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Postal Address:
Institut d'Economia de Barcelona
Facultat d'Economia i Empresa
Universitat de Barcelona
C/ Tinent Coronel Valenzuela, 1-11
(08034) Barcelona, Spain
Tel.: + 34 93 403 46 46
Fax: + 34 93 403 98 32
ieb@ub.edu
http://www.ieb.ub.edu

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ABSTRACT: Several theoretical papers that examine tax competition with agglomeration effects have stressed the possibility that the governments of jurisdictions in which economic activity is concentrated may tax firms more heavily (taxable agglomeration rents). In this paper, we examine the tax rate setting decisions taken with regard to the Spanish municipal business tax (Impuesto sobre Actividades Económicas). The analysis, carried out with a sample of 2,772 municipalities, focuses on the effect that urbanization economies, localization economies and the market potential of municipalities have on their business tax rates. High urbanization economies and high localization economies are found to increase the business tax rate. Although the evidence is weaker, the results also indicate that municipalities with better access to demand (of consumers) set higher tax rates.

JEL Codes: H3, H7, R

Keywords: Local taxes, agglomeration economies, tax competition.

Jordi Jofre-Monseny
Universitat de Barcelona & IEB
Dpt. d'Economia Política i Hisenda Pública
Avda. Diagonal 690, Torre 4, Planta 2ª
08034 Barcelona (Spain)
E-mail: jordi.jofre@ub.edu

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1. Introduction

Agglomeration economies can make certain jurisdictions much better places to run businesses than others. To be able to locate in an area that hosts an agglomeration of firms, companies are willing to pay higher rents and wages. When business taxation is decentralized, a higher tax bill is another cost firms may incur in exchange for being in such a location. The objective of this paper is to analyze whether governments of jurisdictions that host agglomerations of firms set higher taxes on their businesses. To this end, we study the tax rate determinants of a local business tax in Spain, the *Impuesto sobre Actividades Económicas*.

Kind et al (2000), Ludema and Wooton (2000), Andersson and Forslid (2003) and Baldwin and Krugman (2004) were the first papers to introduce agglomeration effects in a tax competition model. All these papers use New Economic Geography (NEG) models, where firms exhibit increasing returns to scale and where transporting goods is costly. In order to save on transport costs, firms prefer to locate in the large market and export elsewhere. This agglomerative force is known in the literature as the market-access effect[1]. In these models, the market-access effect is stronger at intermediate trade costs[2]. Hence, it is at intermediate trade costs that these models produce a Core-Periphery outcome, where all firms locate in a single jurisdiction (the core). In a Core-Periphery outcome, the return of capital in the core is higher than at the periphery (should a firm move there), creating an agglomeration rent. The size of this agglomeration rent is determined by the strength of the market-access effect. Since this effect is stronger at intermediate trade costs, the agglomeration rent is hump-shaped with trade costs. In certain circumstances, the tax differential between the core and the periphery will follow the shape of the agglomeration rent and, therefore, agglomeration rents are said to be taxable (see Kind et al 2000; Ludema and Wooton, 2000; and Baldwin and Krugman, 2004)[3].

Ottaviano and van Ypersele (2005) study tax competition in a NEG model that does not create agglomeration rents[4], focusing on the case of ex-ante asymmetrical

[1] In most NEG models there is a second agglomerative force known as the cost-of-living effect. For the sake of simplicity we do not discuss this effect here (see Baldwin et al (2003)).

[2] If trade costs are too low, geography does not play a role. If trade costs are too high, trade becomes prohibitive.

[3] In this set-up, trade integration (a reduction in trade costs) triggers a 'race to the top' at relatively high transport costs and a 'race to the bottom' once trade costs are relatively low.

[4] That is, the model does not show catastrophic agglomeration. The model these authors use is known as the linear footloose capital model.

jurisdictions. In this model, the large jurisdiction in terms of consumers/population ends up hosting a more than proportionate share of capital, due to the market-access effect. These authors show that the jurisdiction with a higher market potential sets a higher capital tax rate[5]. This hypothesis is empirically tested in Charlot and Paty (2007). Their analysis, conducted using French municipal data, finds that municipalities with better access to demand set higher taxes on business activities, indicating that municipal French governments tax market potential. One concern when one aims to test predictions derived in a NEG model with municipal data is whether or not the market-access effect is a relevant agglomerative force at this spatial level. Fujita and Thisse (2002) point out that the market-access effect is probably responsible for the agglomeration of economic activities at a large geographical scale (e.g. "Manufacturing Belt" in the US or the "Blue Banana" in Europe)[6]. Charlot and Paty (2007) deal with this issue by specifying the market potential of a municipality to be its income plus a weighted sum of the income in the rest of French municipalities, assigning a higher weight to municipalities that are geographically closer.

There are, however, other agglomeration effects which can yield a better match between the geographical scope of agglomeration economies and the tax setting jurisdiction (in this case, the municipality). Knowledge spillovers, labor market pooling and input sharing are three agglomeration theories that are thought to explain agglomeration at the city level (see e.g. Ellison et al, 2010). Knowledge spillovers must operate at a very small geographical scale if they are to work via face-to-face contacts. It is less obvious that input sharing or labor market pooling agglomeration effects should be so localized. All these agglomeration theories predict a positive relationship between productivity (or a related measure like profits, wages or rents) and the size of the local economy (Rosenthal and Strange, 2004))[7]. Hence, regardless of the precise agglomeration theory(ies) at work, it is possible to empirically assess the geographical scope of agglomeration economies. Rosenthal and Strange (2003) use US firm birth data and regress zip code level firm births on (pre-determined) employment levels located at different concentric rings from the zip code. The estimated effects of pre-determined employment levels on firm births fall

[5] An equivalent result is found by Borck and Pflüger (2006) in a NEG model featuring partial agglomeration.

[6] In an empirical study of the effect of the market potential on the location of Japanese FDI across European regions, Head and Mayer (2004) partition France in 8 regions and Spain in 5.

[7] This partly explains the difficulty in distinguishing each of these three agglomeration theories empirically. Rosenthal and Strange (2001) and Ellison et al (2010) are the only studies that we know of that have tried to empirically quantify the importance of each of these agglomeration theories.

sharply after the first mile, suggesting that agglomeration economies have a very limited geographical scope. Van Soest et al (2006) found similar evidence for the Netherlands. For Spain, Viladecans-Marsal (2004) and Jofre-Monseny (2009) found that external effects operating between firms found in neighboring municipalities seem to be, at most, very small. A relevant feature of all these studies is that the regressions include fixed effects for some upper-tier aggregation of the geographical units of observation (e.g. metropolitan area fixed effects in Rosenthal and Strange (2003)). Notice that the metropolitan area fixed effects may be absorbing some of the agglomeration effects operating between the firms found in different zip codes within a metropolitan area. Nevertheless, the results found in these papers indicate that there are agglomeration effects that are geographically highly localized. This provides a rationale for using municipal data to study the effect of agglomeration economies on business tax rates.

In order to shed light on the nature of the relationship between agglomeration economies and local tax rates, we augment the tax competition game set up by DePater and Myers (1994) with agglomeration effects. Due to these agglomeration effects, the jurisdiction that hosts the agglomeration of firms is employing capital owned by non-residents. As a result, the government that hosts the agglomeration of firms taxes businesses more heavily, as a means of exporting taxes to non-resident capital owners.

