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Municipal policies accelerated urban sprawl and public debts in Spain

Blanca Fernandez[1,2,*], Felix Creutzig[1,2]

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.

Keywords: urban sprawl, local finances, municipal land use planning, property tax.

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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, Hortas-Rico, and Li 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 analyse 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.

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[3]. This difference also holds when we normalize by population; the annual land converted to urban use was 70m^2 per capita between 2000 and 2012 in Spain, surpassed only by Ireland and Malta[4] (European Commission 2013).

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

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

Box 1. Desirability and Costs of Urban Sprawl

Although urban sprawl may have several desirable outcomes –e.g. household´s 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; M. T. Fernández and Duarte 2012; M. T. Fernández and Duarte 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; National Research Council 2002; Newman and Kenworthy 1989; Perkins et al. 2009; Rickwood, Glazebrook, and Searle 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, Mühlhoff, and Römer 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, Wu, and Zilberman 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, Leontidou, and Petschel-Held 2007; Díaz Orueta 2007; European Environment Agency 2006; García-Palomares 2010; Hawkins 2013).

Spanish regions located along the Mediterranean coast and the central region are at the forefront of sprawling patterns (Catalán, Saurí, and Serra 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, Saurí, and Serra 2008; Garcia-López 2010; Garcia-López, Holl, and Viladecans-Marsal 2013; Puertas, Henríquez, and Meza 2014, 2010–2045). New development has low-density, spatially segregated land use, accompanied by massive road network development (Catalán, Saurí, and Serra 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 centres (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).

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, Mühlhoff, and Römer 2012; Navalpotro, Pérez, and Quiroga 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; M. T. 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, favouring the construction of employment hubs and shopping and entertainment malls all over the region (Couch, Leontidou, and Petschel-Held 2007; European Environment Agency 2006; M. T. 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 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; Ministerio de Hacienda y Administraciones Públicas 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[5] (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.

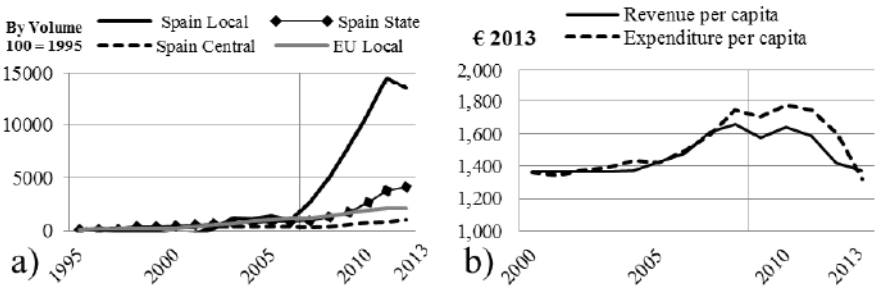


Fig. 1 Local Public Finances in Spain and the EU27. 1a: Cumulative difference between expenditures and revenues for the period 1995-2012 by level of Governance for Spain and EU27 (base year: 1995). 2b: Spanish average local

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

revenue and expenditure per capita in adjusted 2013 € 1998-2012. Source: (European Commission 2014a).

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, García Valiñas, and Suárez Pandiello 2006; G. 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 organisations, 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, Falcón y Tella, and Martínez Lago 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[6]. Regardless of the surcharges to metro areas and unused properties[7], they cannot offset the overall loses (Boletin Oficial del Estado 2004b; Boletin Oficial del Estado 2004a; 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

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

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

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 fuelling 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; M. T. 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, Leontidou, and Petschel-Held 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 under-pricing of infrastructures (Baum-Snow 2007; Brueckner 1997); absence of region-wide cooperation, territorial competitiveness, 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; R. 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, Saurí, and Serra 2008; Chorianopoulos et al. 2014; Couch, Leontidou, and Petschel-Held 2007; European Environment Agency 2010; European Environment Agency 2006). The work by (Couch, Leontidou, and Petschel-Held 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, Leontidou, and Petschel-Held 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, Leontidou, and Petschel-Held 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, Hortas-Rico, and Li 2014; Solé-Ollé and Viladecans-Marsal 2012). In this situation, household´s location preferences shifted towards segregated suburban communities (Díaz Orueta 2007; M. T. 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, Holl, and Viladecans-Marsal 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; M. T. 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 75kWh/year. In Spain this number peaked at 113 kwh/year, the highest by far in the EU27[8]. 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

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

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 labour, but from public intervention and to a certain extent from community actions and environmental quality (R. J. Arnott and Stiglitz 1979; Brandt 2014; Brueckner 2000; Fainstein 2012; Fernandez Milan, Kapfer, and Creutzig 2016; Mattauch et al. 2013; UN-HABITAT 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 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, Hortas-Rico, and Li 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[9] (European Commission 2014b; European Commission 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 behaviour of all real estate taxes and

[9] 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.

