Race to the top or race to the bottom? Non-linearities in tax competition[⋆]

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Abstract

This paper studies the relationship between local business tax rates and agglomeration forces in a sample of Spanish municipalities over the period 2005-2017. On the empirical ground we have used semi-parametric techniques and a number of precautions dealing with endogeneity, spatial dependency, unobserved heterogeneity across jurisdictions and non-linearities. Our central results show evidence in favour of the hypothesis of taxable agglomeration rents when the municipalities are big enough, and indications of tax competition for small local governments. Non-linearities are also present. Finally, we discuss the empirical findings in terms of the standard models of economic geography. The consideration of social welfare functions with (or without) public spending amongst their arguments becomes crucial for explaining the empirics.

Keywords: Geographical Economics, tax competition, market potential, taxable agglomeration rent, municipalities
JEL codes: H2, H3, C23, R12

[⋆] Very preliminary version. Please do not quote and not circulate.

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1. Introduction

Linear foot-loose capital (FC) models are usually used to theoretically back the empirical research avenue assessing the existence of *taxable agglomeration rents* across local jurisdictions. These models predict that when regions are asymmetric in terms of immobile factor endowments (labor), agglomeration creates rents for the mobile factor (capital) that can be taxed, increasing equilibrium tax rates (Andersson and Forslid, 2003; Baldwin and Krugman, 2004; Ottaviano and van Ypersele, 2005). Therefore, jurisdictions that benefit from agglomeration rents are able to be less responsive to neighbours' tax rates because they do not fear capital relocation.

The empirical counterparts of these models have mainly focused on regressing local (municipal) business tax rates against different proxies of agglomeration economies. Examples of that can be found, for instance, in Charlot and Paty (2007, 2010); Jofre-Monseny and Solé-Ollé (2010, 2012); Jofre-Monseny (2013); Koh et al. (2013); Brülhart et al. (2012); Luthi and Schmidheiny (2013); Lopez-Rodriguez et al. (2022a).

However, these models are originally framed in the context of country level corporate taxation and the impact of agglomeration economies and trade costs have on it. Using these models as the theoretical guide to justify the presence of taxable agglomeration rents at local level has several drawbacks. Amongst them, the violation of the labor immobility assumption (at local level, labor is mobile across jurisdictions) and the empirical imposition of a linear relationship between tax setting decisions and agglomeration levels when this is not necessary the case (see for instance Lopez-Rodriguez et al. (2022b)). This fact calls for using non-parametric methods which are best suited to capture potential non-linearities between agglomeration economies on local tax setting decisions.

Other important issues in the empirical estimations which need further analysis are the reverse causality problem (potential endogeneity of variables capturing agglomeration economies). Indeed, local tax differentials can be influenced both by the location of economic activities and hence the agglomeration levels but they can also determine the location of economic activities.

To the best of our knowledge the labor immobility problem has been recently circumvent in Lopez-Rodriguez et al. (2022b), who use local labor markets as the main units of analysis in testing for the presence of agglomeration rents in the Spanish context. The endogeneity issue has been solved applying IV estimation techniques; see, for instance, (Jofre-Monseny, 2013;

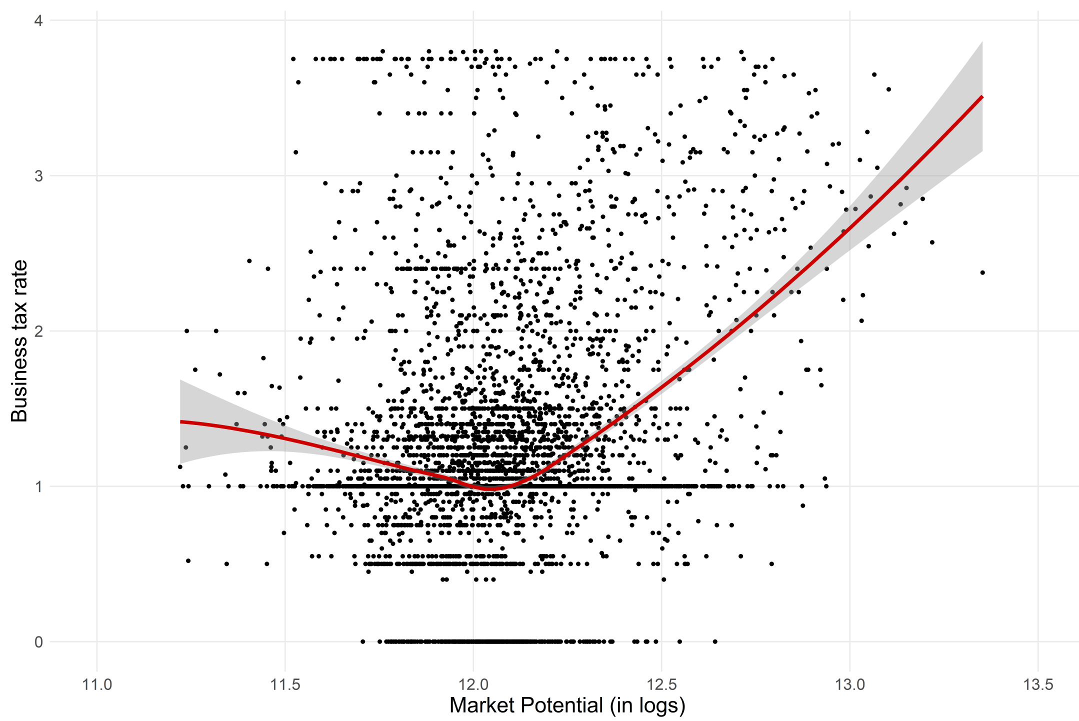
Lopez-Rodriguez et al., 2022a). And with regards to the potential presence of non-linearities in the tax setting-agglomeration relationship, it has been studied yet, neither theoretically nor empirically. In this paper, we have dealt with the three issues simultaneously.

The econometric specification usually employed to test for the presence of taxable agglomeration rents is a fixed effects spatial autoregressive model, also known in the spatial econometrics literature as SAR-FE model (see for instance, Charlot and Paty (2007); Lopez-Rodriguez et al. (2022a)). According to Gibbons and Overman (2012), SAR-FE models are not generally adequate since they impose a set of hypothesis in relation with the functional form, the presence of omitted factors or the structure of the spatial dependence which do not always adjust to the reality of the problem at hand. In particular, the SAR-FE model imposes a series of restrictions in the results (Pinkse and Slade, 2010), namely: a) all the spatial dependence is forced to be included in the autoregressive term, a fact that tends to produce a bias in the estimation of the spatial parameter (Basile et al., 2014); b) the functional form of the model tends to be unknown, so imposing a linear relationship tends to generate a bias in the parameter estimates; and c) the existence of unobserved heterogeneity can introduce biases derived from the omission of variables making causal inference inconsistent.