As in most empirical studies, we distinguish between agglomeration effects taking place between firms within one industry (localization economies) and those taking place between firms in different industries (urbanization economies). We proxy urbanization economies with the employment level in a municipality. In some industries, localization economies are especially strong, providing incentives for firms in these industries to cluster in certain specific locations. We use the Ellison and Glaeser (1997) index to identify industries in which localization economies may be important. We use the term "cluster" to define the municipalities in which these geographically concentrated industries are found. The estimates measuring the effect that higher urbanization and localization economies have on the business tax will be biased if local (business) tax rates determine the location of economic activities. To circumvent this problem we use an instrumental variable approach. As instruments, we use urbanization and localization economies' variables measured in 1970, long before the decentralization of the local business tax in Spain in 1992.

We have argued that the market-access effect may not be the most important source of agglomeration at the municipal level. Nevertheless, when the consumption of a

good involves physical transportation, as is the case in certain services, some municipalities have access to a larger market of consumers than others. Hence, there may also be some rationale for testing whether municipalities with higher market potential set higher tax rates.

In this paper we examine the municipal tax rates set for the Spanish municipal business tax (*Impuesto sobre Actividades Económicas*). The analysis carried out with a (cross-section) sample of 2,772 municipalities in 2002 focuses on the effect that urbanization and localization economies have on this tax rate[8]. High urbanization economies and high localization economies are found to increase it; and although the evidence is weaker, the results also indicate that municipalities with better access to demand (of consumers) set higher tax rates.

After this introduction, in section 2 we augment the tax competition game set up by DePater and Myers (1994) with agglomeration economies. Section 3 presents the empirical analysis. We describe the data and variables in section 3.1. In section 3.2 we explain the econometric specification used. In Section 3.3 we report and discuss the results. Section 4 concludes.

2. Theoretical framework and testable hypothesis.

The model: There is one metropolitan area comprised of two jurisdictions ($i = 1, 2$). Each jurisdiction has an endowment of L_i units of urban land, each unit being the property of one resident landlord. There is a fixed amount of entrepreneurial capital in the metropolitan area ($\overline{K}$) which can be employed in any jurisdiction and is completely mobile, i.e. $\overline{K} = K_1 + K_2$. Each landlord in the metropolitan area owns an equal share of entrepreneurial capital, $\overline{k} = \overline{K} / (L_1 + L_2)$. Land and entrepreneurial capital are employed to produce a homogeneous private good X whose price is normalized to one and can be traded at zero cost. X is produced with the following constant returns to scale production function $A_i \cdot F(K_i, L_i)$, whose intensive form is $x_i = A_i \cdot f(k_i)$ and satisfies $f' > 0$ and $f'' < 0$[9]. A_i denotes the level of agglomeration economies of the jurisdiction and, given capital intensity constant across jurisdictions, it introduces local productivity differentials.

[8] Related papers are Devereux et al (2007), Brülhart et al (2007) and Jofre-Monseny and Solé-Ollé (2008) which empirically assess whether or not agglomeration economies reduce the sensitivity of firm location to local taxes. Carslen et al (2005) study whether (Norwegian) municipalities whose tax base is made up of relatively mobile industries set higher tax rates.

[9] Krogstrup (2008) analyzes the case where $f'>0$, which produces a Core-Periphery outcome.

The mobility of capital implies that its return (r_i) has to be equal across jurisdictions:

$$r_1 = r_2 \tag{1}$$

where $r_i = A_i \cdot f'(k_i)$ is the competitive return of entrepreneurial capital. In turn, the competitive rent for land is $R_i = A_i \cdot f(k_i) - A_i \cdot f'(k_i) \cdot k_i$. We assume throughout the paper that $A_1 > A_2$. Notice that $A_1 > A_2$ implies that $f'(k_1) < f'(k_2)$, so as to make (1) hold, implying that $k_1 > k_2$. Hence, the jurisdiction with higher agglomeration economies ends up with higher capital intensity. This is reminiscent of the 'home market effect' in NEG models.

Tax competition:. The government can use a source-based capital tax (t_i) to raise revenue (Z_i) and provide local public services, $z_i = Z_i / L_i$. Landlords' utility depends on the consumption of the private good and local public services according to the following well-behaved utility function, $U(x_i, z_i)$. Capital mobility ensures that the after-tax return of capital (ϱ) is equal across jurisdictions:

$$\varrho = r_1 - t_1 = r_2 - t_2 \tag{2}$$

The government can use a second tax instrument: a tax on land (t_i^L). Each landlord finances its private good consumption with the rent of its property, R_i, the net return of its capital assets, $\varrho\bar{k}$, minus the tax on land, t_i^L, i.e. $x_i = A_i f(k_i) - A_i f'(k_i)k_i + \varrho\bar{k} - t_i^L$. In turn, the government budget constraint becomes $z_i = t_i^L + t_i k_i$. The government's problem is to choose capital and land tax rates to maximize landlords' utility, $U(x_i, z_i)$. The tax rates at the Nash equilibrium satisfy:

$$\frac{dU_i}{dt_i^L} = -U_{ix} + U_{iz}\left(\frac{dx_i}{dk_i}\frac{dk_i}{dt_i^L} + \frac{dx_i}{d\varrho}\frac{d\varrho}{dt_i^L}\right) + U_{iz}\left(\frac{dz_i}{dk_i}\frac{dk_i}{dt_i^L} + \frac{dz_i}{d\varrho}\frac{d\varrho}{dt_i^L}\right) = 0, \forall i \tag{3}$$

$$\frac{dU_i}{dt_i} = -U_{ix}\left(-k_i + (\bar{k} - k_i)\frac{d\varrho}{dt_i}\right) + U_{iz}\left(k_i + t_i \cdot \frac{dk_i}{dt_i}\right) = 0, \forall i \tag{4}$$

Note that the land tax is non-distortionary since its supply is completely inelastic and it does not affect the location of capital or its return (i.e. $dk_i / dt_i^L = 0$ and $d\varrho / dt_i^L = 0$). Hence the third and fourth terms in (3) vanish. Thus, expression (3) implies $U_{ix} = U_{iz}$, indicating that local public services are optimally provided. Plugging $U_{ix} = U_{iz}$ in expression (4) yields:

$$\frac{d\varrho}{dt_i}\left(\bar{k}-k_i\right)+t_i\frac{dk_i}{dt_i}=0 \tag{5}$$

If the capital intensity is higher than the capital endowment, $(\bar{k}-k_i)<0$, the jurisdiction taxes capital $(t_i>0)$. Conversely, if the capital intensity is lower than the capital endowment, $(\bar{k}-k_i)>0$, the jurisdiction subsidizes capital $(t_i<0)$. The capital importing jurisdiction, $(\bar{k}-k_i)<0$, taxes capital because this lowers the net return of capital and, thus, reduces the value of its imports. Conversely, the tax exporting jurisdiction subsidizes capital because this increases the value of its exports. Hence, each jurisdiction has an incentive to alter the terms-of-trade in its favor. Notice that the capital importing jurisdiction exports part of the capital tax burden to the capital exporting jurisdiction, in the form of a lower return to capital, ϱ. The capital exporting jurisdiction also has the incentive to export taxes by decreasing the net return to capital. However, lowering the net return of capital only pays off if the jurisdiction is a net capital importer.

We have seen that the capital importing jurisdiction will set a higher tax rate than the capital exporting jurisdiction. This result, first obtained by DePater and Myers (1994), is well known in the literature. We now show that under tax competition, jurisdiction 1 (with high agglomeration economies) will import and tax capital whereas jurisdiction 2 (with low agglomeration economies) will export and subsidize capital. To see why this is the case, assume that jurisdiction 2 wants to become a capital importer. This is only possible if $(t_1-t_2)>0$ such that $k_2>k_1$ in equilibrium (if $t_1-t_2=0$ then jurisdiction 2 exports capital because $A_1>A_2$ implies $k_1>k_2$). However, being a capital importing jurisdiction implies taxing capital more than the capital exporting jurisdiction, as (5) shows, implying that $(t_2-t_1)>0$ which contradicts $(t_1-t_2)>0$. Hence, jurisdiction 2 cannot import capital. This leads to the main testable prediction of the paper, namely, that jurisdictions with high agglomeration economies set higher capital tax rates.

