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Municipal policies accelerated urban sprawl and public debts in Spain

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ABSTRACT

Urban form and resource consumption co-evolve dynamically with public finances. While in compact urban settlements public service is provided more efficiently, and in larger amounts per surface area, sprawled developments often translate into larger marginal infrastructure investments, and into higher rates of consumption of resources per capita: land, raw materials, and transport fuels. Yet the relationship between municipal tax policies, rapid urban land consumption and municipal debts is poorly understood. In this paper we first scrutinize the relationship between urban sprawl and municipal deficits in Spain, and contextualize this development in the European situation. We then investigate statistically how urban economic drivers and municipal policies influence sprawling patterns, municipal debt and location values, demonstrating that local interventions jointly influence all three variables and that location value taxes can reduce both sprawl and debts. The linkages between local decisions and global land markets deserve further scrutiny.

1. Introduction

Industrialized and urbanized nations face two grand challenges: an immediate shortage of public finances, and limiting environmental damage within local, regional and planetary boundaries. The more immediate one crystallizes in the aftermath of the financial crisis, which co-evolved with a real estate bubble in countries like the USA, Ireland and Spain. In austerity-marked politics public expenditures are crumbling and public entities, especially municipalities, are deeply indebted. The long-term challenge is to deal with limited resources, notably land, and climate change. Both challenges converge in the issue of urban sprawl and stable municipal finances, which themselves are required to implement low-carbon transport systems and infrastructures.

When the Wall Street engineered financing of housing in the USA imploded and the Great Recession hit major economies, Spanish budgets were stable, showing a relatively modest public debt of 36.2% of GDP in 2008 (European Commission, 2014a). But revenues were fed by an unceasing stream of constructions; and worse, these constructions were financed by uncontrolled and unstable financial instruments. It came then not as a surprise when in 2012 Spain had to apply for a rescue package from the European Stability Mechanism to rescue its banks, which had emitted these financial instruments. Yet another part of the story turns out to impact Spanish citizens even more directly: municipalities had learned to live on a steadily rising revenue stream from real estate construction. When the Spanish real estate bubble burst, the revenue stream ceased from one day to the other, while large expenditures still needed to be paid. House prices imploded; newly constructed towns were born as ghost towns. While arguably the pervert financing mechanisms and greed of banks caused these disastrous dynamics, the specific sprawl dynamics of Spanish municipalities and its tax system exacerbated the crisis of municipal debts. This is the starting point of our analysis.

The main concern of our investigation entertains the nexus of urban sprawl and local public intervention. Recent literature agrees that sprawled development leads to greater provision costs of local public services based on economics of density or agglomeration economics (Carruthers and Úlfarsson, 2008; Carruthers and Ulfarsson, 2003; Gómez-Antonio et al., 2014; Hortas-Rico, 2014; Hortas-Rico and Solé-Ollé, 2010; Solé-Ollé and Viladecans-Marsal, 2012). But interestingly enough, the work made by (Hortas-Rico, 2014) for the Spanish case identifies additional dynamics in the public finance-sprawl relationship that may lead to short-term surpluses of local finances. Taking her work as a starting point, we go a step further and analyze the medium to long-term effects on municipal budgets for the Spanish case. Our analysis focuses on the period when the intergovernmental transfers stopped as a consequence of the financial crisis to better estimate the role of local fiscal and planning instruments.

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We review literatures that provide insights on the nexus between urban sprawl, local debts, and location values (Section 2). After explaining our methods (Section 3), we investigate quantitatively how local land-use decisions shape municipal finances (Section 4). We then discuss our results and conclude by suggesting that land use decisions at the local level influence both local financial sustainability and environmental change, and therefore should become focal points for municipalities that wish to tackle these two fronts to their own and the larger common benefit (Sections 5 and 6). Our results reveal that municipal property tax level and design drives urban sprawl; and that short-sighted public finance strategies backlash upon the implosion of real estate bubbles. We point to the importance of recurrent location value taxes to stabilize municipal finances.

2. Literature review

2.1. Urban sprawl and municipal indebtedness in Spain exceeds EU levels

Although different definitions exist to measure urban sprawl, they have common features: low levels of population density, lack of mixed use and long commuting distances (Brueckner, 2000; Galster et al., 2001). Since the mid-1990s, Southern European cities experienced rapid urban expansion with these characteristics (European Environment Agency, 2006; Kasanko and Barredo, 2006; Saliba, 1990; Schwarz, 2010). Historical data shows that European cities now cover a surface 75% larger than in the mid-1950s, whereas population has grown only by 35% (European Environment Agency, 2006). In particular, recent data points to an alarming trend: almost 1000 km^2 per year were converted to urban land cover in the last decade, the majority of it turned into housing and recreation areas (European Commission, 2013). But Spain is by far the largest contributor (25%), doubling its total amount since 2000[1]. This difference also holds when we normalize by population; the annual land converted to urban use was 70 m^2 per capita between 2000 and 2012 in Spain, surpassed only by Ireland and Malta[2] (European Commission, 2013) (Box 1).

Spanish regions located along the Mediterranean coast and the central region are at the forefront of sprawling patterns (Catalán et al., 2008; Ortuño-Padilla and Fernández-Aracil, 2013; Saliba, 1990; Solé-Ollé and Viladecans-Marsal, 2012; Stellmes et al., 2013). Recent development shows strong residential suburbanization, experiencing growth on the fringes of cities with low densities, large losses of non-urban land cover, depopulation of metropolitan inner cores, predominant construction of single-family houses, and great expansion of motorized transport networks (Catalán et al., 2008; Garcia-López, 2010; Garcia-López et al., 2013; Puertas et al., 2014 pp. 2010–2045). New development has low-density, spatially segregated land use, accompanied by massive road network development (Catalán et al., 2008). Barcelona and Madrid metropolitan regions are typical examples of the overall loss of land-use efficiency in the country (European Environment Agency, 2006; García-Palomares, 2010; Marull and Pino, 2010). In Barcelona, the historical polycentric urban form has been highly disturbed through large suburbanization trends at the central business district and the pre-existing sub centers (Garcia-López, 2010). Likewise, Madrid is regarded as one of the EU hotspots in suburban development (European Environment Agency, 2006), with 50% greater urbanization surface compared to 1990s (European Commission, 2013).

Box 1: Desirability and costs of urban sprawl.
Although urban sprawl may have several desirable outcomes—e.g., householdís preferences for larger housing units-, the undesirability of sprawl has been widely justified in the literature through multiple arguments. Inefficient land consumption depletes natural resources, including land and soil (Cervero, 2001; Duarte and Tornés Fernández, 2014; European Environment Agency, 2006; Fernández and Duarte, 2012, 2012; Marmolejo Duarte and Tornés Fernández, 2012; Stellmes et al., 2013). Sprawl induces high operational energy consumption of households, mostly due to the large shares of motorized transport modes, and longer distances travelled, increasing transport emissions consequently (Bart, 2010; Cervero, 2001; National Research Council, 2009, 2002; Newman and Kenworthy, 1989; Perkins et al., 2009; Rickwood et al., 2008; Su, 2011; Troy et al., 2003). Sprawl-related commuting patterns also cause significantly higher adverse health effects than transit-oriented modal shares (Berrigan et al., 2014; Bhatta and Drennan, 2003; Creutzig et al., 2012; Creutzig and He, 2009; Dulal and Akbar, 2013; Echenique et al., 2012; Griffin et al., 2013; James et al., 2013; OECD, 2013). In addition, urban sprawl contributes to socioeconomic segregation, income inequality and polarization, and drives urban decay in core areas (Brueckner and Helsley, 2011; Mieszkowski and Mills, 1993; Mills and Price, 1984). Such a space-explicit environment makes households highly vulnerable to changes in fuel prices (Dodson and Sipe, 2007; Ferdous et al., 2010; Sexton et al., 2012). Last but not least, urban sprawl makes financing of public infrastructures more difficult as economies of density get lost. In Southern Europe, the combination of sprawled development with local politics lead to an inefficient allocation of vast amounts of local investment (Couch et al., 2007; Díaz Orueta, 2007; European Environment Agency, 2006; García-Palomares, 2010; Hawkins, 2013).