To overcome several of the econometric issues raised by SAR-FE models, we follow an empirical strategy based on the estimation of *Spatial Autoregressive Semiparametric Geoadditive Models*, also known as PS-SAR models. These models allow to simultaneously control for the presence of potential non-linearities in the relationship between the dependent variable and the regressors, different types of spatial dependencies and also for unobserved heterogeneity across regions.

The higher flexibility of these models compared with the SAR-FE model is particularly very appealing in testing for taxable agglomeration rents. The reason is that the specification can simultaneously accommodate "race-to-the-top" and "race-to-the-bottom" scenarios in business tax setting decisions. These types of scenarios seem to be present in the local tax setting decisions across Spanish municipalities as the following Figure 1 shows.

Figure 1: Non-linearities tax setting-agglomeration (2017)



Note : Own elaboration

In particular, within the family of Spatial Autoregressive Semiparametric Geoadditive Models, we use as our baseline specification to test for the presence of taxable agglomeration rents across the Spanish municipalities the PS-SAR model developed by Minguez et al. (2020), Lee and Durban (2011) and Montero et al. (2012). For robustness purposes, we have also carried out alternative econometric specifications to the baseline PS-SAR controlling for autoregressive disturbance terms (PS-SAR-AR1), introducing dynamics to the previous one (PS-SAR-AR1 dynamic) and introducing spatial dependencies in the disturbance term (PS-SARAR-AR1 dynamic). In a sense, we have followed a nested strategy in the empirics, using more complex specifications aimed at reaching the best fit to data as possible.

In general, our PS-SAR estimates for the period 2005-2017 show indications of non-linearities in business tax setting decisions. These non-linearities take the form of a higher reaction of business tax rates to agglomeration economies at the top-end of the agglomeration economies distribution. But the "race-to-the-top" prediction of linear FC models regarding corporate taxation still holds for the whole distribution. The results of alternative specifications show important differences by reporting "race-to-the-bottom" scenarios for low levels of agglomeration and "race-to-the-top" scenarios for high levels of agglomeration. In both cases, the presence of non-linearities is found and that calls for alternative theoretical frameworks to understand the economics behind the local tax setting decisions.

In our estimations we also control for the potential endogeneity between tax setting decisions and the level of agglomeration by using the methodology developed by Basile et al. (2014) and known as PS-SAR-2-steps. The number of Covid-19 cases and an index of infrastructures built at the municipality level have been used as instruments. The potential impact of vertical tax externalities coming from tax decisions taken by upper levels of government with tax power on the local bussines tax has been taken into consideration as well.

This paper also contributes to the debate in the tax competition literature by presenting a theoretical discussion of the empirical findings. To the best of our knowledge, this is the first time in which taxable agglomeration rents are not an *always and everywhere* rule in local tax setting decisions as linear FC models predict. By contrast, on the basis of standard assumptions of economic geography models, such as imperfect competition, increasing returns to scale and trade cost, there is scope for tax competition. The non-linearities found in the empirics and some interesting results related to the connection between trade cost and agglomeration forces are theoretically fitted as well.

The rest of the article is organized as follows. In Section 2 we present the PS-SAR model. Section 3 deals with the empirical strategy we follow to test for taxable agglomeration rents. In section 4 we briefly introduce the Spanish institutional context and describe the data and variables used in our estimations. In Section 5 we present the theoretical discussion, giving a rational to the empirical results we have achieved. Finally, Section 6 concludes.

2. Methodology

2.1. Spatial dependence approach in the taxable agglomeration rents literature

The empirical literature that deals with testing taxable agglomeration rents overwhelmingly use spatial autoregressive fixed effects models (SAR-FE) (see for instance, Charlot and Paty (2007); Lopez-Rodriguez et al. (2022a,b)). In these models the spatial dependence is observed through “spillover” effects across regions. However, there is another way of dealing with this cross-section dependence, the so-called ”common effects” models (CCEP) in which the cross-section spatial dependence is generated by common factors affecting the regions (Pesaran, 2006).

The difference between these two options to handle spatial dependence relies on the fact that ”strong” dependence across regions is required in the ”common effects” models while ”weak” dependence suffices in the case of SAR-FE (Bailey et al., 2016). On the other hand, SAR-FE models allow to control for spatial dependence when this is originated from spillover effects across regions while CCEP allows to model the spatial heterogeneity. To deal with this problem, a new type of models have emerged in the literature in which it is possible to simultaneously include spillover effects (typical of SAR models), together with effects derived from common factors that generate spatial heterogeneity (typical of CCEP models). These families of models are usually referred to as SAR-CCEP models, which were initially developed by Bai and Li (2013). However, despite the fact that these models are able to simultaneously control for the type of spatial dependence and for the potential heterogeneity present in the data, they do not allow the inclusion of non-linearities in the relationship between the dependent and independent variables. To circumvent this problem, Montero et al. (2012), Basile et al. (2014) and Minguez et al. (2020) developed a model known as PS-SAR model.

2.2. Spatio-temporal semiparametric autoregressive models: PS-SAR

A PS-SAR model can be specified as follows:

$$y_{it} = \underbrace{\rho W y_{jt}}_{A} + \underbrace{\sum_{\delta=1}^{k} m_\delta(x_{\delta,it})}_{B} + X'_{it}\beta + \underbrace{f(s_{1i}, s_{2i}, \tau_t)}_{C} + \epsilon_{it} \tag{1}$$

where the term A captures the spillover effect of a SAR specification, i.e., it represents a weighted average of the dependent variable across the ”j” locations which are neighbours to location ”i”. This term is made up of an autoregressive parameter, ρ, the spatial weights matrix, W, which defines the neighbourhood criteria across locations and the values of the dependent variable in the ”j” locations. The B term captures the non-parametric part of the model, where $m_\delta(\cdot)$ is a non-linear function of the δ-th variable $x_{\delta,it}$. The C term is the spatio-temporal trend of the model and captures the spatial heterogeneity, being (s_{1i}, s_{2i}) the spatial coordinates (latitude and longitude) of the centroid in the i and τ_t is the temporal dimension. Coordinates and the temporal dimension are related through an unknown function $f(\cdot)$ with the dependent variable. Finally, the X'_{it} term captures the effects of other explanatory variables interacting in a linear way with y_{it} and ϵ_{it} is the disturbance of the model which is assumed to be a white noise.