So far, agglomeration economies have been considered to be exogenously determined. One way to make agglomeration economies endogenous is to write A_i as a function of capital (the mobile factor) in the jurisdiction, i.e. $A_i=A(K_i)$[10]. In the annex, we study the case in which $A_i=A(K_i)=K^{\gamma}$, where γ is a positive constant. In this particular example, making agglomeration economies endogenous does not alter the empirical prediction of the model, namely, a positive statistical association between

[10] Notice that localization and urbanization economies are conceptually equivalent in this model since there is only one sector.

agglomeration economies and the capital tax rate. This result also arises in Burbidge and Cuff (2005) and Wrede (2009) who study tax competition in models with increasing returns to scale. Like Burbidge and Cuff (2005) and Wrede (2009), we consider agglomeration effects to be external to the firm level. This modeling strategy is most adequate if one assumes that knowledge spillovers are the agglomeration mechanism at work (Fujita and Thisse, 2002). However, this model can also be interpreted as a reduced form version of a fully-fledged model with micro foundations (Krogstrup, 2008).

3. Empirical analysis

3.1. Data and variables

Data: The empirical analysis is carried out with a cross-section of Spanish municipalities. The agglomeration economies' variables are constructed using data drawn from the Census of Establishments 2001 (*Censo de Locales del INE*). This database contains information on employment at the industry-municipality level. The agglomeration economies' variables, along with a number of control variables also measured in 2001, are used to explain differences in the local business tax rates across municipalities in 2002. In Table 1 we describe the variables. Some of the control variables are not available for the smallest municipalities (those with a population below 1 thousand inhabitants). Nevertheless, we are able to gather a sample of 2,772 municipalities. All municipalities from the Basque Country and Navarra are excluded because, for historical reasons, these two regions have their own tax regimes. Our sample of 2,772 municipalities contains 95% of the Spanish population that do not reside in the Basque County or in Navarra.

[Insert Table 1 here]

Local taxes: The size of Spanish municipal governments is moderate, with municipal budgets representing 15% of total public spending. Inter-governmental grants represent a third of local budgets, local taxes represent another third, and the rest is made up by user charges. The business sector is charged a number of municipal taxes and fees. This list includes a local business tax, a property tax, a tax on vehicles, a tax on building activities, and a tax on the sale of land and buildings. Although the property tax (*Impuesto sobre la propiedad inmueble*) comes first in terms of tax revenue, the local business tax (*Impuesto sobre*

Actividades Económicas) is the main local tax burden borne by the business sector (see Jofre-Monseny and Solé-Ollé, 2009)[11].

The tax base of the local business tax is determined by national tax laws according to input usages (surface area, electricity usage, number of workers) and the economic sector of the firm. In principle, the tax base of each firm represents a proportion of its profits. This tax base is then multiplied by a municipal-specific augmentative coefficient, τ_i, which applies to all establishments in each municipality regardless of economic sector. We refer to this municipal coefficient as the municipal business tax rate although, strictly speaking, it is not a 'rate'. Note that two identical firms located in different municipalities pay a different share of their profits. In 2002, the tax revenue raised by the local business was 5 percent of the corporate income tax revenue. Since the effective tax rate of the corporate tax was around 24% in those years the local business tax revenue represented about 1.2% of the firms' profits. This figure, however, underestimates the quantitative importance of the tax in the preceding years: in 1999, the local business tax revenue represented about 2.4% of the firms' profits and the figure had been as high as 3.4% in 1995. The reason is that the corporate tax revenue grew substantially during the economic expansion between 1995 and 2002, whereas the local business tax revenue remained relatively stable. This is due to the fact that the local business tax is a presumption tax, with a tax base computed from simple indicators of economic activity, meaning that this tax is less volatile than corporate tax.

Municipal governments are given considerable tax autonomy in setting the municipal augmentative coefficients, which can vary from 0.8 to 1.9. However, the range within which municipalities can set their tax rate varies with population size. The maximum tax rate increases from 1.4 (<5,000 inhabitants) to 1.6 (5,001-20,000 inhabitants), to 1.7 (20,001-50,000 inhabitants), to 1.8 (50,001-100,000 inhabitants) and to 1.9 (>100,000 inhabitants). The minimum tax rate is 0.8 for all municipalities. In Figure 1 we plot the local business tax rate against population for all municipalities whose population exceeded 1,000 inhabitants in 1999.

[Insert Figure 1 here]

[11] The effect of the Spanish local business tax on the location of economic activity is addressed in Solé-Ollé and Viladecans-Marsal (2003) and Jofre-Monseny and Solé-Ollé (2009) and Jofre-Monseny and Solé-Ollé (2008).

Note that the variation in statutory tax rates is considerable. Note also that the number of municipalities that set a tax rate equal to the maximum permitted by law is far from negligible (20%). For most municipalities with binding maximum tax rates, the decision to change tax rates is obviously a constrained one. Hence, maximum tax rates are very likely to influence tax rate choices. For non-binding municipalities, maximum tax rates can partly determine tax setting behavior as well. For instance, municipal governments may be reluctant to choose the maximum tax rate level, or one that is too close to it, since this leaves them with no room for maneuver in the case of future budget difficulties. Therefore, differences in maximum tax rates need to be considered as a determinant of the tax rate.

Agglomeration economies: Urbanization economies refer to agglomeration effects operating between firms outside the industry. They can be understood as the advantages that firms obtain from city size and are generally measured by the total amount of economic activity (firms or employees) in a given locale (Rosenthal and Strange, 2004). Hence, our measure of agglomeration economies is simply the employment level of municipality *i*, $urbanization_i = \ln(employment_i)$.

In some industries, agglomeration economies are especially strong between firms within the industry (localization economies). As a result, firms in these industries tend to locate in a few locales creating highly specialized economic environments or clusters. We first identify the industries in which localization economies are particularly strong by computing a variant of the Ellison and Glaser (1997) index. This index measures the geographical concentration of an industry 'controlling' for: 1) the geographical distribution of the overall economic activity and 2) the fact that employment in one industry may be concentrated in a few plants. Here we use not the original index but a variant developed by Guimarães et al. (2007) which can be computed with data on plant-counts by industry and municipality. These authors show that the plant-count data and the original version of the index yield the same expected value. Besides, the variance of the index is smaller using the plant-count data version. We compute this estimator using data from all continental Spanish municipalities for the year 2002[12]. Notice that measuring industry concentration at the municipal level is important in order to identify the industries in which the geographical scope of their agglomeration effects matches Spanish municipalities. We consider that localization economies are relevant within an industry if the estimated Ellison-Glaeser

[12] We use Social Security Register data since the Census of Establishments 2001 contains employment but not plant counts at the industry-municipality level.

index is above 0.02 in that industry[13]. This yields six (2 digit) industries: *Manufacture of textiles* (CNAE 17), *manufacture of leather and leather products* (CNAE 19), *publishing, printing and reproduction of recorded media* (CNAE 22), *manufacture of other non-metallic mineral products* (CNAE 26)[14], *manufacture of motor vehicles, trailers and semi-trailers* (CNAE 34) and *manufacture of other transport equipment* (CNAE 35). This set of industries conforms to the a priori expectations with respect to the industries that create specialized economic environments in Spain[15].