The adverse effects of such sprawled developments become increasingly evident. Spanish transport emissions, by half coming from private vehicles, have increased by one third since 1990 (Creutzig et al., 2012; Navalpotro et al., 2012). Commuting volumes, distances, and car use mode share have multiplied in metropolitan areas, decreasing the energy efficiency of transport networks (García-Palomares, 2010). Artificial land in coastal areas has doubled and by this, increased the vulnerability of these ecosystems and affecting its biodiversity. Soil sealing has diminished extremely important soil functionalities like its water storage capacity (Duarte and Tornés Fernández, 2014; European Environment Agency, 2006; Fernández and Duarte, 2012). The Barcelona metropolitan regions displayed a simultaneous loss of energy and land-use efficiency since the mid-19th century, as tracked by changes in the functional landscape structure (Duarte and Tornés Fernández, 2014; Marull and Pino, 2010).

But sprawl has also provoked socioeconomic consequences. The rocketing of single-family houses' development in Spanish suburban areas has been linked to household's indebtedness (European Environment Agency, 2006; García-Palomares, 2010). The most extreme case is Madrid, where urban planning was based on real estate suburban development and a decentralization process for all economic activities, favoring the construction of employment hubs and shopping and entertainment malls all over the region (Couch et al., 2007; European Environment Agency, 2006; Fernández and Duarte, 2012; García-Palomares, 2010). People have been pushed out of the city, and commuting volumes, distances, and car use mode share have skyrocketed together with increase in social segregation and share of households with mortgages (Díaz Orueta, 2007; García-Palomares, 2010).

The public sector has not been spared, especially after the financial crisis in 2008. Evidence tell us that the costs of

[1] Share of built-up area for the years 2000, 2012: Spain (1.93%; 3.9%) EU27 (4.0%; 4.9%).

[2] Land converted to urban use per capita 2000–2012 for the EU27: 34 m^2.

providing local public services in more sprawled urban settlements increases notably (Carruthers and Úlfarsson, 2008; Carruthers and Ulfarsson, 2003; Hortas-Rico and Solé-Ollé, 2010). At the same time, municipal revenues have dropped in more than 15% since 2007 (European Commission, 2014a). At first, intergovernmental transfers and short-term funding schemes were used to cushion the financial crisis, aiming at maintaining the economic activity in the construction sector. Urban plans were used as budget adjustment instruments. But after the bursting of the real estate bubble many private investment projects stopped (Torres-Machí et al., 2013). Real estate-based revenues declined drastically; sales, income and value added taxes reacted immediately, and entitlement programs costs started to increase (Council of Europe, 2011; Ministerio de Hacienda y Administraciones Públicas, 2014a; Pérez López et al., 2013). The increasing uncertainty made supranational bodies curtail their financial assistance to municipalities, causing reductions in loans and transfers from 2011 onwards. Alternatives used to offset budgetary constraints in previous times, such as Public Private Partnerships (PPP), were also notoriously hindered (Council of Europe, 2011). The central government launched a municipal rescue plan between 2012 and 2013, which granted local government's financial help under strict restrictions. However, only one-third of the municipalities absorbed more than 80% of the state fund (Ministerio de Hacienda y Administraciones Públicas, 2015, 2014a). Altogether, local budgets have been most severely affected by the financial crisis; the gap between revenues and expenditures appears insurmountable when previous sources of revenues are not taken into account (Council of Europe, 2011). Regardless of ambitious budget cuts since 2009, the gap still remains. Adjustments have caused multiple adverse effects: temporal school closures due to poor hygiene, gradual deterioration of public transport, late payroll payments, and mass dismissals through employment regulation plans and privatization of public services between 2008 and 2013. But the local debt distribution among the more than 8000 Spanish municipalities is highly unequal: roughly a hundred of them represent more than 50% of the total local debt (Ministerio de Hacienda y Administraciones Públicas, 2014a).

But the imbalance between revenues and expenditures dates back some time and it is not solely related to the financial crisis. Annual differences at the local level have increased almost 75% since 1995. Cumulative imbalances have multiplied by a factor of 10. Tellingly, these figures are much greater at the local and regional government level (Fig. 1a). When comparing with other EU members, local per capita indebtedness in Spain is above 180 EUR, whereas in the EU27 is only 10 EUR (both values close to 0 in 2000) (European Commission, 2014a) (Fig. 1b). Spanish local public debt is the largest among EU states; it has risen to more than 11 million EUR, 220% of local annual revenues and almost 4% of the national Gross Domestic Product (GPD) in 2010[3] (Council of Europe, 2011; European Commission, 2014a; Ministerio de Hacienda y Administraciones Públicas, 2014a). Debt management has become the Alpha and Omega of Spanish municipalities.

2.2. Political particularities of Spanish municipalities

The Spanish municipal map (in terms of its high local political fragmentation) plays an important role in local dynamics. Land-use regulatory responsibilities are shared by different levels of government. The central government establishes the land-use regulation benchmark regarding protected areas, whereas local governments pass municipal land-use plans, which gives them freedom to define their land use management and urban planning strategy (Bilbao et al., 2006; Fernández, 2008; Hortas-Rico, 2014). But municipalities also have the duty to provide a range of services according to their population, independently or in partnership with other municipalities. In order to exercise its powers, they have the power of regulation and self-fiscal organization, and tax and financial management, among others. Specific to real state taxation, municipalities may require non-recurrent taxes, recurrent taxes and development taxes. Non-recurrent taxes include: property transfer and certified legal documents tax, tax on inheritances and locations, special contributions. Recurrent taxes include: real estate tax, excises on real estate of non-resident organizations, tax on large commercial establishments, capital gain tax, and real estate tax for empty housing. Developing taxes include: urbanization fees, tax in the increase in value of urban land, fee on urban uses (Boletin Oficial del Estado, 1985; Ministerio de Hacienda y Administraciones Públicas, 2015; Velasco et al., 2015). But the tax base is eroded in many ways. The real estate tax (IBI) for instance, excludes more than one third of the existing land uses. Reductions apply to properties with recent reassessments for the following 9 years. Deductions also apply to the tax bill, especially to new developments. [4]Regardless of the surcharges to metro areas and unused properties, [5]they cannot offset the overall loses (Boletin Oficial del Estado, 2004a, 2004b; Ministerio de Hacienda y Administraciones Públicas, 2014b). In practice, Spanish municipalities enjoy a freedom to manage land use, which counteracts its relatively low fiscal responsibility.

2.3. The nexus between urban sprawl, municipal indebtedness and planning policies

To explore the link between urban sprawl, public indebtedness, and public intervention, we briefly point to important insights from the literature.