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 amout 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 urbanised 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[10]. 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 2004a; Boletin Oficial del Estado 1985; Velasco, Falcón y Tella, and Martínez Lago 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 (R. J. Arnott and Stiglitz 1979; Burge 2014; Fainstein 2012; Mattauch et al. 2013; UN-HABITAT 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"[11] 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, Leontidou, and Petschel-Held 2007; Gómez-Antonio, Hortas-Rico, and Li 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, Hortas-Rico, and Li 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 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 10000 people (INE 2015). The vast majority of the Spanish municipalities correspond to rural areas; with very low number of people and little urbanised location (Fig. 2). We therefore fix the population limit to 13000 to raise the average urban share of the sample from 10 to 20%[12] (see Fig. A.1).

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

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

[12] A Kernel density curve serves us to estimate the optimal population limit to increase the urban share in the sample. Municipalities with population between 10000 and

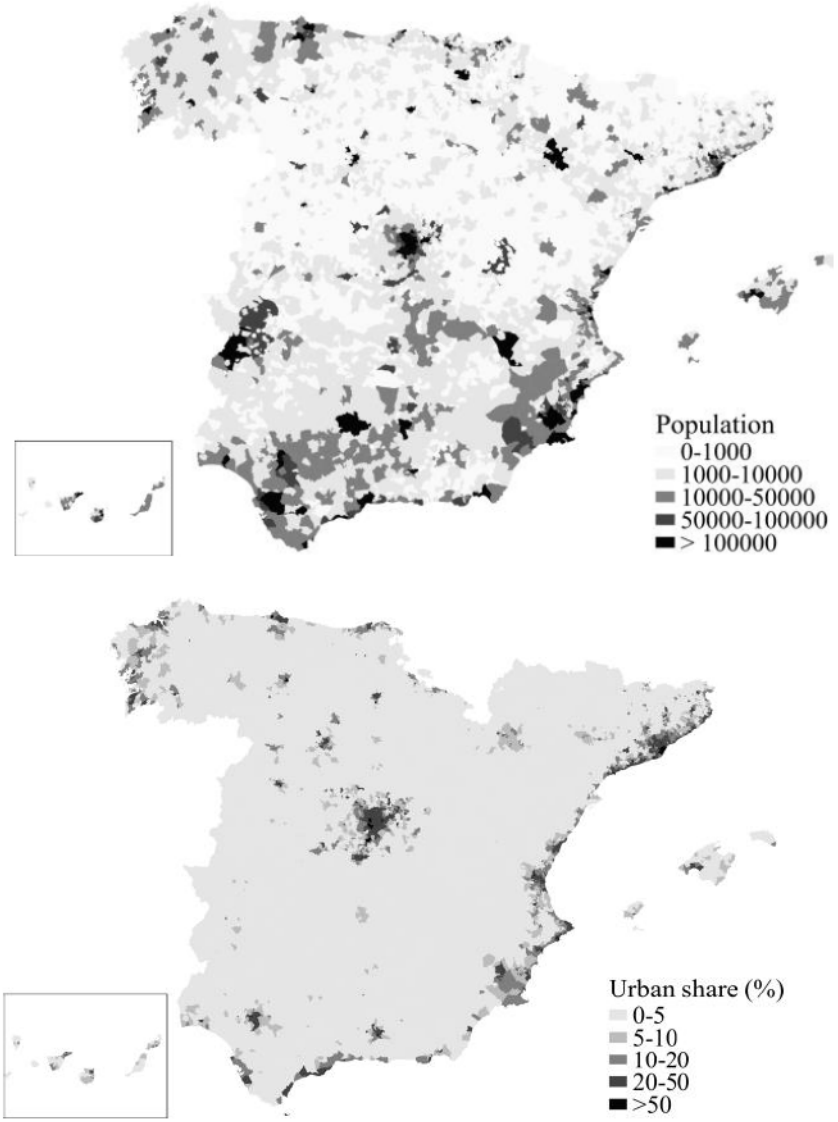


Fig. 2 Population and urban share of Spanish municipalities in 2013[13]