This model allows us to simultaneously control for the three sources of bias that are detected in previous specifications, namely, the spatial spillover effects (A term), the potential non-linearities in the relationships among the variables (B term) and the spatial heterogeneity (C term). The inclusion of the temporal dimension through the f function can be very costly from a computational point of view and not flexible enough to capture the structure of the observations (Minguez et al., 2020). In these cases, Lee and Durban (2011) developed an ANOVA type of decomposition of the f function with the following structure:

$$\begin{aligned} f(\boldsymbol{s_1}, \boldsymbol{s_2}, \boldsymbol{\tau}) =& f_1(\boldsymbol{s_1}) + f_2(\boldsymbol{s_2}) + f_t(\boldsymbol{\tau}) + f_{1,2}(\boldsymbol{s_1}, \boldsymbol{s_2}) + f_{1,t}(\boldsymbol{s_1}, \boldsymbol{\tau}) \\ &+ f_{2,t}(\boldsymbol{s_2}, \boldsymbol{\tau}) + f_{1,2,t}(\boldsymbol{s_1}, \boldsymbol{s_2}, \boldsymbol{\tau}) \end{aligned} \tag{2}$$

Non-parametric estimations of the PS-SAR model are carried out from the methodology of penalized splines (P-splines) developed by Eilers and Marx (1996) and using the statistical package *pspatreg* developed by Minguez et al. (2022) with the programming language R.

2.3. P-splines methodology

The P-splines methodology, developed by Eilers and Marx (1996), is a modification of the B-splines technique which consists of introducing a penalization in the objective function to be minimized (least squares). The penalization term allows to significantly improve the goodness of fit properties.

A B-spline is a function made up by joining polynomials at certain levels of the "x" variable which are known as *knots* (De Boor, 1978). This type of functions is widely used as the base when adjusting non-parametric regressions. The base is determined by the way in which the knots are distributed over the range of the "x" variable and by the degree of the polynomial. It is quite common the use of polynomials of degree three for B-splines, however, there is some discrepancy in how to establish the optimal number of knots (Ruppert, 2002; Eilers and Marx, 1996; Minguez et al., 2020).

The adjustment of a variable through the B-splines methodology is determined according to the following expression:

$$\hat{y}_i = \sum_{j=1}^{n} \hat{a}_j B_j(x_j) \tag{3}$$

where n is the number of knots, B_j is the base of order p splines (generally $p = 3$) at the x_j point and $\hat{a_j}$ is the vector of coefficients obtained in the following minimization process:

$$S = \sum_{i=1}^{m} \left(y_i - \sum_{j=1}^{n} a_j B_j(x_j) \right)^2 \tag{4}$$

The P-splines technique modifies the previous function by introducing a penalization term, usually by second degree differences in adjacent B-splines coefficients. In particular:

$$S = \sum_{i=1}^{m} \left(y_i - \sum_{j=1}^{n} a_j B_j(x_j) \right)^2 + \lambda \sum_{j=k+1}^{n} (\Delta^k a_j)^2 \tag{5}$$

The introduction of this penalization term shows the following advantages with regards to the B-splines method (Eilers and Marx, 1996; Eilers et al., 2015):

(i) P-splines does not show frontier effects.

(ii) P-splines can fit polynomial data exactly.

(iii) The fit is robust to the selection of knots from a certain value.

(iv) It is less expensive in computational terms than other types of models with penalties such as O'Sullivan (1986).

(v) Re-parametrization of the model as a "mixed model" allows estimating simultaneously all the parameters of the model and the optimal value of the smoothing parameter λ.

2.4. Neighborhood criteria

To be completed.

2.5. Treatment of endogeneity

The exogeneity asssumption, which is at the heart of testing causal effects in econometrics, is rarely verified by the data due to problems caused by either omitted variables bias or reverse causation or both. This problem yields inconsistent estimates of the model parameters. In a parametric context, the use of instrumental variables (IV) through a 2SLS is a standard procedure to deal with this issue. In this paper, we need to modify this methodology to adapt it to a semi-parametric context. There are several methods such as those proposed by Hoshino (2018) and Blundell and Powell (2003). However, the approach we use is a modification proposed by Basile et al. (2014) from the concept of two steps "control function" (CF) developed by Blundell and Powell (2003). In this case, in the first step, the endogenous explanatory variable is regressed against the set of instruments. In the second step, the residuals from the first-stage regression are added as control variables to the original specification. This estimation method is known as 2-steps-PS-SAR. The control for potential endogeneity issues is carried out on the autoregressive term (following Basile et al. (2014)), and on all those covariates that do not verify the exogeneity assumption.

3. Empirical Strategy

3.1. Baseline specification

Our baseline PS-SAR econometric specification can be expressed as follows:

$$t_{it} = \rho W t_{jt} + \underbrace{m(MP_{it})}_{B} + \beta_1 t_{it}^p + f(lat_i, lon_i, \tau_t) + \epsilon_{it} \tag{6}$$

where t_{it} is the business tax rate of municipality 'i' in year 't'; the term $\rho W t_{jt}$ captures spatial spillovers where W is the weights matrix built from different neighbourhood criteria; MP_{it} is the market potential of municipality 'i' in year 't', which is added to the model through an unknown $m(\cdot)$ function; t_{it}^p is the provincial surcharge business tax rate and is added in a linear way through the parameter β_1; $f(lat_i, lon_i, \tau_t)$ is an unknown multivariate function which captures the spatio-temporal trend which is added to the model through the ANOVA decomposition presented in (2); finally, ϵ_{it} is the disturbance term associated with the municipality 'i' in year 't'.