Conceptually, urbanization dynamics are described through changes in population, income, and transport costs, all of them linked through the price of housing (Alonso, 1964; Mills, 1967; Muth, 1968). Fuel prices play a key causal role: they determine not only urban expansion and urban form but indirectly also the financial viability of public transit (Creutzig, 2014). Urban sprawl is partially driven by cheap money fueling new real estate development (Squires, 2002) and by physical geography and local amenities (Burchfield et al., 2006; Saiz, 2010). Sprawled development aligns with individual preferences for large affordable consumption of land (Fujita, 1989). Population growth, enhanced purchasing power and changes in transport infrastructure and expenditures explain sprawling patterns to a great extent (Baum-Snow, 2007; de Bartolome and Ross, 2007; Leroy and Sonstelie, 1983; Molloy and Shan, 2012; Rodriguez, 2013; Small, 1981). Urban form characteristics also influence land consumption and commuting patterns—e.g., fragmentation of urban fabrics and job ratio balance—(Duarte and Tornés Fernández, 2014; Fernández and Duarte, 2012). But fiscal policies and other public interventions are equally important in explaining recent developments. Literature highlights the role of market failures, fiscal distortions and similar government interventions (Brueckner, 2000; Couch et al., 2007). For example, mortgage deductions and related housing policies encourage excessive land use conversion for residential use (Burchfield et al., 2006; Hamidi and Ewing, 2014; Squires, 2002). Excessive spatial growth of cities is also caused by underpricing of infrastructures (Baum-Snow, 2007; Brueckner, 1997); absence of region-wide cooperation, territorial competitiveness,

[3] National total debt has doubled in the same period up to 95% of GDP in 2013 (Ministerio de Hacienda y Administraciones Públicas, 2014a).

[4] Deductions: Regions of Ceuta and Melilla (−50%); new urban development (50–90%); social housing (50%).

[5] Surcharges for metro areas (0.2%); unoccupied residential buildings (0–50%).

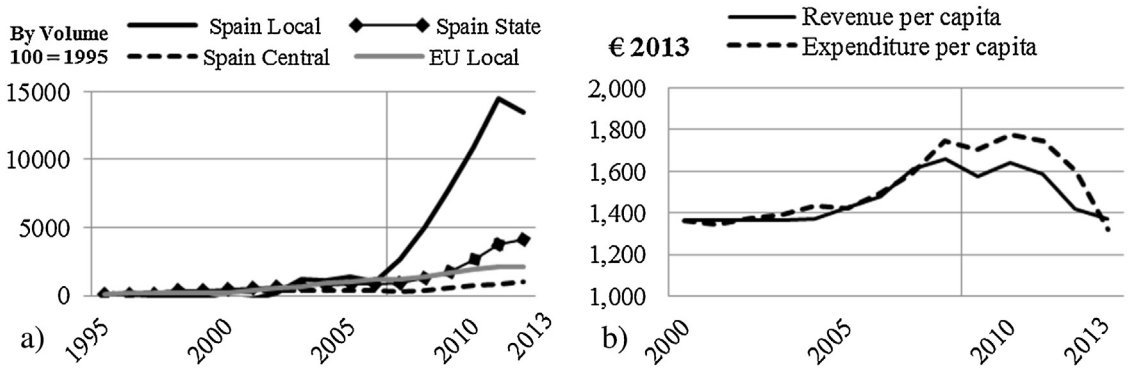


Fig. 1. Local Public Finances in Spain and the EU27. 1a Cumulative difference between expenditures and revenues for the period 1995–2012 by level of Governance for Spain and EU27 (base year: 1995). 2b: Spanish average local revenue and expenditure per capita in adjusted 2013 € 1998–2012.
Source: (European Commission, 2014a).

decentralized land use planning polices and permissive urban plans (Carruthers and Ulfarsson, 2001; Chorianopoulos et al., 2014; Eicher, 2008). Last but not least, property tax regimes are key in explaining urban development patterns (Anderson, 1986; Arnott, 2005; Brueckner and Kim, 2003; Cocconcelli and Medda, 2013; Groves, 2009; Song and Zenou, 2006).

Interestingly, in Europe fiscal and land-use policies are more important for urbanization dynamics than transport costs and income, especially compared to land-rich regions such as the US (Catalán et al., 2008; Chorianopoulos et al., 2014; Couch et al., 2007; European Environment Agency, 2010, 2006). The work by (Couch et al., 2007) singles out political and social aspects as fundamental explaining factors of the recent urban growth patterns in Europe.

The Spanish case exemplifies this local political influence starkly. Here, income, transport costs, housing and the economic recession explain recent urban development only to a certain extent for suburbanized areas. While such variables explain up to 80% of the variation in the construction of highly dense centralized development, they can only explain 48% of suburban sprawled development (Ortuño-Padilla and Fernández-Aracil, 2013). Also, although the relatively low fuel taxation in Spain in comparison to other EU countries makes it more susceptible to fuel price variations, no major changes on commuting patterns have been observed since the start of the crisis (Álvarez et al., 2011), possibly due to lock-in effects in land-use/commuting patterns. Social factors accelerated the sprawling development: Seasonal life-style patterns, fragmented work, and leisure time multiplied the demand for second homes and led to an oversupply of new dwellings unadjusted to population growth figures (Couch et al., 2007; European Environment Agency, 2006; Hortas-Rico, 2014). Crucially, suburbanization trends have gone hand in hand with planning decisions at the local level, such as the provision of public infrastructure, planning regulations and other public-related interventions (Couch et al., 2007; Jaraíz Cabanillas et al., 2013). In fact, local governments competed for the creation of new suburbs and increased the supply of land (Gómez-Antonio et al., 2014; Solé-Ollé and Viladecans-Marsal, 2012). In this situation, householdís location preferences shifted toward segregated suburban communities (Díaz Orueta, 2007; Fernández and Duarte, 2012; García-Palomares, 2010). In addition, national freeways and highways projects lacked planning restrictions, and lead to uncontrolled urban growth along transport corridors (Garcia-López et al., 2013). In metro areas, motorway rings and duplications of pre-existing radial highways facilitated residential suburbanization even more (Díaz Orueta, 2007). In Madrid for example, a decentralization process on all economic activities led to the development of employment hubs, shopping and entertainment malls throughout the region (Duarte and Tornés Fernández, 2014; European Environment Agency, 2006; Fernández and Duarte, 2012). In Spain, urban sprawl was fed by municipal action.

But how does the above link with local indebtedness? Municipalities slipped into a vicious circle of mounting provision of public resources to attract external capital investment, mainly taking the form of real estate development. Urban surface per person has increased in more than 10% since 2000; importantly most of this increase is due to unused urban land (Ministerio de Hacienda y Administraciones Públicas, 2014b). Consequently, there has been an overprovision of infrastructures and services for urbanization, financed through large public investments. One example is street light consumption. EU energy efficiency goals for 2012 limited the per capita average consumption at 75 kWh/year. In Spain this number peaked at 113 kwh/year, the highest by far in the EU27. [6]The total cost of streetlight doubled between 2007 and 2012, from EUR 450 million to EUR 830 million (Sánchez de Miguel et al., 2010). Mammoth investment in transport infrastructure driven by political interests is another reason, where underestimation of investment and maintenance costs bankrupted municipalities in numerous occasions, especially for those municipalities higher degree of decentralization and inter-municipal cooperation (Pérez López et al., 2013).

Property taxation, often the most important source of local revenue, aims at recovering public expenditures in municipalities. When public investment—especially for new development- takes place, these fiscal instruments must ensure the raise of enough revenues to cover a share of the expenditures (Cho and Choi, 2014; Medda, 2012; Wang et al., 2015). In the case of new development, developers pay for the cost of new development (Almeida et al., 2013; Brueckner, 1997; McFarlane, 1999). Literature refer to as the so-called unearned value of locations, the share of property's worth which is not produced by landowner's labor, but from public intervention and to a certain extent from community actions and environmental quality (Arnott and Stiglitz, 1979; Brandt, 2014; Brueckner, 2000; Fainstein, 2012; Fernandez Milan et al., 2016; Mattauch et al., 2013; UNHABITAT, 1976). But Spanish municipalities have long counted on regional and national grants to balance their budgets. Additional infrastructure requirements associated with urban growth are mostly funded by upper tiers of government as some capital transfers are dependent on the municipalities' infrastructure deficit (Hortas-Rico, 2014; Ministerio de Hacienda y Administraciones Públicas, 2015). Literature has already pointed at the role of planning decisions on land values and, as a

[6] France: 90–77 kwh/year; Germany: 48–43 kwh/year (Sánchez de Miguel et al., 2010)

consequence, development patterns (Almeida et al., 2013; Altes, 2009; Cocconcelli and Medda, 2013; Rebelo, 2009).