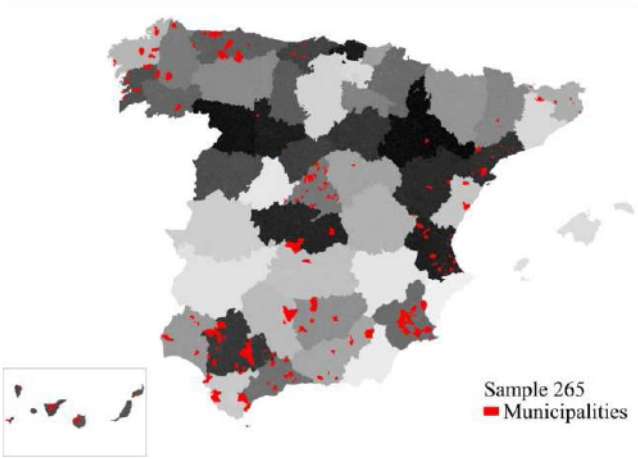
We also control for residential land share to exclude municipalities that did not base their development on residential sprawl. As there is no data on the location use surface of the municipalities, we take the share of total cadastral value corresponding to residential land share. The total sample shows a residential cadastral value share between 55 and 85 (see Fig. A.1), 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 centres – province capital municipalities- and

13000 have relatively low urban share and would therefore not be representative if they were to be included.

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

municipalities located within a ratio of 4.5[14] km as well as those municipalities that are no longer in the metropolitan areas of influence -45 km-[15]. Our statistical analysis is based on a sample of 265 municipalities, representing the 54% of the total Spanish population[16] and 63% of the province map[17] (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).



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.

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

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

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

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

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	n°	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 Intervent.	Tax induced distortion	Tax rate	%	0.6	0.2	1.2	0.2
		Exemptions	%	3.29	0	33.5	4.0
		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

4. Results

First, we analyse 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. A.2 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 towards recovery.

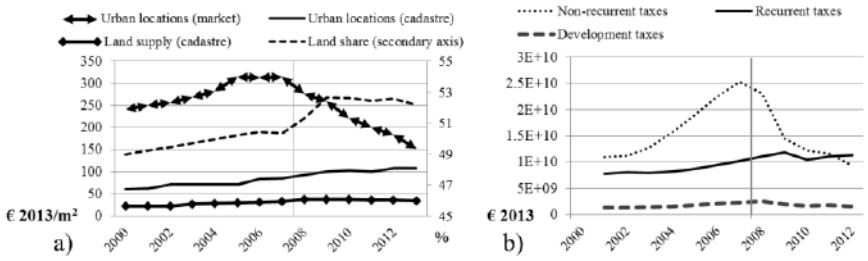


Fig. 4 a) Urban location values 2000-2013 (market and cadastral value) and land share (secondary axis); b) Revenue from fiscal instruments based on property in Spain, 2000-2013. Source: European Commission, 2014a, 2014b; Ministerio de Fomento, 2015; Ministerio de Hacienda y Administraciones Públicas,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

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 don't work, or not enough). Possibly municipalities learnt 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 subsidised. 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 A.1-. 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 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).

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	n°	-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**

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, Hortas-Rico, and Li 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 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[18] (Boletin Oficial del Estado 2004b; 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 and Mirrlees 2011; Raslanas, Zavadskas, and Kaklauskas 2010; UN-HABITAT 2011).