3.2. Robustness checks

As robustness tests for our baseline PS-SAR econometric estimates we proceed as follows:

a) Comparison of the baseline PS-SAR results with a SAR-FE model.

b) Comparison of the baseline PS-SAR results with other alternative PS-SAR specifications: i)PS-SAR-AR1 specified in (7), that is, a PS-SAR which controls for autoregressive disturbances; ii) PS-SAR-AR1-dynamic specified in (8), i. e., a PS-SAR-AR1 that introduces dynamics, and iii) PS-SARAR-dynamic specified in (9), that is, a PS-SAR-AR1-dynamic controlling for spatial dependencies in the disturbance term. Particularly, the PS-SAR-AR1 model is given by

$$\begin{aligned} t_{it} = \rho W t_{jt} + \underbrace{m(MP_{it})}_{B} + \beta_1 t^p_{it} + f(lat_i, lon_i, \tau_t) + \epsilon_{it} \\ \epsilon_{it} = \phi\epsilon_{it-1} + \nu_{it} \end{aligned} \tag{7}$$

where ϕ is the parameter associated to the first-order autoregressive term of the disturbance and nu_{it} is a white noise. The PS-SAR-AR1 specification is

$$\begin{aligned} t_{it} = \rho W t_{jt} + \delta t_{i,t-1} + \underbrace{m(MP_{it})}_{B} + \beta_1 t^p_{it} + f(lat_i, lon_i, \tau_t) + \epsilon_{it} \\ \epsilon_{it} = \phi\epsilon_{it-1} + \nu_{it} \end{aligned} \tag{8}$$

where δ is the parameter associated to the one-year lag of the business tax rate. And the PS-SARAR-dynamic is given by

$$\begin{aligned} t_{it} = \rho W t_{jt} + \delta t_{i,t-1} + \underbrace{m(MP_{it})}_{B} + \beta_1 t^p_{it} + f(lat_i, lon_i, \tau_t) + \epsilon_{it} \\ \epsilon_{it} = \phi\epsilon_{it-1} + \theta W \epsilon_{jt} + \nu_{it} \end{aligned} \tag{9}$$

where θ is the parameter associated to the spatial autoregressive term and W is the spatial weights matrix built from different neighbourhood criteria.

c) Controlling for endogeneity of W

4. The Spanish institutional context, variables and data

4.1. The Spanish institutional context

The Spanish local institutional context is characterised by three tiers of overlapping governments, municipalities, provinces and Autonomous Communities (article 137 of the Spanish Constitution). The lowest tier of the territorial organization is made up of 8131 municipalities (local jurisdictions). These municipalities are aggregated into 50 provinces (NUTS[1] III level), excluding the autonomous provinces of Ceuta and Melilla (middle tier), and 17 Autonomous Communities (NUTS II level) (upper local tier). The government and administration system of the municipalities corresponds to the Town Councils, consisting of Mayors and Councillors. The government system and autonomous administration of the provinces is entrusted to Provincial Councils which the Spanish Constitution attributes to a body known as *"Diputaciones*[2]*"*. Finally, the government and administration of the Autonomous Communities is based on a Legislative Assembly, a Governing Council and a President elected by the Assembly and appointed by the King (art. 152 of the Spanish Constitution). Furthermore, simply for comparison purposes with other European member-states, the 17 Autonomous Communities can be aggregated into seven administrative regions (NUTS I level), which have no real internal political or administrative meaning.

Municipalities are responsible for local urban services (street lighting, waste collection, supply of drinking water), building and maintaining nursery and primary schools and sport facilities, municipal roads and urban public transport. The *"diputaciones"* offer legal, economic and technical assistance and cooperation to municipalities, especially those with less economic capacity and management (waste management, fire prevention and extinction, maintenance and cleaning of medical offices, maintenance of provincial roads). Autonomous communities are responsible for vocational training, economic development and building and maintenance of high schools.

[1]The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU and the UK for the purpose of the collection, development and harmonisation of European regional statistics, to carry out socio-economic analyses of the regions and framing of EU regional policies.

[2]In the Canary and Baleares archipelagos, the islands have their own government in the form of *"Cabildos"* or Councils

4.2. Data and variables

The empirical analysis is carried out by building a dataset with 8382 Spanish municipalities. We have pooled municipality for a 13 year-period, starting in 2005 and covering therefore the period (2005-2017), yielding a total of 108,975 observations.

4.2.1. Business tax

There are three mandatory taxes and two taxes of voluntary establishment by municipalities. The compulsory levying taxes are the real estate or property tax (*Impuesto sobre Bienes Inmuebles*), which is the most important in terms of tax revenue, the local business tax (*Impuesto sobre Actividades Económicas*), which is the main local tax burden borne by the business sector and the vehicles tax (*Impuesto de Vehículos de Tracción Mecánica*). The other two voluntary taxes are those applied to the increase in the value of urban land (Impuesto sobre la plusvalía) and to request a license to build or repair a premise (*Impuesto de Instalaciones, Construcciones y Obras*).

The local business tax is a presumption tax computed from different indicators of economic activity. The tax base is determined by national tax laws and is meant to approximate a share in a firm's profits. This tax base is then weighted by a municipal-specific augmentative coefficient (*coeficiente de localización*), t_{it}, which applies to all establishments in each municipality. This municipal-specific weighted coefficient is applied based on the establishments' physical setting within the municipality in relation to the category of the street in which is located and cannot be lower than 0.4 and higher than 3.8. We refer to this municipal coefficient as the local business tax rate. Although there is an important degree of autonomy in setting this tax rate, the size of the municipal population establishes an upper bound for it.

In the period (2005-2017), the average tax rate increases from 1.27 (municipalities with less than 5,000 inhabitants) to 2 (5,000–20,000 inhabitants), to 2.59 (20,001–50,000 inhabitants), to 2.79 (50,001–100,000 inhabitants). For municipalities with more than 100,000 inhabitants the maximum tax rate is a bit lower that for the group of municipalities with population between (50,001–100,000 inhabitants) (2.66 versus 2.79).