In Spain, land supply and the property tax design are particularly relevant. Land supply is considered to be one major contributor to sprawled development especially in the suburbs, making developable land cheap enough to attract investors (Gómez-Antonio et al., 2014; Solé-Ollé and Viladecans-Marsal, 2012). But revenues of property taxes in Spain have been relatively instable since early 2000's compared to EU27; temporal variability emerges especially when investigating recurrent and non-recurrent property taxes independently[7] (European Commission, 2014b, 2012; European Environment Agency, 2010). As property taxes are the most important source of revenue for municipalities, they are likely to play a crucial role in explaining debt levels.

We here look at all these views together and focus on exploring the link between urban developments, municipal finances and location values at the same time to see if local decision-making does have a say in the simultaneous sprawled settlements, location value increase and indebtedness. We use systematic statistical analysis to understand the role capitalization dynamics in real estate markets and the link with urban sprawl and debts in Spain. We explain our data and method in the next section.

3. Methods

3.1. Temporal development of urban location values and property taxes

To overview the development of real estate taxes and land supply with that of municipal indebtedness we first look at the behavior of all real estate taxes and compare them with location values for the period 2000–2013. We include values for developable land to tell us about land supply prices. We use data on market and cadastral location values from the Spanish Ministry of Public Works and the Ministry of Finance and Local Administration respectively (Ministerio de Fomento, 2015; Ministerio de Hacienda y Administraciones Públicas, 2014b). We also calculate the location share (the% of real estate values coming from location values) to indicate the capitalization dynamics of public intervention in the real estate market. Tax revenues come from the European Commission report "Taxation trends in the European Union (European Commission, 2014b)" and the Tax Revenue Statistics Database (European Commission, 2015). All prices are adjusted to 2013€.

3.2. The nexus between sprawl, indebtedness and location values

For analysis, we rely on the urban economic framework explained in Section 2. Formally, the urban economic budget equation allocates income Y to spurious consumption c, transport costs T = tr (with t marginal transport costs and r the travel distance to the inner city), and land consumption S = sR (with R rental costs per unit land and s the amount of land consumed): Y = c + Tr + Rs. This framework clarifies that urban sprawl is driven by higher income and lower marginal transport costs, both of which enable an higher amount of land consumption. In contrast, a restriction of land available for residential purposes would increase R and by this limit land consumption. Municipal expenditures on road infrastructure would reduce marginal transport costs and increase urban sprawl. Everything else being equal, higher expenditures would also be related to higher debt levels. Also, a tax rate on property would reduce urban sprawl and the value of property compared to the untaxed case. We use this theoretical framework to motivate the statistical analysis.

We focus on the specific link between sprawl, indebtedness and location values and their relation with municipal intervention. We define four urban indicators to look at sprawl, indebtedness, and location values, five to look at municipal characteristics, and six indicators to evaluate municipal intervention (Table 1). In order to have a study period where intergovernmental transfers and short-term urban development revenues do not distort municipal budgets, we use data for the year 2013 for all variables except from sprawl.

The sprawl variable is defined as the difference in urban surface built per capita between 2006 and 2013. Among the multiple approaches to define sprawl, the per capita urbanized land has been recently used in the Spanish context by (Hortas-Rico and Solé-Ollé, 2010) accompanied by other variables to increase preciseness. We take the urban surface built (following the sprawl definition used by (Hortas-Rico, 2014)) for two points in time—2006 and 2013—and calculate the percentage change for the period to better assess the development pattern. Looking only at urban surface built—not total urban surface—and having two points in time, together improve the sprawling indicator. Municipal indebtedness is defined as per urban surface to better account for the spatially explicit capitalization dynamics of public investment.[8] We only look at urban surface because the majority of the public services municipalities are responsible for are carried out in designed urban land (Boletin Oficial del Estado, 2004b, 1985; Velasco et al., 2015). For location values, the Spanish cadastre database distinguishes between location and structural value of properties. We use the location values as they are a closer indicator of the capitalization dynamics we here want to look at—property values includes structure values, which do not necessarily come from the capitalization of public investment (Arnott and Stiglitz, 1979; Burge, 2014; Fainstein, 2012; Mattauch et al., 2013; UNHABITAT, 1976). We use per surface location value and residential property average value—the Spanish cadastre does not distinguish between structure and location values for different land uses. Based on the insights from urban economic theory, we define the following municipal characteristics: share of urban surface—urbanity indicator—population, total urban surface, and the distance to the nearest provincial capital—economics of density indicators- (Brueckner, 2000; Brueckner and Fansler, 1983; Burchfield et al., 2006; Fujita, 1989; McDonald, 2009). We include a dummy variable "Province"[9] to control for regional effects—notably income. For evaluating the public intervention, we focus on tax-induced distortions and land supply because they have been identified as major drivers of recent development in southern Europe (Couch et al., 2007; Gómez-Antonio et al., 2014). Tax-induced distortions are evaluated though the urban property tax rate, the frequency of assessment (last assessment year) and the erosion of the tax base—in% loss—due to exemptions, reductions and deductions. The amount of land classified as developable indicates the land supply (Gómez-Antonio et al., 2014; Solé-Ollé and Viladecans-Marsal, 2012).

The data is from the Spanish cadastre (Ministerio de Hacienda y Administraciones Públicas, 2014b) except from that of municipal debt, which belongs to the Ministry of Finances and Public Administrations (Ministerio de Hacienda y Administraciones Públicas, 2014a). There were 8188 Spanish municipalities in 2013. The

[7] Recurrent taxes refer to those ones that are collected periodically, mostly on an annual basis. Non-recurrent taxes consist on transfer taxes, applicable only when a property changes its ownership.

[8] Typically, public investment variables are expressed in per capita (Bernardino Benito, 2009; Garcia-Sanchez et al., 2012; Hortas-Rico, 2014), but it does not reflect capitalization dynamics into location values.

[9] There is no data available for income at the municipal level for the year 2013.

Table 1
Definition of the variables and descriptive statistics for the sample of 265 municipalities (for the year 2013, except for the sprawl variable).