As we mentioned above, this set of industries in which intra-industry agglomeration economies are especially strong is concentrated in a small number of locations. In order to identify the municipalities that host these industries, we define the variable cluster. We consider that there is a cluster in municipality *i* if it hosts a minimum share of the nation-wide industry employment in any of the geographically concentrated industries defined above. In our baseline regressions, we specify this minimum share to be 1%. In Table 2, we report the number and size of clusters that result from specifying different minimum shares (0.1%, 0.5%, 1% and 5%)[16].

[Insert table 2 here]

As regards the measurement of the market potential of a municipality, one could take its total income (population times the average income in the municipality). A positive statistical effect of this variable on the business tax rate would be consistent with the view that governments with better market-access set higher tax rates. However, income may be a determinant of the demand of local public services (and the business tax rate, as a consequence) if higher income is associated with a higher (or lower) preference for spending. Similarly, population can also determine spending (and the business tax rate, as a consequence) if there are economies of scale in providing local public services. Hence, our view is that it is problematic to identify the market potential effect using the income and population levels of the municipality. Note, however, that people can move across nearby jurisdictions to consume certain services. Hence, a municipality surrounded by populous and wealthy municipalities may have a better market potential than another municipality

[13] An industry whose Ellison-Glaeser index is below 0.02 can be considered as showing little or no geographical concentration (Ellison and Glaeser, 1997).
[14] This industry includes the ceramics, glass and stone industries.
[15] We do not consider activities whose geographical concentration is obviously reflecting an uneven distribution of natural resources such as mining activities. Nor do we consider some geographically concentrated services such as the financial services. The reason is that these services are disproportionately located in a few very large cities, making the separate identification of localization and urbanization economies empirically difficult.
[16] In the results section we provide results for these different minimum shares.

surrounded by poor and small municipalities. Hence, we propose the following market potential measure:

$$market\ \ potential_i = \ln(\sum_l w_{il} \cdot population_l \cdot income_l) \quad (8)$$

where w_{il} is a dummy variable that takes the value of one if municipalities i and l belong to the same local labor market (and $i \neq l$)[17]. Hence, the measure we use for market potential exploits the location of each municipality but does not make use of its own market potential[18].

Control variables: In the stylized model of section 2, the business tax rate only depends on the agglomeration economies of the jurisdiction. The existence of a lump sum tax (the tax on land) ensures that the local public services are optimally provided (recall $U_{ix} = U_{ig}$). Hence, any variable determining the optimal level of local public services provision affects the tax rate on land but not the tax rate on capital. Note, however, that this is a very stylized model. Therefore, in the empirical analysis we include a comprehensive set of control variables to capture potential differences in the desired level of local public services and the tax rate, as a consequence.

Income changes the intensity with which citizens value local public services. For this reason, we include a proxy for the average income level of a municipality. As we have already pointed out, higher income can also reflect a higher (or lower) preference for public goods. We include a dummy variable that reflects whether the mayor belongs to a left-wing party, given that left-wing governments generally tax (spend) more[19]. We also include variables that capture special expenditure needs such as the share of population below 14 years old, the share of population above 65 years old, the share of unemployed and the share of immigrants. We also include the share of population that live in disseminated nuclei of population, as this has been recognized as a relevant cost factor in the Spanish case (Solé-Ollé and Hortas-Rico, 2010). Population size has also been found to be an important determinant of the cost of providing local public services. We introduce 5 dummy variables reflecting different groups of municipalities in terms of size which correspond to the size intervals defined by the Spanish tax law in relation to maximum tax rates. We do so for three reasons: 1) Spanish tax law also determines different expenditure

[17] The local labor markets that we use have been computed by Boix and Galletto (2009). Rafel Boix kindly provided us with these data.

[18] Note, however, that in the regressions we will control for differences in income and population across municipalities.

[19] The political determinants of municipal tax rates in Spain are analyzed in Solé-Ollé (2003).

responsibilities according to these size intervals. 2) Solé-Ollé and Bosch (2005) have found that the relationship between the cost of providing public services and population size is u-shaped, and therefore, a flexible functional form may be preferable. 3) By including this set of dummy variables we control for the direct effect of maximum tax rates on tax rate setting behavior. In all regressions, we also include provincial dummies (European NUTS 3 classification) to control for differences across regions in factors such as ideology or remoteness.

The level of current grants received by the municipality can also change the intensity with which citizens value local public services and, hence, determine tax rates. In Spain, current grants to municipalities are formula-based and are (virtually) fully distributed on a population basis. The formula establishes different per capita amounts for different population size intervals. These coincide with the population size intervals defined by the Spanish tax law in relation to maximum tax rates. Hence, the effect of current grants on tax rates is absorbed by the population size dummies.

3.2. Econometric specification

We explained in Section 3.1 that municipal tax rates have legal limits that vary with population discretely. This implies that the tax rate setting decision has a constraint and, as we have seen, this constraint is binding for approximately 20% of our sample. We will use the Tobit model to deal with the fact that optimal and observed tax rates may differ for 20% of our municipalities. In this application, different municipalities have different maximum tax rates. According to Cameron and Trivedi (2005), in a linear model with additive error term, this can be dealt with using the following simple normalization. We re-define our dependent variable to be $\tau_i - \tau_i^{MAX}$ (a negative variable constrained at zero for all municipalities) and estimate a standard Tobit model introducing a set of dummies (one for each group of municipalities facing the same maximum tax rate).

3.3. Results

Tobit results: In Table 3 we report the baseline Tobit results. We start with a relatively parsimonious specification in which the local business tax rate is regressed on the agglomeration economies' variables and provincial and population size interval dummies. The results are shown in the first column.

[Insert Table 3 here]

Municipalities with higher employment (higher urbanization economies) are more likely to set higher tax rates. In particular, the results imply that a 10 per cent increase in the employment level of municipality *i* increases its tax rate by 1.3 standard deviations. Municipalities that host a cluster also set higher tax rates. Hosting a cluster is associated with a 1.34 standard deviation increase in the local business tax rate, ceteris paribus. Hence, these results are consistent with the hypothesis that urbanization and localization economies are taxable. Municipalities with relatively wealthy and populous neighboring municipalities (higher market potential) are also found to set higher tax rates, suggesting that municipalities with better access to demand set higher local business tax rates. However, this effect is economically very small. A 10 per cent increase in the market potential of a municipality only increases the local business tax rate in 0.12 standard deviations. Notice that the market potential variable is based on the population (and their income) found in neighboring municipalities. Hence, the comparison of this effect with those of the urbanization and cluster variables should be performed with caution.

In the second column of Table 3, we perform the same exercise but include the rest of control variables (income, left-wing government, share of population aged 0-14, share of population aged 65 or more, share of unemployed, share of immigrants and the share of disseminated population). The inclusion of these controls leaves the estimates of the agglomeration economies' variables virtually unchanged. Left-wing governments set higher tax rates, either because if elected, they implement high tax (spending) policies or because in municipalities in which voters prefer high tax (spending) policies, left-wing governments are elected. A higher unemployment rate is associated with a higher local business tax rate. The rest of control variables (income, share of population aged 0-14, share of population over 65, share of immigrants and the share of disseminated population) do not seem to be relevant determinants of the business tax rate choice.

For the sake of completeness, we report OLS results for the specification that includes all the control variables in the third column of Table 3. In this particular analysis, the Tobit and OLS results are remarkably similar.

Instruments: There is evidence that local tax differentials can determine the location of economic activities[20]. The effect of the Spanish local business tax on the location of economic activity is analyzed in Solé-Ollé and Viladecans-Marsal (2003), Jofre-

[20] Among the papers that show the effect of tax differentials on the location of economic activities Hines (1996) may be the most convincing one.

