesting from the standpoint of supervisory bodies, the Ministry of Finance, public audit institutions and other institutions interested in controlling and improving the fiscal policies in LGs. The factors identified provide advance warning of situations of default risk and, as we show, the relevant factors vary between large, medium-sized and small municipalities. Accordingly, in order to prevent and/or correct problems of LG default, these agencies should be alert to the evolution, at a national level, of municipal income from property and housing taxes, and rates of immigration and unemployment, particularly with respect to women. In summary, to define effective fiscal policies against default, policy-makers, managers and tax authorities should take into account the influence exerted on the risk of LG default by financial, socioeconomic and population variables, and pay special attention to those which are most relevant to each population size.

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Appendix 1. Descriptive Statistics

Variable	Minimum	Maximum	Mean	Std. Deviation
Fin_Aut	0.0462	0.9243	0.553259	0.1726455
Fin_Struct	0.0015	232.1708	0.580472	4.0368785
Comp_Debt	0.0031	909.8978	4.554066	24.4265755
Source_Debt	0.0001	10.7784	0.411102	0.5499567
IBI/Liabilities_due	0.0001	14.8942	0.376910	0.5045115
VT/Liabilities_due	0.0003	4.0914	0.086041	0.1044495
Unemployment	0.0001	0.2565	0.091942	0.0313807
F_Unemployment	0.0000	0.8571	0.489871	0.0785200
Elec_Cycle	0	1	0.49	0.500
Political_Sign	0	1	0.50	0.500
Abs_Maj	0	1	0.59	0.492
IPC	0.1500	9.6538	1.122780	0.4531080
Pop_Size	0.0005	32.7305	0.252700	1.0701577
Pop_Dens	0.0024	21.2621	0.631865	1.6895569
Total_Depend_Pop	0.2069	0.5045	0.335909	0.0332181
Female_Depend_Pop	0.4000	0.6441	0.522955	0.0209105
Total_Immigr_Pop	0.0000	0.7792	0.105506	0.1035974
Female_Immigr_Pop	0.0000	0.8888	0.4750008	0.0760990