Indicator	Measure	Variable	Unit	Mean	Min	Max	S.D
Urban indictors	Sprawl	Δ Urban surface built per capita 2006–2013	m^2/pop	6.5	−164	179	33.8
	Debt	Surface debt: municipal debt per surface	€/m2	3.7	0	33	4.4
	Location values	Location value	€/m^2	152	14	1086	151
		Residential property value (mean)	€	72529	16694	262797	45138
Municipal characteristics		Population	no.	43171	13068	296479	46955
		Share urban: urban surface in% of total surface	%	22.2	0.5	76	17
		Urban Surface	ha	858	32	5546	842
		Distance to capital	km	22.9	4.6	45	11
		Province (dummy)	–	–	–	–	–
Local intervention	Tax induced distortions	Tax rate	%	0.6	0.2	1.2	0.2
		Exemptions	%	3.29	0	33.5	4
		Reductions	%	11.85	0	56.33	15.79
		Deductions	%	3.12	0	18.23	3.62
		Assessment year	year	2003	1986	2013	–
	Land supply	Share of urban surface not built	%	37.3	7.4	82.8	13

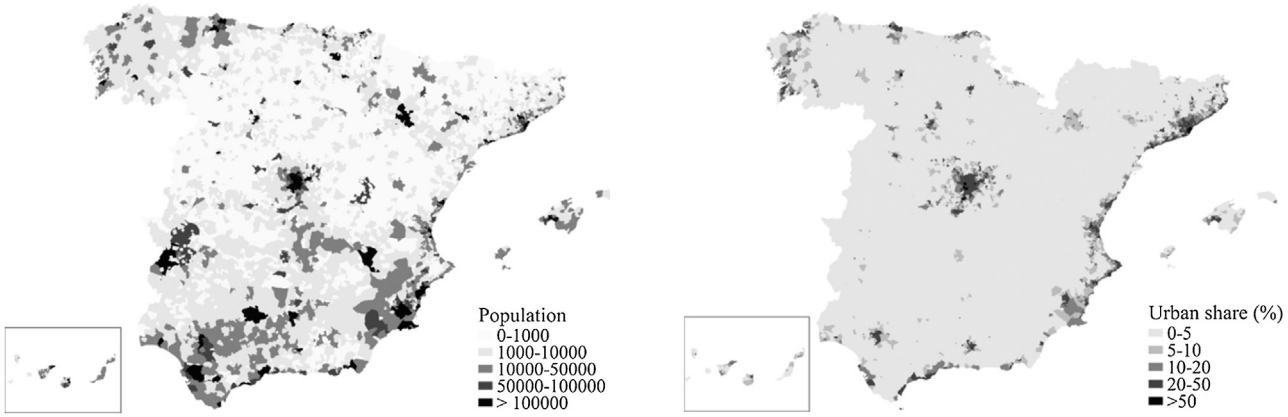


Fig. 2. Population and urban share of Spanish municipalities in 2013.[11]

cadastral database does not provide data for municipalities in the Basque Country and Navarra (594) and we therefore exclude them from the study. Next, 9 municipalities changed their boundaries between 2006 and 2013, and we cannot calculate the sprawl variable. This said our initial sample consists of 7585 municipalities. The National Institute of Statistics defines a city one municipality with more than 10,000 people (INE, 2015). The vast majority of the Spanish municipalities correspond to rural areas; with very low number of people and little urbanized location (Fig. 2). We therefore fix the population limit to 13000 to raise the average urban share of the sample from 10 to 20% [10](see Fig. A1).

We also control for residential land share to exclude municipalities that did not base their development on residential sprawl. As there is no data on the location use surface of the municipalities, we take the share of total cadastral value corresponding to residential land share. The total sample shows a residential cadastral value share between 55 and 85 (see Fig. A1), thus we exclude those municipalities with less than 55% of residential cadastral value. Finally, we control for the municipal distance to capital to focus on suburban sprawled development. We exclude metropolitan urban centers—province capital municipalities—and municipalities located within a ratio of 4.5 km[12] as well as those municipalities that are no longer in the metropolitan areas of influence—45 km.[13] Our statistical analysis is based on a sample of 265 municipalities, representing the 54% of the total Spanish population[14] and 63% of the province map[15] (Fig. 3).

We perform a statistical analysis by looking at how our selected municipal characteristics and the public intervention indicators have a relation with sprawl, surface indebtedness and location values. We use ordinary least squares models—multivariate regression analysis—to explain the external dimensions in the empirical data. We test several linear regression models according to the existing literature that substantiate our models, including both municipal characteristics and local intervention indicators as explanatory variables. We further contemplate the link between the three urban indicators—in case of endogeneity—as we include the additional other two in the regressions, although they do not always have explanatory power (e.g., for sprawl, the regression model also includes surface debt and location value).

[10] A Kernel density curve serves us to estimate the optimal population limit to increase the urban share in the sample. Municipalities with population between 10,000 and 13,000 have relatively low urban share and would therefore not be representative if they were to be included.

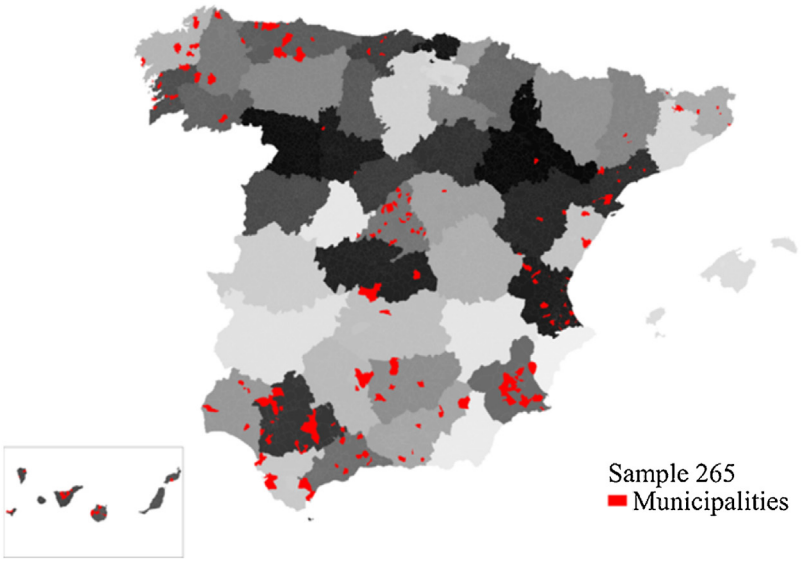
[11] Data missing for Basque Country and Navarra for urban share as it is not available in the cadastre.

[12] Average ratio of regional capitals: 4.5 km (INE, 2015).

[13] Recent case studies looking at commuting patterns in Spain report community distances typically varying between 0 and 45 km in metro areas (Creutzig et al., 2012; Muñiz and Galindo, 2005; Romaní et al., 2003; Royuela and Vargas, 2009).

[14] Spanish population 44274277; sample population: 23838423.

[15] Spanish provinces: 52; sample provinces: 33.



Province	N°	Province	N°
Albacete	1	Jaen	4
Alicante	16	Lleida	2
Almeria	4	Lugo	2
Asturias	9	Madrid	28
Badajoz	1	Malaga	11
Barcelona	45	Murcia	11
Cadiz	8	Ourense	1
Cantabria	4	Palmas, Las	7
Castellon	4	Pontevedra	10
Ciudad Real	2	S.C. Tenerife	9
Cordoba	2	Sevilla	16
A Coruna	6	Tarragona	7
Girona	6	Toledo	2
Granada	6	Valencia	24
Guadalajara	1	Valladolid	2
Huelva	5	Zaragoza	1
I. Baleares	8	**Total**	**265**

Fig. 3. Sample of 265 selected municipalities for the statistical analysis and their regional distribution according to provinces.

4. Results

First, we analyst how locations values and municipal tax revenue developed before and after the implosion of the real estate bubble in 2008. Motivated by the results, we then quantitatively assess, with regression analysis, how urban sprawl, debts, and location value depend on urban characteristics, and municipal tax design. The results demonstrate that sprawl, debt, and location value vary with location, and that municipal design of land taxation has a notable impact.

4.1. Disjoint development of location values and property tax revenues

With the financial crisis, the mean location value, as determined by the market, more than halved between its peak in 2007 and 2013, our last data point (Fig. 4a). Interestingly, the cadastral value increased slightly, reflecting a convergence of market and assessed value; in fact the share of location cadastral value increased by 2% between 2008 and 2010, indicating a higher assessed value of locations compared to structures in the property price. The price of land supplied by municipalities for further residential build-up only increased 10%. This suggests that, on the one hand, further residential build-up ceased or slowed down, while, on the other hand, municipalities still set land aside for further development.