4.2.2. Measuring agglomeration economies

We measure agglomeration economies resorting to the market potential concept initially developed by (Harris (1954)). The Harris (1954) market potential (MP) concept represents the size of the potential demand that each jurisdiction faces and is defined as a distance-weighted sum of the volume of economic activity of the neighbouring municipalities. This variable is usually used in the literature that test for taxable agglomeration rents Charlot and Paty (2007, 2010) The expression used to calculate municipality's market potential is given by expression (10):

$$MP(\lambda)_{i,t} = \frac{Pop_{i,t}}{d_{i,i}} + \sum_{j \neq i}^{N} \frac{Pop_{j,t}}{d_{i,j}} = DMP(\lambda)_{i,t} + FMP_{i,t} \tag{10}$$

where $MP(\lambda)_{i,t}$ represents the total market potential of municipality "i" in year t; $Pop_{i,t}$ and $Pop_{j,t}$ represent the population of the municipality "i" and "j" in year t; $d_{i,i}$ is the internal distance within each municipality "i" and $d_{i,j}$ is the distance between municipality "i" and "j". The internal distance within each municipality is estimated assuming that the geometric shape of the municipality is a circle which yields an internal distance proportional to the radius. The radius is multiplied by a coefficient λ (see Crozet (2004), Head and Mayer (2004) and Keeble et al. (1982)) obtaining two different intra-municipalities "i" distances (km) depending on the λ coefficient assumed in the computations (see expression (11)).

$$d_{i,i} = \lambda \sqrt{\frac{area_i}{\pi}}, \quad where \quad \lambda = \left\{ \frac{1}{2}, \frac{2}{3} \right\} \tag{11}$$

The distance between municipalities i" and "j" is the distance measured in Kms. between their centroids. Finally, the last part of expression (10) represents the fact that total market potential for each municipality "i" can be broken down into a *domestic* market potential component, $DMP(\lambda)_{i,t}$, (market potential generated by municipality "i") and a *foreign* market potential component, $FMP_{i,t}$ (market potential generated by all municipalities "j" which are surrounding municipality "i"). Two domestic market potential indices, according to the two different λ coefficients, are computed generating therefore three total market potential proxies of agglomeration.

4.2.3. Control variables

Business tax rates in the Spanish tax system are set by two different government layers (municipalities and provinces). We control for the potential presence of vertical tax interactions in our estimations by adding to our baseline estimation the effects that provincial business tax rates (t_i^p) (known as *Recargo Provincial IAE*) have on the municipality ones.

Table 1 provides some descriptive statistics for the main variables used in our econometric estimations. To build the database, data from the Spanish Institute for Statistics (INE) and the Ministry of Finance (*Ministerio de Hacienca y Función Pública*) were used.

Table 1: Summary statistics (N=108975)

Statistic	Mean	St. Dev.	Min	Median	Max
Business tax rate	1.16	0.49	0.40	1.00	3.80
Total Market Potential (MP(2/3)) (logs)	12.03	0.21	11.43	12.01	13.11
Provincial surcharge tax rate (%)	30.66	9.08	0.0	32.0	40.0

5. Results

5.1. Baseline estimates: PS-SAR

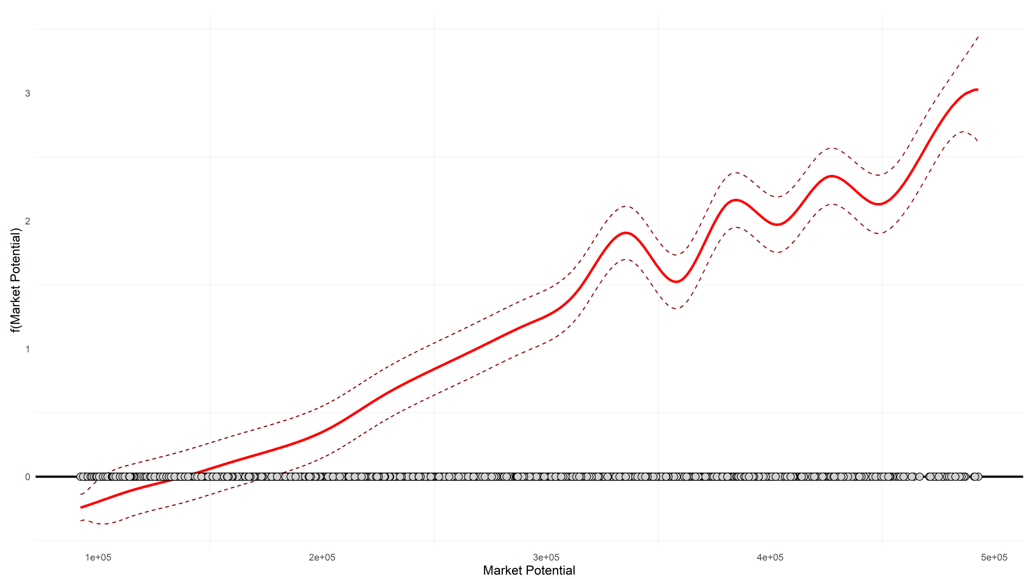
The results of the baseline specification (6) are shown in Table 2 and in Figure 2. Firstly, we present a table with the parametric results of the model, i.e, the estimates of the coefficient associated with the horizontal interaction between municipalities and estimates of the coefficient associated with the provincial surcharge tax rate.

Table 2: Estimates of parametric coefficients in specification (6)

Variable	Coefficient	Std. desviation	P-value
ρ (W_{05})	0.027	0.005	0.000
Intercept	1.131	0.342	0.001
Provincial surcharge tax rate	0.001	0.000	0.000
EDF Total	375.37		
σ	0.392		
AIC	-91886		
BIC	-88283.1		

Figure 2 shows the model's non-parametric estimates of the effects of market potential on business tax rates (the term B in (6)). The dashed lines in Figure 2 represent significance bands at 5% level and the dots on the horizontal axis the distribution density for the market potential variable. It can be observed that market potential exerts a positive effect on business tax rates, corroborating the presence to taxable agglomeration rents across the Spanish municipalities. Moreover, an increase in the intensity of the "market potential-business tax rate" relationship can also be observed (the slope of the red line increases substantially for municipalities with high market potential values), pointing to the existence of non-linearities in the market potential-business tax rate relationship. A careful reading of the "market potential-business tax rate" zigzagging behaviour for high market potential values is in order. This behaviour may be caused by an over fitting problem of the polynomial. Excluding this potentially over fitted part, no range of the market potential variable is detected to exert a negative effect on tax setting decisions, i.e. there is no a "race-to-the-bottom" effect in tax setting decisions.

Figure 2: Estimates of non-parametric part B in specification (6): Relation between market potential and business tax rate



Note : Own elaboration

5.2. Robustness estimations

5.2.1. Alternative PS-SAR estimates: PS-SAR-AR1, PS-SAR-AR1-dynamic and PS-SARAR-AR1-dynamic

This section presents the results of the three alternative econometric specifications to the baseline PS-SAR specification discussed in the previous section. Table 3 shows the results of the parametric parts of specifications (7), (8) and (9). In column 1 we repeat the results of the baseline PS-SAR specification and in columns 2-4 the results of the parametric parts of specifications (7), (8) and (9) are shown respectively.