Monseny and Solé-Ollé (2009) and Jofre-Monseny and Solé-Ollé (2008). The results indicate that high local taxes deter local economic activities, implying that Tobit (OLS) estimates of the agglomeration economies' measures on the local business tax rate may suffer from a simultaneity bias. We propose to instrument the agglomeration economies' variables in 2001 with industry-municipality employment data from the 1970 Census of Establishments (*Censo de Locales del INE, 1970)*[21]. This approach is particularly appealing in this application because we can measure the agglomeration economies' variables prior to the decentralization of local business taxation in Spain. The local business tax that we analyze (*Impuesto sobre Actividades Económicas*) replaced an earlier local tax on business activities (*Licencias fiscales de actividades comerciales e industriales y de actividades profesionales y de artistas*). This reform was passed in 1988 although it was not fully implemented until 1992. The reform increased the importance of local business taxation in terms of local tax revenue which increased in real terms by 25% from 1991 to 1992. More importantly, the reform introduced tax power for the municipalities which could, within the described limits, set their own tax rate.

We instrument the employment level in 2001, our measure of urbanization economies, with its lagged value in 1970. The binary variable cluster in 2001 is instrumented with the 1970 employment levels in the six industries considered to form clusters (see Table 2). There are two assumptions that the urbanization and localization economies' variables in 1970 must satisfy in order to be appropriate instruments. First, they must determine the urbanization and cluster variables in 2001 (the instruments are relevant). This assumption can be based on the observation that agglomeration economies drive new firms to locations with many (old) firms (see e.g. Rosenthal and Strange, 2003)[22]. This is, however, a testable hypothesis, and we test it below. Second, the instruments must be valid. The maintained assumption is that no unobserved tax rate determinant determines the urbanization and localization economies' variables in 1970. We deem this assumption plausible given that we measure the agglomeration economies' variables long before municipalities could set different tax rates.

[21] Instrumenting the variable of interest with its lagged value measured far apart in time is not new in the economics literature (see e.g. Ciccone and Hall, 1996)).

[22] Dumais et al (2002) find that new firms tend to locate in areas with more employment/firms. However, they find that a 1% increase in employment leads to less than a 1% subsequent increase in new firm creation, contributing to generate a certain mobility in the geographical location of industries.

Instrumental variables (Tobit) results: In Table 4 we re-estimate the specifications reported in table 3, instrumenting the urbanization and cluster variables in 2001. In the first column, we report the results of a regression of the business tax rate on the agglomeration economies' variables and provincial and population size interval dummies, using the Smith and Blundell (1986) Two Step Tobit estimator.

[Insert Table 4 here]

The results obtained from this specification are qualitatively similar to those obtained when we did not instrument (first column in Table 3), i.e. municipalities with a high employment level and municipalities that host a cluster set higher local business tax rates. However, the estimated effects are larger. A 5% increase in the employment level of a municipality increases its business tax rate by 1.12 standard deviations (almost twice the effect obtained when we did not instrument). Likewise, the results imply that a municipality that hosts a cluster sets a business tax rate that is 0.7 standard deviations higher (almost three times the effect obtained when we did not instrument). These results are consistent with the view that high tax rates generate losses of economic activity. In the second column in Table 4, we introduce the rest of control variables (income, left-wing government, share of population aged 0-14, share of population aged 65 years old or more, share of unemployed, share of immigrants and the share of disseminated population). The results with and without these control variables are very similar, as was the case with the Tobit model estimates (see Table 3). In the third column, we report the results that we obtain using the Two-Stage Least Squares estimator instead of the Two-Step Tobit estimator. The results closely resemble those in column 2, indicating that the use of a particular estimation technique (Two-Step Tobit vs. 2SLS) makes no difference in this case.

As we mentioned above, the instruments we construct from industry-municipality employment data in 1970 should determine the urbanization and cluster variables in 2001. This is a testable hypothesis. The F-test and the partial R-Squared, two first stage statistics, are 103 and 0.30 for the urbanization equation and 15 and 0.32 for the cluster equation, suggesting that the instruments used are relevant. Notice, however, that these statistics can not formally test the hypothesis that the model is identified, since there is more than one variable to instrument. We, therefore, complement these statistics with the Kleibergen-Paap rk LM statistic which rejects the null hypothesis that the model is not identified[23].

[23] This statistic was produced by the Stata unofficial command ivreg2.

Robustness checks: As a first robustness check, we explore the extent to which the results we obtain are robust to the definition of the cluster variable. In the above analysis, we considered that a municipality hosts a cluster if its employment level in any of the industries defined in table 2 exceeds 1% of the nation-wide employment in the industry. In table 5 we report the results obtained when clusters are defined as municipalities hosting a minimum of 0.1, 0.5, 1 and 5% of the nation-wide industry employment. The numbers of clusters in each industry for each of these alternative thresholds are shown in Table 2. Notice that the results reported in the second column in table 4 (the baseline Two-step Tobit estimates) are identical to those in the third column in Table 5. These are maintained to aid comparability.

[Insert Table 5 here]

As expected, the results of these different specifications are very similar, except for the estimate of the cluster variable. Using the 0.1% threshold, the cluster variable estimate is smaller in size (0.094) and not significantly different from zero. For the rest of the threshold values (0.5%, 1% and 5%) the point estimate changes little (0.225, 0.176 and 0.199) although the latter estimate is not statistically different from zero at the 5% significance level. Overall, the results seem robust to the definition of the cluster variable, once the specified threshold (the minimum share of the nation-wide employment) is above a critical value (in this case 0.1%).

The relevant localization and urbanization economies of jurisdiction *i* may not be restricted to the level and characteristics of employment in municipality *i*. That is, firms in municipality *i* can also benefit from the presence of firms found in neighboring municipalities. After all, like consumers, employers/employees can also move across nearby municipalities. As we have mentioned, some papers have found that the geographical scope of agglomeration economies is highly localized. For Spain, Viladecans-Marsal (2004) and Jofre-Monseny (2009) find little evidence that agglomeration effects spill over municipal boundaries. In the light of these results, the effect of the spatial lag of the urbanization and cluster variables on the business tax rate should be positive (yet very small) or zero. However, a negative effect of the spatial lag of the urbanization and cluster variables on the business tax rate is also conceivable: this would be the case if municipalities that are geographically closer compete more intensely for firms[24]. In this case, the agglomeration

[24] This hypothesis has found some empirical support for the Spanish case in Jofre-Monseny and Solé-Ollé (2009).

economies of one municipality could be undermined by higher agglomeration economies in neighboring jurisdictions.

In order to construct spatial lags of the urbanization and cluster variables, we consider that two municipalities are neighbors if they belong to the same local labor market, as we did when we defined the market potential variable. The variable measuring the urbanization economies of the neighboring municipalities is the log of the number of employees found in the rest of municipalities within the local labor market. Likewise, the cluster variable of neighbors takes the value of one if another municipality within the local labor market hosts a cluster. The results of this exercise are reported in Table 6.