The development of tax revenues before and after the financial crisis clarifies the dynamics. Revenues from development taxes decreased with the crises by 47% indicating continued development albeit at lower speed (Fig. 4b). However, the non-current taxes display a drastic dynamic. Non-recurrent taxes i.e. transfer taxes of properties at market value, more than doubled in the build-up of the real estate bubble between 2002 and 2007; and they dropped drastically when the market collapsed to below 2002 values (Fig. 4a). In absolute terms, 2013 revenues were 15% less than those from 2000. At the same time recurrent taxes have increased more than 40%, uninterrupted by the real estate bubble. This reflects that recurrent taxes are levied against the cadastral value, not the market value (compare with Fig. 4a). Together, all taxes in place captured on average no more than 0.25% of the total annual cadastral value (see Fig. A2 for disaggregated revenues from all types of property taxes), which is, in addition, far below market prices (on average urban market values are almost 65% higher than cadastral values in the period 2000–2013). This suggests that recurrent taxes prevent municipal budgets from the absolute worst, but that they could also play a larger role toward recovery.

We now proceed by investigating the independent variables influencing urban sprawl, municipal debt, and location value, revealing location-specific variation between municipalities.

4.2. Statistical analysis

We present the regression models on urban sprawl, surface debt and location value in Table 2. We run different test to check for collinearity, where none of the variables from the three reported regressions are worrisome. Our results show the following: urban sprawl can only be explained to a limited degree by our set of variables (R2: 0.22). Specifically, surface debt influences urban sprawl, albeit weakly: the higher the surface debt, the higher the sprawl. This result coincides with the hypothesis that public infrastructure investment for urbanization has been cost-free for developers (development taxes do not work, or not enough). Possibly municipalities learn to live on transfers, redesigning from rural and urban, a result that goes in line with the bubble dynamics (results substantiated by (Hortas-Rico, 2014)). As expected from urban economic theory, the results show that the lower the residential value the higher the sprawl, as sprawl occurs in “cheap land” or where developable land is subsidized. In the same line, lower population, higher urban surface and higher distance to metropolitan areas lead to higher sprawl. (Brueckner and Fansler, 1983; Burchfield et al., 2006; Mieszkowski and Mills, 1993; Saiz, 2010). As expected, the lower tax rates of developed land, the higher sprawl: a low tax rate appears to incentivize development (Anderson, 1986; Groves, 2009). The assessment year is also related to sprawl: land for development is reassessed before and after development. Contra intuitively, land supply does not explain sprawl in our sample—although they correlate significantly, see Table A1. An explanation could be that our land supply variable is not well defined on a temporal scale. Development occurred already in the previous years and land reclassification for urban development is no longer occurring.

Surface debt can be partially explained by our set of variables (R2:0.44). Surface debt co-varies to considerable degree with

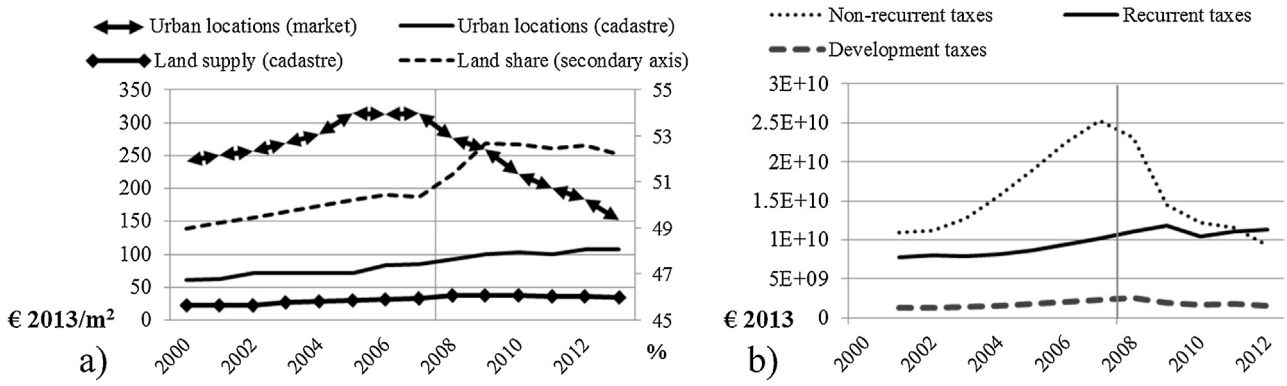


Fig. 4. (a) Urban location values 2000–2013 (market and cadastral value) and land share (secondary axis) (b) revenue from fiscal instruments based on property in Spain, 2000–2013.
Source: (European Commission, 2014a, 2014b; Ministerio de Fomento, 2015; Ministerio de Hacienda y Administraciones Públicas, 2014a).

Table 2
Regression models of urban indicators, correlation coefficients and p-values from a statistical analysis of a dataset comprising 265 municipalities. Coefficients listed (adjuted R^2) are for the following models (a) sprawl = surface debt + residential value + population + urban surface + distance to capital + tax rate + assessment year (b) surface debt = location value + population + urban surface + deductions (c) location value = surface debt + population + share urban + urban surface + tax rate + assessment year + land supply. Ommited values ("–") denote variables that removing them from the model changed R^2 by less than 0.01 (the results presented therefore are refered to models that omit such variables in question). Statistical significance: *significant at $p < 0.05$ and **$p \leq 0.01$ respectively.

		Dependent variable for the regression models analysed		
	Data units	Sprawl (Δ Urban surface built per capita 2006–2013)	Surface debt (Municipal debt per surface)	Location value
R^2 (adjusted)		0.22	0.44	0.67
Debt	€/pop	–	–	–
Surface debt	€/m2	0.82*	–	9.18**
Location value	€/m2	–	0.01**	–
Residential value	€	−0.0003**	–	–
Population	no.	−0.0001*	0.0005**	0.0006*
Share urban	%	–	–	1.59**
Urban surface	ha	0.02**	−0.002**	−0.03*
Distance	km	0.44**	–	–
Province	(dummy)	–	yes	yes
Tax rate	%	−20.37**	–	−316.35**
Exemptions	%	–	–	–
Reductions	%	–	–	–
Deductions	%	–	0.12*	–
Assessment year	%	1.17**	–	7.33**
Land supply	%	–	–	−2.61**

location values. Higher location values produce higher debt when they are not captured by taxes. This confirms our hypothesis that public surface debt is privately capitalized by location values. In addition we observe that the more population and the lesser the urban surface, the higher the surface debt. Clearly, in areas with higher population density, the higher construction volume per surface leads to higher debts. Local intervention is also relevant. As expected, the more deductions the more surface debt, because, as noted above, new urban development benefits from deductions that go from 50 to 90% of the tax bill.

Finally, location value is surprisingly well explained through a larger set of variables (R2:0.67). Higher surface debt produces higher location values as public investment increases location values (see Fig. 5 for a spatial visualization). More population, share urban and less surface leads to higher values, a result that also complies with urban economics (Alonso, 1964; Mills, 1967; Muth, 1968). Quite intuitive, the more recent the assessment of cadastral values the higher value, highlighting the importance of the frequency of assessment. The lesser the land supply, the higher the land scarcity and thus the higher the market competitiveness leading to higher location values. Finally, lower tax rates lead to higher location values. This result is coherent with the insights from land taxation theory, indicating that higher taxation leads to counterfactually lower location values (not increase location values but stabilize them) (Cocconcelli and Medda, 2013; Dye and England, 2009; Tideman, 1982).