It can be seen that the models goodness of fit improves when we incorporate dynamics to the model (one-year lag in the tax setting decisions). Making the model dynamic yields two important effects: a) the term A associated to the SAR model is no longer statistically significant, i.e. we do not find local spatial dependency processes. Instead, this local spatial dependency is substituted by a global core-periphery one which can be seen in the spatio-temporal trend term; and b) As opposed to the theoretical predictions of linear FC models of "race-to-the-top" scenarios in corporate taxation, our results only corroborate these scenarios at the top-end of the market potential distribution. At the bottom part of distribution of agglomeration levels, a "race-to-the-bottom" scenario is found. This finding is in sharp contrast with the presence of taxable agglomeration rents predicted by linear FC models. The results also seem to suggest that there is a range of agglomeration levels for which business tax setting decisions have a mild reaction to them.

The results of the non-parametric estimates (the term B) in the specifications (7), (8) and (9) are shown in Figure 3. As it was previously commented, an overall assessment of the results lead to the conclusion of "taxable agglomeration rents" across the Spanish municipalities. However, a more careful reading of the estimations shown that the dynamic PS-SAR estimations support the presence of taxable agglomeration rents for high market potential values (after a certain market potential threshold is surpassed), very mild effects of agglomeration economies on the business tax setting decisions for intermediate market potential values and, more importantly and contrary to linear FC models theoretical predictions, a "race-to-the-bottom" scenario in tax setting decisions for low levels of agglomeration.

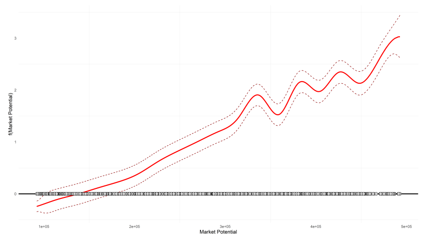
In other words, for low levels of agglomeration, standard neoclassical tax competition results hold. In light of these empirical results, a reassessment of linear FC models is in order to guiding from a theoretical standpoint the

Table 3: Parametric estimates of PS-SAR-AR1 (2), PS-SAR-AR1-dynamic (3) and PS-SARAR-AR1-dynamic (4)

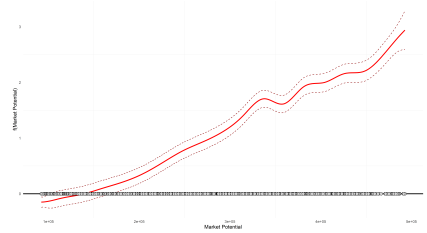
	Dependent variable: Business Tax Rate			
	(1)	(2)	(3)	(4)
ρ (W_{05})	0.027***	0.028***	0.000	0.000
	(0.005)	(0.006)	(0.000)	(0.000)
Spatial error				0.002***
				(0.000)
AR1 error		0.744***	-0.018***	-0.018***
		(0.001)	(0.000)	(0.000)
Business tax rate lag			0.933***	0.933***
			(0.000)	(0.000)
Provincial surcharge rate	0.001***	0.001***	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	1.131***	1.831***	0.114***	0.0114***
	(0.342)	(0.236)	(0.001)	(0.001)
EDF Total	375.37	455.82	733.44	734.44
σ	0.392	0.392	0.111	0.111
AIC	-91886	-212813	-342039	-342037
BIC	-88283	-208437	-335050	-335038
Note:		*p<0.1; **p<0.05; ***p<0.01		

results achieved. Accommodating both ”race-to-the-top” and ”race-to-the-bottom” scenarios in local tax setting decisions in presence of agglomeration economies is the goal we pursue in the next section of the paper.

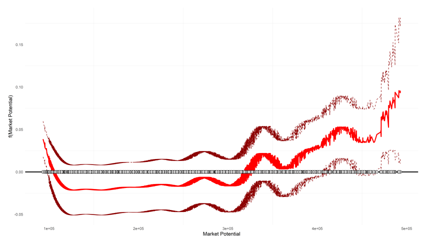
Figure 3: Estimate of relation between agglomeration and business tax rate



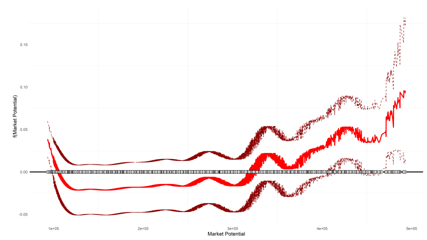
(a)



(b)



(c)



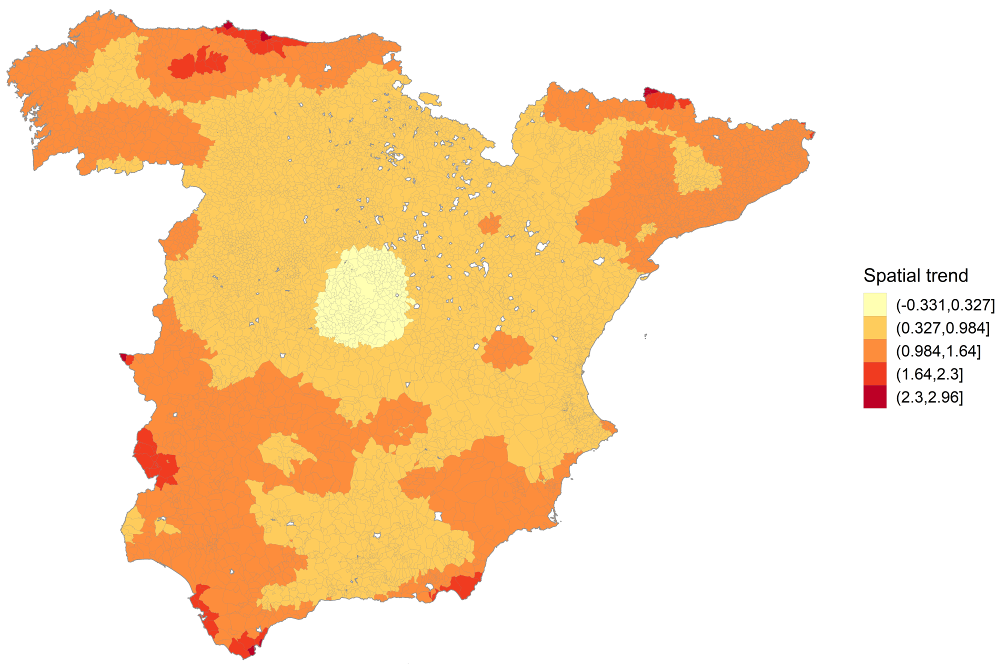
(d)