[Insert Table 6 here]

The first column in Table 6 reports the (Tobit) estimates of a specification in which the business tax rate is regressed on the agglomeration economies' variables (including their spatial lags) and provincial and population size interval dummies. In the second column, the rest of control variables (income, left government, share of population aged 0-14, share of population over 65, share of unemployed, share of immigrants and the share of disseminated population) is also included. Finally, we re-estimate this specification using the Smith and Blundell (1986) Two-Step Tobit estimator, where the urbanization and cluster variables and their spatial lags are instrumented. The results of this last specification, reported in the third column, indicate that municipalities whose neighbors host higher levels of employment do not set higher tax rates. In contrast, a municipality located in a local labor market in which another municipality hosts a cluster sets a tax rate that is 0.24 standard deviations higher, ceteris paribus. Notice, however, that the presence of a cluster nearby generates an increase in the tax rate that is fairly small in comparison to the effect of hosting a cluster within the municipal boundaries (the effect is three times smaller). These results seem consistent with the findings of Rosenthal and Strange (2003), van Soest et al (2006), Viladecans-Marsal (2004) and Jofre-Monseny (2009) who found agglomeration economies to be highly localized. Notice that the market potential variable that we use is, in fact, total income in neighboring municipalities. The results of this exercise suggest that the small effect that we find for the market potential variable on the tax rate could be the result of the particular way in which we measure market potential.

In our view, the fact that we measure agglomeration economies more than two decades before municipalities were able set different tax rates makes the validity of our instruments plausible. However, municipalities with high urbanization and localization

economies might have higher expenditure needs, generating a spurious correlation between agglomeration economies' variables and tax rates. Notice, though, that the inclusion of variables proxying for expenditure needs such as income, the share of unemployed or the share of immigrants does not alter the estimated effects of the agglomeration economies' variables on the tax rate, suggesting that our results are not completely driven by the omission of unobserved expenditure needs. To address this concern further, we make use of the fact that the local business tax is not the only municipal tax in Spain. If the correlation between high tax rates and agglomeration economies were driven by unobserved expenditure needs, we would not expect this correlation to be specific to the local business tax. As a robustness exercise, we re-define the dependent variable to be a measure of the local property tax burden. Unlike the local business tax, the property tax is paid by both home and establishments owners and, therefore, seems less suitable as an instrument for taxing agglomeration economies. The local property tax bill is determined by the nominal tax rate times the assessed value of the property. The nominal tax rate is not very informative because re-assessments are infrequent and are not carried out simultaneously across municipalities[25]. We, therefore, measure the local property tax burden as the average property tax bill in the municipality (Tax revenue/Number of bills). We report the results of this exercise in table 7.

[Insert Table 7 here]

The first column in Table 7 reports Tobit estimates of a specification in which the average property tax bill is regressed on the agglomeration economies' variables and provincial and population size interval dummies. In the second column, we introduce the rest of control variables (income, left-wing government, share of population aged 0-14, share of population over 65, share of unemployed, share of immigrants and the share of disseminated population). Finally, we re-estimate this specification using the Two-Step Tobit estimator, where the urbanization and cluster variables are instrumented. Notice that the dependent variable is measured in € per capita and therefore the estimates cannot be directly compared to the results reported in the previous tables. In the most parsimonious specification, the results indicate that municipalities with higher urbanization economies and a higher market potential set higher local business tax rates. These effects, however, vanish almost completely in the specification that includes all the control variables (second column). When, additionally, we instrument the agglomeration economies' variables (third

[25] In 2002, 65% of municipalities in Spain had not re-assessed their property for the last 12 years.

column), the estimates of interest are even smaller and none of them is statistically different from zero. The last specification (fourth column) additionally includes a third order polynomial of the number of years since the last property re-assessment took place in the municipality. The results remain largely unchanged. Overall, the results reported in table 7 are reassuring, given that the agglomeration economies' variables are not found to determine the property tax burden. Notice too, that there are substantial differences with respect to the variables that determine the business and property tax rate choices. While the political color of the government and the agglomeration economies' variables are key determinants of the local business tax rate, the property tax rate seems to be determined by variables that affect the demand and the cost of providing public services such as the level of income, the share of elders, and the share of immigrants in the municipality.

4. Summary and conclusions

The aim of this paper is to empirically test whether the jurisdictions that host an agglomeration of firms tax their businesses more heavily, using municipal data from Spain. In order to shed light on the nature of the relationship between agglomeration economies and local business tax rates, we augment the DePater and Myers (1994) tax competition game with agglomeration economies. In the presence of agglomeration effects, capital locates disproportionally in the jurisdiction with higher agglomeration economies. Hence, the government with high agglomeration economies taxes businesses more heavily in order to export taxes to non-resident capital owners. We examine the municipal tax rates set in the Spanish municipal business tax (*Impuesto sobre Actividades Económicas*) with a (cross-section) sample of 2,772 municipalities in the year 2002. The main findings of the paper can be summarized as follows. Municipalities with high urbanization economies set higher tax rates. Municipalities that host a cluster of firms in an industry in which localization economies are important also set higher tax rates. We use an instrumental variables approach to address the fact that tax rates may determine the location of economic activities. As instruments, we use agglomeration economies' variables measured in 1970, long before the decentralization of local business taxation in Spain in 1992. Although the evidence is much weaker, we also find that municipalities with a higher market potential set higher business tax rates.

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Table 1. Descriptive statistics for municipalities (# observations is 2,772).

	Mean	St. dev	Max	Min	Source
Taxes					
Bussiness tax "rate"	1.223	0.245	1.9	0.8	*a*
Negative dist. to the max. tax "rate"	-0.272	0.228	0.0	-0.9	*a*
Average property tax bill	121	99	2279	11	*a*
Agglomeration economies					
No. of employees (employees)	5,104	30,321	1,287,388	125	*b*
Cluster (1%)	0.019		1	0	*b*
Market potential neighbors (×10³€)	2,379	7,819	42,000	0	*c*
Controls					
Left Government	0.50		1	0	*d*
Income	4.28	1.98	8	1	*e*
Population 0-14 (in %)	13.38	3.80	24.29	0.10	*c*
Population >65 (in %)	20.03	8.36	48.12	0.02	*c*
Unemployment rate (in %)	3.92	1.89	14.10	0.40	*e*
Share immigrants (in %)	3.73	5.13	55.70	0.00	*c*
Disseminated pop. (in %)	6.43	13.35	100.00	0.00	*c*

Notes: *a* denotes Spanish Ministry of Finance, *b* National Institute of Statistics (Census of establishments 2001), *c* Population and Housing Census 2001, *d* Spanish Ministry of Domestic affairs and *e Anuario Economico de España* Yearbooks.

Table 2. Descriptive statistics for industry clusters. Number of clusters and minimum and maximum employment levels defining cluster as a municipality that hosts a minimum share of the industry employment.

Industry employment threshold	0,1%	0,5%	1%	5%
Industries	# clusters (Min/Max)	# clusters (Min/Max)	# clusters (Min/Max)	# clusters (Min/Max)
Manufacture of Textiles (CNAE 17)	153 (87/5,526)	30 (432/5,526)	11 (874/5,526)	4 (4,511/5,526)
Manufacture of leather and leather products (CNAE 19)	88 (100/27,805)	27 (545/27,805)	15 (1,029/27,805)	3 (6,559/27,805)
Publishing, printing and reproduction of recorded media (CNAE 22)	139 (198/27,292)	33 (989/27,292)	11 (2,065/27,292)	2 (19,602/27,292)
Manufacture of other non-metallic mineral products (CNAE 26)	181 (158/8,789)	21 (816/8789)	9 (1,636/8,789)	1 (8,789/8,789)
Manufacture of motor vehicles, trailers and semi-trailers (CNAE 34)	162 (228/11,759)	30 (1128/11,759)	10 (2,630/11,759)	1 (11,759/11,759)
Manufacture of other transport equipment (CNAE 35)	130 (61/4,026)	35 (323/4,026)	19 (621/4,026)	2 (3,061/4,026)

Table 3. Baseline results: The determinants of the business tax rate.