5. Discussion

The combination of financial crisis and real estate bubble caused high damages on the national economy and the overall welfare of the population through public budget cuts, high unemployment and mortgage rates. And land intensive urban development is deeply entangled with environmental consequences such as higher greenhouse gas emissions. The 20 years preceding the financial crisis have seen an explosion of land use for housing and transport, particularly during the last decade, with often-detrimental outcome for the environment and climate change. Our analysis reveals how municipal policies participated in the making of this disaster.

Our results need to be understood in the context of previous studies. Notably, empirical studies already demonstrated the downside of sprawling patterns for municipal budgets (Carruthers and Úlfarsson, 2008; Carruthers and Ulfarsson, 2003; Gómez-Antonio et al., 2014; Hortas-Rico, 2014; Hortas-Rico and Solé-Ollé, 2010; Solé-Ollé and Viladecans-Marsal, 2012). Specifically, Hortas-Rico and Solé-Ollé (2010) indicate that sprawled development

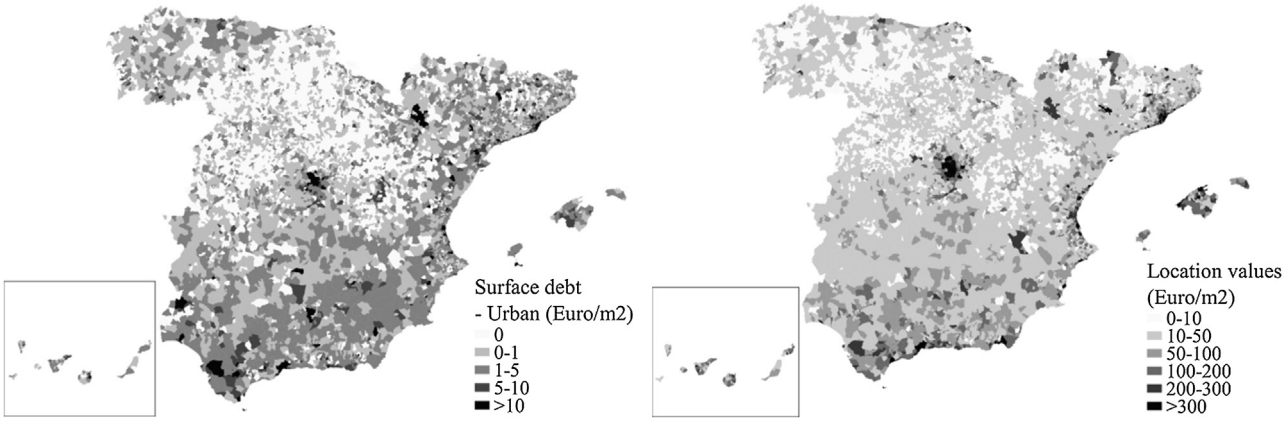


Fig. 5. Surface debt and location values are spatially joint.
Source: (Ministerio de Hacienda y Administraciones Públicas, 2014b).

leads to greater provision costs of local public services. García-Sánchez (2006) evaluated the efficiency of the water supply and found that population density has a statistically significant impact on the indexes of efficiency. But Hortas-Rico (2014) also provided empirical evidence of the municipal interest of promotion urban development. Her results indicate that the increase in current revenues offsets the increase in current expenditures due to public service provision for new development. Although sprawl demands new infrastructures, the deficit generated by this new infrastructure is covered by intergovernmental transfers and, to a lesser extent, by revenues linked to the real estate cycle (including planning permissions, construction taxes, and taxes on land value improvements, revenues from sales of public land and asset revenues).

These findings suggest that municipalities may be interested in encouraging urban sprawl. But our research points at the pitfalls of such a rationale. The financial crisis stopped the upcoming revenues from grants from upper tiers of governments and evinced the inefficiencies of revenue associated with the real estate cycle itself.

In Spain – like most Southern European countries – municipal revenues system relied mainly on non-recurrent property taxation. But these fiscal packages were unable to recapture public urbanization investments—previously refer to as unearned values. Development taxes captured a very limited share of the public investment related to urban growth and non-recurrent taxes – taxes, stamps, duties, etc., – crashed with the financial crisis. Revenues from recurrent taxes remained stable or increased slightly but their magnitude was capturing only a small part of market values. The causes are many and varied. First, cadastral values remain below market values by a large margin. Second, the municipalities' right to adjust the tax rate within a certain range encourages them to fix it at maximums of around 0.5% due to fiscal competitiveness[16] (Boletin Oficial del Estado, 2004a; Ministerio de Hacienda y Administraciones Públicas, 2014b). But most important, third, are the uncountable number of exemptions, reductions and deductions of the property tax regime. Last but not least, municipal budgets have lacked in transparency and accountability around their urban development plans (Pérez López et al., 2013). As in many other countries, Spain lacks in adequate long-term fiscal instruments able to recover significant shares of public investments in the real estate market cycle, which has provoked exacerbated capitalization dynamics in the last decade (Dye and England, 2009; European Environment Agency, 2010; Gaffney, 2009; Ingram and Hong, 2012; Institute for Fiscal Studies, 2011; Raslanas et al., 2010; UN-HABITAT, 2011).

The canonical variables from urban economics can hardly explain the difference that exists between Europeís and Spanish recent urban land consumption and municipal indebtedness. In fact, local decision-making greatly influences the variables that shape the development of urban settlements. Notably, we find that surface debt contributes to explaining location value. Location values are higher where municipalities capture only a small fraction by taxes. This may indicate capitalization dynamics through real estate values. In fact, debt values in turn are higher were tax deductions are more common (but not were tax rates are lower). The role of tax deduction may appear somewhat surprising but, in fact, is in accordance with the literature, emphasizing that tax deduction became a major instrument in municipalities, systematically skewing the tax revenue statistics (Brueckner and Kim, 2003; Groves, 2009; McFarlane, 1999).

Urban planning shapes land use mix, determines connectivity and accessibility to urban services, its attractiveness and, ultimately, their perceived value in the real estate market. Thus, household location preferences and private investor's decisions rely heavily on how municipal intervention is designed. Inversely, municipal decision-making for urban planning can create market distortions that – in a climate of propriety – inflict externalities. Often land will then be excessively developed. Our research combines the insights on urban sprawl from public finances, urban economics and environmental sciences and creates an explicit link between this type of development and municipal indebtedness. We argue that, if no capture of the value added by public intervention occurs, this value accumulates in real estate assets through location value increase. As municipal debts enlarge, strict budgetary constraints affect the provision of public services and investments. Our study also points toward a potential remedy: location value taxation has considerable to stabilize municipal budgets again, especially in those areas struggling the most (Cho and Choi, 2014; McCluskey and Trinh, 2013; Wang et al., 2015) and, at the same time, can help curve urban sprawl and its related CO_2 emissions (Almeida et al., 2013; Altes, 2009; Bart, 2010; Roakes, 1996). Furthermore, location value taxes are also slightly more progressive than a property tax and stabilize real estate prices even under market bubbles conditions (Cocconcelli and Medda, 2013; Haila, 1985; Plummer, 2010; Wang et al., 2015).

Clearly, both local policy instruments and national and global real estate markets and financial engineered contributed to the Spanish real estate bubble. We suggest that the joint analysis of local and global factors to the real estate crisis, both with statistical assessment, and with theoretical analysis, is a fruitful field. A more

[16] Urban tax rate range: 0.4–1.1%

comprehensive analysis would also improve the resolution of urban economic variables, such as income on household level, and travel time costs, but also include a wider perspective on municipal budgets. Such studies would further contribute to help policy makers in preventing new outbreaks of real estate and banking crises.