(a) PS-SAR (b) PS-SAR-AR1 (c) PS-SAR-AR1 dinamic (d) PS-SARAR-AR1 dynamic

Note : Own elaboration

The spatial trend of the model can be seen in the following figure 4. This figure is based in data for 2017 and shows how business tax rates are influenced by the geography (latitude and longitude) of the Spanish municipalities. There are potentially many omitted variables that cause spatial heterogeneity in business tax rates. In this case, figure 4 shows this spatial heterogeneity. The reading of the map is as follows: If all regions were similar in all counts (included in the econometric specification), differences in tax setting decisions across municipalities would be generated by these omitted factors that show a geographic pattern captured by this spatial trend. In this case, as figure 4 shows there is a clear spatial core-periphery pattern, which means that central municipalities, such as Madrid, tend to set lower business tax rates than other located in the geographical periphery of Spain. This core-periphery trend is not influenced by the size of the municipalities.

Figure 4: Spatial trend (2017)



Note : Own elaboration

The overall effect on the tax setting decisions across municipalities weights both municipal sizes as well as this spatial trend.

6. A theoretical discussion of the empirical results

The crucial result to be explained here is under which circumstances the relationships between the tax rate and agglomeration follow a linear or a non-linear pattern, as the previous empirical results have shown. We also discuss here other complement issues regarding the optimal decisions on tax rates when trade costs or the differential impact of agglomeration on jurisdictions are involved as well. With this aim, we use the canonical model initially described by Ottaviano (2001) and further developed by Ottaviano and van Ypersele (2005) and Charlot and Paty (2007), among others. We just summarize its main preliminary features, without entering into its technical details, because this theoretical framework is well-known enough to repeat here its standard theoretical developments. When introducing the behaviour of local governments, we will see that, in line with Baldwin and Krugman (2004), depending upon the social welfare function to be optimized, the impact of agglomeration on the optimal tax rates will affect in a particular fashion.

We consider here an economy with two local governments (North, N, and South, S), two production factors (labour, L and private capital, K) and two private sectors (agricultural and manufacturing sectors). The labour is assumed to be immobile across jurisdictions whereas the services of the capital are allowed to be provided in a jurisdiction different to where the owner of such capital is located. The agricultural sector employs only labour to produce a freely tradable good under constant return to scale (CRS). The manufacturing sector uses labour and capital to produce $n_N + n_S$ non-freely tradable i industrial varieties of goods under monopolistic competition and increasing returns to scale (IRS); each industrial firm is assumed to require one unit of K as a fixed factor to produce one variety. Shipping one unit of industrial variety of good i costs τ units of the agricultural good, which is used as *numeraire*, to take the trade costs into account.

The representative consumer, with a fixed endowment of production factors and the agricultural good, maximizes a utility function with love-for-variety. Given the mobility of private capital across jurisdictions, we need to distinguish between the share of capital owned by the residents in the jurisdiction N, denoted by σ and that we shall use as a measure of agglomeration, and the share of capital employed in the region N, named as γ. From the consumer optimization problem we obtain the following linear demand for the quantities of a variety i:

$$q(i) = a - bp(i) + c \int_{j=0}^{n_N+n_S} [p(j) - p(i)]dj. \tag{12}$$

In this demand function $p(i)$ and $p(j)$ are the prices of variety i and j; a, b and c are combinations of parameters of the utility function α, β and ν[3], particularly $a \equiv \frac{\alpha}{\beta+(N-1)\nu}$, $b \equiv \frac{1}{\beta+(N-1)\nu}$ and $c \equiv \frac{\nu}{(\beta-\nu)[\beta+(N-1)\nu]}$, and $n_N + n_S$ are the total number of varieties made in jurisditions N and S, respectively. The consumption of agricultural good is determined as a residual.

[3] α refers to the intensity of preferences for the manufacturing good, β the love-of-variety and ν the degree of substitutabilty between different varieties, with $\beta > \nu > 0$.

Whereas in the agricultural sector, with CRS and perfect competition, the maximization of profits leads to equalize the price to the marginal cost of production, in the industrial sector things are quite different. Under monopolistic competition, profit maximization involves pricing strategies related the trade costs and the intensity of competition across the firms in particular markets.

Moreover, there will be two-way trade between region N and region S if a critical threshold for trade costs is set up according to:

$$\tau < \tau_{trade} = \frac{2a}{2b + cN}. \tag{13}$$

In the model, in the long-run, private capital moves freely across the two jurisdictions searching for the highest rewards. Considering that the capital employed in each region is given by the parameter $\gamma \in [0, 1]$, the arbitrage condition establishes that in equilibrium capital rewards r must be the same in the two jurisdictions. Therefore, the following condition must hold:

$$r_N(\gamma) = r_S(\gamma). \tag{14}$$

Solving (14) for γ we obtain γ^M, which is the closed-form solution for the spatial distribution of industry across jurisdictions and depending, among other things, on the trade cost τ and private capital endowment K.

We consider now two local governments maximizing a social welfare function in a Nash-type game. Under such environment, both local governments simultaneously choose first their tax rates, taking the decision of the other as given. The consumers and firms, whose behaviour has been briefly drawn above, maximize then their objective functions given the tax rates established by both local governments. The main modification in the framework sketched above lies in the arbitrage condition (14), which becomes:

$$r_N(\gamma) - t_N = r_S(\gamma) - t_S = \rho, \tag{15}$$

where t_N and t_S are the capital tax rates of local government N and S, respectively. Solving implicitly the new arbitrage condition (15) for γ we arrive at:

$$\gamma\left(t_N, t_S\right) = \gamma^M - 2\frac{t_N - t_S}{\tau^2}\frac{(2b + cK)}{cKL\left(b + cK\right)}. \tag{16}$$

This function $\gamma\left(t_N, t_S\right)$ guides the distribution of industry across the territory but taking now into account the local tax rates set by the different governments N and S.