	Tobit		OLS
Agglomeration economies			
Urbanization economies	0.033***	0.031**	0.030***
	(0.011)	(0.012)	(0.010)
Cluster	0.062**	0.063**	0.059**
	(0.031)	(0.031)	(0.028)
Market potential (neighbors)	0.003**	0.002*	0.002*
	(0.001)	(0.001)	(0.001)
Controls			
Left Government		0.043***	0.033***
		(0.011)	(0.009)
Income		0.007	0.005
		(0.005)	(0.004)
Population 0-14 (in %)		-0.001	-0.001
		(0.002)	(0.001)
Population >65 (in %)		0.001	0.001
		(0.001)	(0.001)
Unemployment rate (in %)		0.008**	0.007**
		(0.004)	(0.003)
Share immigrants (in %)		0.002	0.001
		(0.001)	(0.001)
Disseminated population (in %)		0.000	0.000
		(0.001)	(0.000)
Dummies for population size intervals	Yes	Yes	Yes
Provincial dummies (NUTS 3)	Yes	Yes	Yes
# observations	2,772	2,772	2,772

Notes: Robust standard errors in parenthesis; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 4. Instrumental Variables estimates: The determinants of the business tax rate.

	Two-Step Tobit		2SLS
Agglomeration economies			
Urbanization economies	0.055**	0.055**	0.051***
	(0.023)	(0.023)	(0.017)
Cluster	0.183**	0.176**	0.154***
	(0.072)	(0.073)	(0.055)
Market potential (neighbors)	0.003**	0.003*	0.002*
	(0.001)	(0.001)	(0.001)
Controls			
Left Government		0.043***	0.033***
		(0.012)	(0.009)
Income		0.007	0.004
		(0.006)	(0.004)
Population 0-14 (in %)		-0.001	-0.001
		(0.002)	(0.001)
Population >65 (in %)		0.002	0.002*
		(0.001)	(0.001)
Unemployment rate (in %)		0.008**	0.007**
		(0.004)	(0.003)
Share immigrants (in %)		0.002	0.002*
		(0.001)	(0.001)
Disseminated population (in %)		0.000	0.000
		(0.001)	(0.000)
Dummies for population size intervals	Yes	Yes	Yes
Provincial dummies (NUTS 3)	Yes	Yes	Yes
First Stage Results			
Kleibergen-Paap rk LM stat.			265[0.00]
# observations	2,731	2,731	2,731

Notes: Robust standard errors in parenthesis; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level. P-values within brackets.

Table 5. Robustness checks I. The determinants of the business tax rate. Defining cluster at different thresholds of the industry employment

	Two-Step Tobit			
	0.1%	0.5%	1%	5%
Agglomeration economies				
Urbanization economies	0.052**	0.049**	0.055**	0.059***
	(0.026)	(0.023)	(0.023)	(0.023)
Cluster	0.094	0.225**	0.176**	0.199*
	(0.101)	(0.089)	(0.073)	(0.106)
Market potential (neighbors)	0.003*	0.003*	0.003*	0.003*
	(0.001)	(0.001)	(0.001)	(0.001)
Controls				
Left Government	0.041***	0.042***	0.043***	0.043***
	(0.012)	(0.012)	(0.012)	(0.012)
Income	0.006	0.009	0.007	0.006
	(0.006)	(0.006)	(0.006)	(0.006)
Population 0-14 (in %)	-0.001	-0.001	-0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Population >65 (in %)	0.002	0.001	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Unemployment rate (in %)	0.007*	0.007**	0.008**	0.008**
	(0.004)	(0.004)	(0.004)	(0.004)
Share immigrants (in %)	0.002	0.002*	0.002	0.001
	(0.002)	(0.001)	(0.001)	(0.001)
Disseminated population (in %)	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Dummies for population size intervals	Yes	Yes	Yes	Yes
Provincial dummies (NUTS 3)	Yes	Yes	Yes	Yes
# observations	2,731	2,731	2,731	2,731

Notes: Robust standard errors in parenthesis; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 6. Robustness checks II. The determinants of the business tax rate accounting for agglomeration economies of neighbors.

	Tobit		Two-Step Tobit
Agglomeration economies			
Urbanization economies	0.030***	0.031**	0.058**
	(0.011)	(0.012)	(0.023)
Neighbors urbanization economies	0.000	-0.000	-0.003
	(0.005)	(0.005)	(0.006)
Cluster	0.059*	0.061**	0.153**
	(0.031)	(0.031)	(0.073)
Neighbors Cluster	0.046**	0.042**	0.061**
	(0.018)	(0.019)	(0.030)
Market potential (neighbors)	0.002	0.001	0.003
	(0.003)	(0.003)	(0.004)
Controls			
Left Government		0.042***	0.042***
		(0.011)	(0.012)
Income		0.004	0.003
		(0.005)	(0.006)
Population 0-14 (in %)		-0.001	-0.001
		(0.002)	(0.002)
Population >65 (in %)		0.001	0.002
		(0.001)	(0.001)
Unemployment rate (in %)		0.007**	0.007**
		(0.004)	(0.004)
Share immigrants (in %)		0.002	0.002
		(0.001)	(0.001)
Disseminated population (in %)		0.000	0.000
		(0.001)	(0.001)
Dummies for population size intervals	Yes	Yes	Yes
Provincial dummies (NUTS 3)	Yes	Yes	Yes
# observations	2,772	2,772	2,731

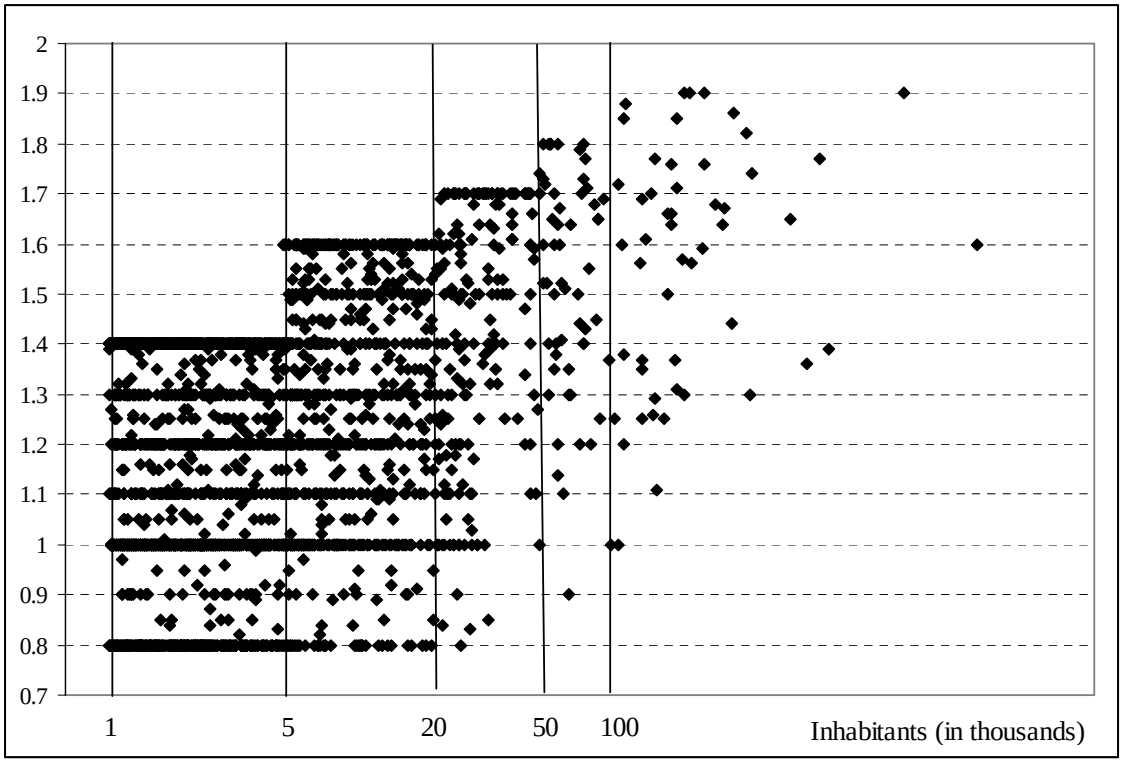
Notes: Robust standard errors in parenthesis; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level. Figures within brackets are p-values.