[18] Urban tax rate range: 0.4%-1.1%

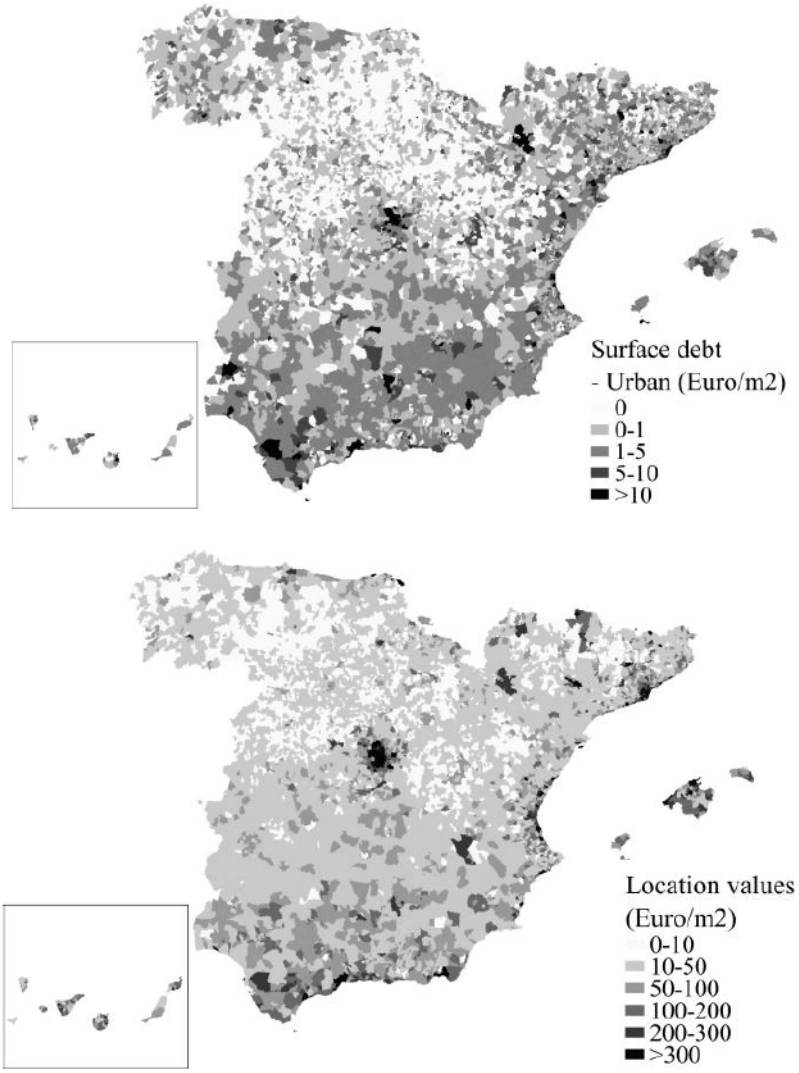


Fig. 5 Surface debt and location values are spatially joint. Source: (Ministerio de Hacienda y Administraciones Públicas 2014b).

The canonical variables from urban economics can hardly explain the difference that exists between Europe´s 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 towards 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 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.

Appendices

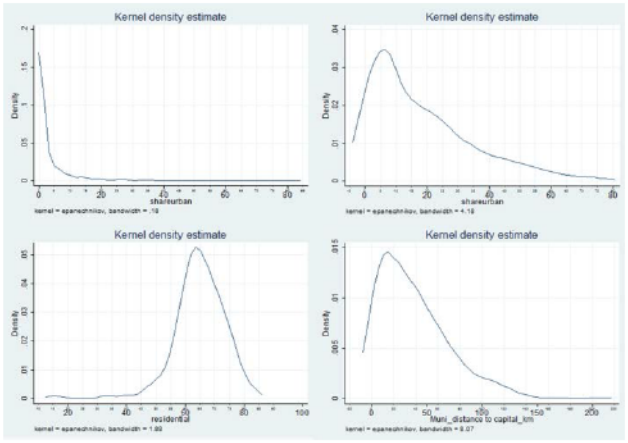


Fig. A1. Sample selection criteria for statistical analysis; a,b) Difference in the variable share urban for municipalities with a) below 13000 people and b) above 13000 people; c,d) density distribution of c) residential values and d) municipal distance to capital for the whole sample (7585 municipalities).

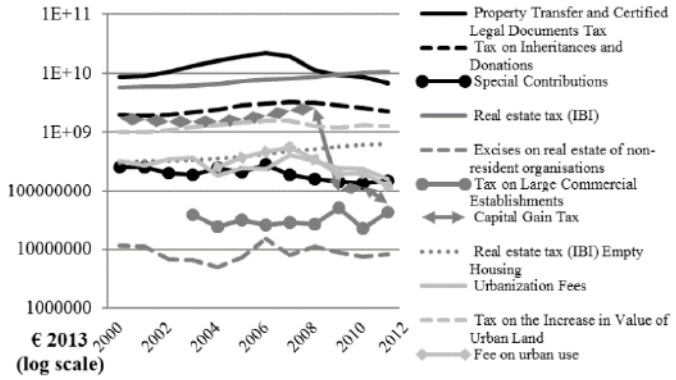


Fig. A.2. Disaggregated revenues from property taxes in Spain (2000-2013) Source (European Commission 2015; European Commission 2014b).

Table A.1. 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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