6. Conclusion

In this paper, we investigated the joint development of rapid urban land consumption and municipal public finances in Spain. While shaped by global dynamics in financial markets, public intervention shapes sprawl and local debts through land values. The combination of permissive urban planning and tax-induced distortions exacerbated the housing bubble, and unsustainable urban expansion. To remedy this situation, we suggest that recurrent location values in real estate markets would reduce debt burdens and less permissive planning would alleviate sprawl in the long run. Crucially, these results demonstrate that municipal policies that seem adequate in times of expanding financial markets and associated liquidity can prove disastrous in the long-run. Instead prudent municipal policies disentangle public finances from temporary growth dynamics. Our analysis serves as a basis to investigate the entangled role of local decisions and global markets on land use, and its multi-scale effects.

Acknowledgements

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Appendix A

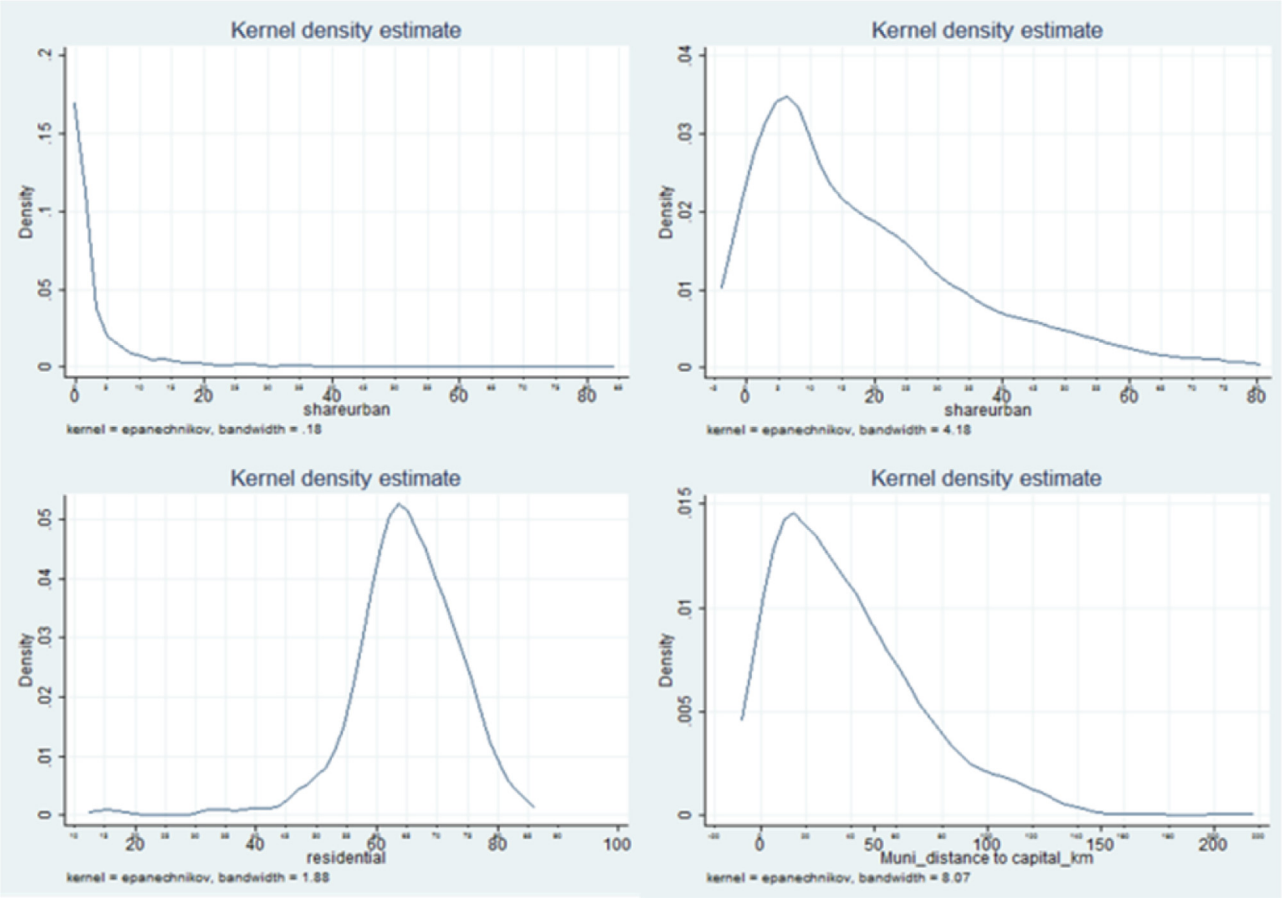

Fig. A1. Sample selection criteria for statistical analysis (a,b) Difference in the variable share urban for municipalities with (a) below 13000 people and (b) above 13,000 people (c,d) density distribution of (c) residential values and (d) municipal distance to capital for the whole sample (7585 municipalities).

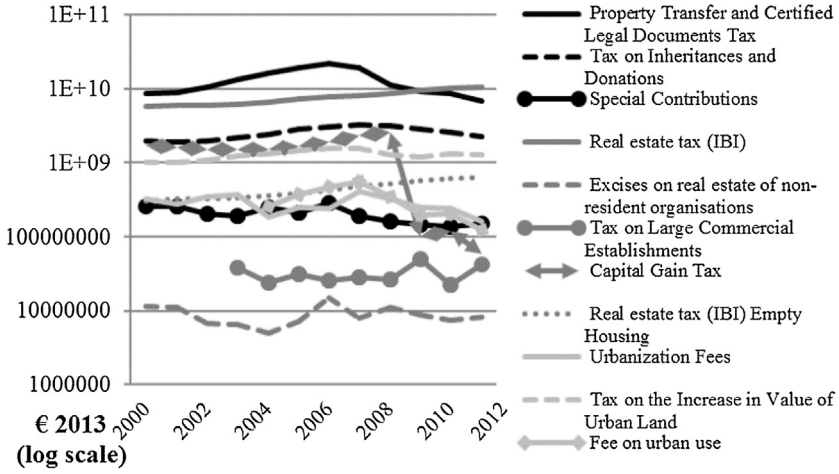

Fig. A2. Disaggregated revenues from property taxes in Spain (2000–2013).
Source: (European Commission, 2015, 2014b).

Table A1
Relationship between urban indicators, municipal characteristics and local intervention. (Pearson's coefficient). Significant relationship if $p < 0.01$ (*), and strong relation if $p < 0.001$ (**).

	Sprawl	Surface debt	Land value	Residential mean	Population	Share urban	Urban surface	Distance to capital	Tax rate	Exemptions	Reductions	Deductions	Assessment year
Surface debt	0.0												
Land value	−0.1*	0.5**											
Residential mean	−0.3**	0.0	0.5**										
Population	0.1	0.4**	0.3**	0.1									
Share urban	−0.1*	0.2**	0.4**	0.3**	0.3**								
Urban surface	0.2**	0.0	0.0	0.2**	0.7**	0.1							
Distance to capital	0.2**	−0.1	−0.2**	0.01	−0.1	−0.4**	0.0						
Tax rate	0.0	0.2**	−0.2**	−0.4**	−0.1	0.0	−0.2*	0.1					
Exemptions	0.0	0.0	0.1	0.2*	0.0	0.1*	0.0	0.0	−0.1				
Reductions	0.0	0.1	0.3**	0.5**	0.1	0.1	0.1	0.0	−0.1	0.0			
Deductions	0.0	0.2*	0.0	0.0	0.2*	0.1	0.1*	0.0	0.0	0.0	0.0		
Assessment year	0.0	0.1	0.4**	0.6**	0.1	0.2*	0.1	−0.1	−0.2**	0.2*	0.8**	−0.1	
Land supply	0.2**	−0.3**	−0.3**	0.0	0.0	−0.1	0.3**	0.1*	−0.2**	0.1	0.0	0.0	0.1

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