Table 7. Robustness checks III: The determinants of the property tax burden.

	Tobit		Two-Step Tobit	
Agglomeration economies				
Urbanization economies	27.095***	7.753**	6.764	6.092
	(3.037)	(3.285)	(7.726)	(7.539)
Cluster	-7.451	7.664	10.918	12.496
	(9.483)	(9.431)	(18.423)	(18.361)
Market potential (neighbors)	1.373***	0.351	0.349	0.395
	(0.345)	(0.361)	(0.401)	(0.408)
Controls				
Left Government		-5.270	-4.893	-5.179
		(3.445)	(3.470)	(3.476)
Income		16.611***	16.597***	16.166***
		(1.293)	(1.450)	(1.469)
Population 0-14 (in %)		0.808	0.824	0.833
		(0.512)	(0.509)	(0.508)
Population >65 (in %)		-1.179***	-1.234***	-1.170***
		(0.236)	(0.279)	(0.283)
Unemployment rate (in %)		-1.396*	-1.428*	-1.336
		(0.812)	(0.848)	(0.835)
Share immigrants (in %)		1.262***	1.234**	1.195**
		(0.489)	(0.504)	(0.501)
Disseminated population (in %)		-0.162	-0.160	-0.192
		(0.133)	(0.135)	(0.135)
Third order polynomial of years since last re-assessment	No	No	No	Yes
Dummies for population size intervals	Yes	Yes	Yes	Yes
Provincial dummies (NUTS 3)	Yes	Yes	Yes	Yes
# observations	2,772	2,772	2,731	2,731

Notes: Robust standard errors in parenthesis; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Figure 1. Scatter plot of business tax rates vs. population in 2002. Legal maximum business tax rates jump at 5, 20, 50 and 100 thousand inhabitants.



Annex 1. Tax competition with endogenous agglomeration economies.

To examine this issue we write A_i as $A_i = H(K_i) = K^{\gamma}$, reflecting that local productivity increases with the size of the local economy (localization economies and urbanization economies are conceptually equivalent in this model since there is only one sector). We assume that $F(K,L) = K^{a}L^{1-a}$ which implies that $x_i = (k_i L_i)^{\gamma} k_i^{\alpha}$. Notice that local productivity is not a function of the capital/labor ratio but depends on the overall capital level in the jurisdiction. This assumption is made in order to make productivity increase with size. This generates an agglomerative force in the model. In the absence of taxes, it must be the case that $k_1 > s_1$ if $s_1 > 1/2$, where $s_1 = L_1/(L_1 + L_2)$. This implies that, in the absence of taxes, the large jurisdiction will import capital and the small jurisdiction will export capital.

The marginal productivity of capital, *MPK* differs from the private return to capital, i.e. $r_i = A(k_i)f'(k_i)$, by the value of the externality $A'(k_i)f(k_i)$. Hence, $A'(k_i)f(k_i)$ constitutes a wedge between the return and the marginal productivity of capital. Assuming $x_i = (k_i L_i)^{\gamma} k_i^{\alpha}$ implies that the marginal productivity of capital and the private return of capital are proportional to each other[26]. Hence, the value of the externality, i.e. $A'(k_i)f(k_i)$, is also proportional to the private productivity of capital r_i, implying that $A'(k_i)f(k_i)$ is also a decreasing function of k_i given that $dr_i/dk_i < 0$, by assumption. Tax rates at the Nash equilibrium of the tax competition game satisfy:

$$\frac{dU_i}{dt_i^L} = -U_{ix} + U_{iz}\left(\frac{dx_i}{dk_i}\frac{dk_i}{dt_i^L} + \frac{dx_i}{d\varrho}\frac{d\varrho}{dt_i^L}\right) + U_{iz}\left(\frac{dz_i}{dk_i}\frac{dk_i}{dt_i^L} + \frac{dz_i}{d\varrho}\frac{d\varrho}{dt_i^L}\right) = 0, \forall i \qquad \text{(A1)}$$

$$\frac{dU_i}{dt_i} = -U_{ix}\left(-k_i + (\bar{k} - k_i)\frac{d\varrho}{dt_i}\right) + U_{iz}\left(k_i + \left(A'(k_i)f(k_i) + t_i\right)\cdot\frac{dk_i}{dt_i}\right) = 0, \forall i \qquad \text{(A2)}$$

which implies that:

$$\left(\bar{k} - k_i\right)\frac{d\varrho}{dt_i} + \left(A'(k_i)f(k_i) + t_i\right)\frac{dk_i}{dt_i} = 0 \qquad \text{(A3)}$$

At the symmetric equilibrium neither jurisdiction imports or exports capital, implying that equation (A3) reduces to $-t_i = A'(k_i)f(k_i)$, $\forall i$. Hence, in the symmetric equilibrium both governments subsidize capital. Governments subsidize capital in equilibrium because

[26] This condition guarantees that the no-tax decentralized equilibrium is efficient in the sense that it maximizes total output in the economy, the reason being that output maximizes when the marginal productivity of capital is equal across jurisdictions.

of the existence of a wedge between the return and the marginal productivity of capital. Firms perceive the marginal productivity of capital to be $A(k_i)f'(k_i)$ whereas it is actually $A(k_i)f'(k_i)+A'(k_i)f(k_i)$. Hence governments subsidize each unit of capital for the value of its external effect, i.e. $A'(k_i)f(k_i)$. We now turn to the asymmetrical case. In general, (A3) implies that the capital exporting jurisdiction ($i=E$) subsidizes capital above the wedge between private and social marginal productivities, i.e. $-t_i > A'(k_E)f(k_E)$. In turn, the capital importing jurisdiction ($i=I$) either taxes capital or subsidizes it below the wedge between private and social marginal productivities $-t_i < A'(k_I)f(k_I)$. Given that $A'(k_i)f(k_i)$ is a decreasing function of k_i by assumption, the capital exporting jurisdiction subsidizes capital more than the capital importing jurisdiction, i.e. $-t_E > -t_I$. The reason is that the value of the external effect, $A'(k_i)f(k_i)$, will be higher for the tax exporting jurisdiction since $(k_I > k_E)$. Hence, the following sequence of inequalities holds.

$$\text{subsidy (or tax) importer} \equiv -t_I < A'(k_I)f(k_I) < A'(k_E)f(k_E) < -t_E \equiv \text{subsidy exporter}$$

Under tax competition and endogenous production externalities, the large jurisdiction will import capital and the small jurisdiction will export it. To see this, assume that jurisdiction 2, the small jurisdiction, wants to become a capital importer. This is only possible if $(t_1 - t_2) >> 0$ such that $k_2 > k_1$ in equilibrium (if $t_1 - t_2 = 0$ then the jurisdiction 2 exports capital). However, being a capital importing jurisdiction implies subsidizing capital less than the capital exporting jurisdiction, that is, $(t_2 - t_1) > 0$, which contradicts $(t_1 - t_2) > 0$. Hence, the small jurisdiction cannot import capital. Hence, under tax competition, the jurisdiction with a larger endowment of the fixed factor sets a higher tax rate while keeping higher capital intensity. Hence, tax competition reduces the gap in capital intensities but does not eliminate it.

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