We start by maximizing the social welfare function of the jurisdiction N given by:

$$W_N = G_N - \frac{t_N^2}{2}, \tag{17}$$

where G_N is tax revenue in jurisdiction N (Baldwin and Krugman (2004)). This specification of the social welfare function is compatible with a government modelled as benevolent or as a Leviathan. If the government is benevolent, the utility function of the consumer should include public spending as argument; this is not the case here but other related papers have considered this possibility (Lopez-Rodriguez et al. (2022b)). The government budget constraint in N is:

$$G_N = \gamma t_N K, \tag{18}$$

where t_N is the tax rates levied on capital by the jurisdiction N. Following Ottaviano and van Ypersele (2005), we set up without loss of generality that G is exogenously fixed and since the government budget must be balanced, the tax rate on capital is accordingly chosen. Consequently, the optimization problem is one-dimensional and the optimal tax rate on capital in N is obtained as a function of t_S, $t_N(t_S)$, that is, the reaction function of t_N with respect to t_S.

Coping with the symmetric optimization problem of the other jurisdiction is straightforward. The social welfare function is quite similar to that used for the jurisdiction N, namely,

$$W_S = G_S - \frac{t_S^2}{2}. \tag{19}$$

The government budget constraint is identical to the jurisdiction N (except from the obvious change in the subindexes). Therefore, using again the expression (16), the derivative of (19) with respect to t_S allow us to obtain its first-order condition. With the two reaction functions both local tax rates are achieved. For sake of brevity, given the symmetry of Nash-type game, we focus hereafter in the case of jurisdiction N.

Analytically, the derivative of t_N with respect to the agglomeration σ depends on constant parameters of utility function, the total endowment of capital K and the trade cost τ. That is, there exists a linear relationship between the local tax rate and agglomeration σ, which is present in the closed-form of such a derivative ($-\frac{2(b+cK)L\tau(-2a+b\tau)}{12b+6cK+c(b+cK)L\tau^2}$), which is independent of σ. It can be also proved that this relationship is always positive, given the restrictions on a, b, c and τ, and the general parametrization of L and K used below.

In other words, the higher the levels of agglomeration found in a jurisdiction, the higher the tax rates set up by its local government, keeping an invariant proportionality between both variables as well. As is known, this is the standard result behind the presence of taxable agglomeration rents across jurisdictions with a mobile factor, capital, that can be taxed. Our previous empirical findings showed this kind of results in panels (a) and (b) of Figure 3.

But things substantially change when a different social welfare function is considered. Indeed, let us now assume, following Ottaviano and van Ypersele (2005), the following functional form for the social welfare function in jurisdiction N:

$$W_N = S_N(\gamma)\sigma L + \sigma L + \gamma r_N(\gamma)K - (\gamma - \sigma)\rho K, \tag{20}$$

where S_N is the consumer surplus in N, σL represents the total wages paid in N, $\gamma r_N(\gamma)K$ is the corresponding reward to private capital and $(\gamma-\sigma)\rho K$ refers to the net contribution of private capital located in jurisdiction N. The government budget constraint is:

$$G_N = t_N \gamma K + t_N^L \sigma L, \tag{21}$$

where G_N is tax revenue and t_N and t_N^L are the tax rates levied by the jurisdiction N on capital and labour, respectively. Again according to Ottaviano and van Ypersele (2005), setting G as exogenous and since the government budget must be balanced, choosing the tax rate on capital implicitly determines the tax rate on labour.

Coping with the symmetric optimization problem of the other jurisdiction is straightforward. The social welfare function is quite similar to that used for the jurisdiction N, namely,

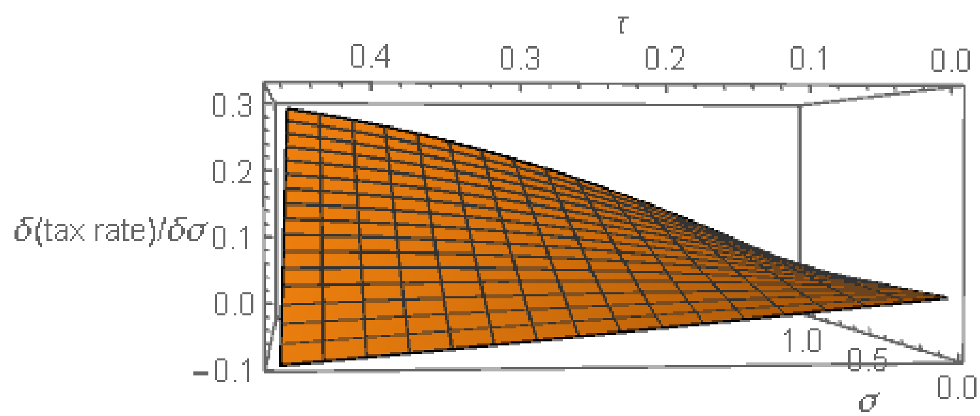
$$W_S = S_S(\gamma)\left(1-\sigma\right)L + \left(1-\sigma\right)L + \left(1-\gamma\right)r_S(\gamma)K + (\gamma-\sigma)\rho K. \tag{22}$$

The government budget constraint follows the same pattern than that of N.

Therefore, using again the expression (16), the derivative of (22) with respect to t_S allow us to obtain its first-order condition. With the two reaction functions both local tax rates are achieved. Focussing again on the jurisdiction N, the analytical expression for the derivative of t_N with respect to σ is rather cumbersome and difficult to reach as a closed-form. Yet, a clear result arises: the relationship between the local tax rate and agglomeration is now non-linear.

And interestingly, this relationship is positive or negative depending upon the value of σ. In order to see that, we have carried out a numerical simulation of the derivative at play. With this aim, we have set up that $\beta = \alpha = 1$ and $\nu = 0.7$, $L = 1$, and $N = K = 1$ as usual convention (Ottaviano and van Ypersele (2005)).

Figure 5: The impact of agglomeration on changes in tax rate: Numerical simulation with (20)



Note : Own elaboration

On the vertical left axis of Figure 5, we have the derivative of t_N with respect to σ. It can be clearly seen that its value is negative for relatively low values in σ. This corresponds to the first interval in panels (c) and (d) of Figure 5, in which a depressing impact of agglomeration on local tax rates is found. As the value of σ goes up, the derivative of t_N with respect to σ becomes positive and higher, reflecting an increasing positive effect of agglomeration on local tax rates. In this latter case the situation is that of the positive and increasing-slope part of estimates in the right hand side of Figure 5, panels (c) and (d).

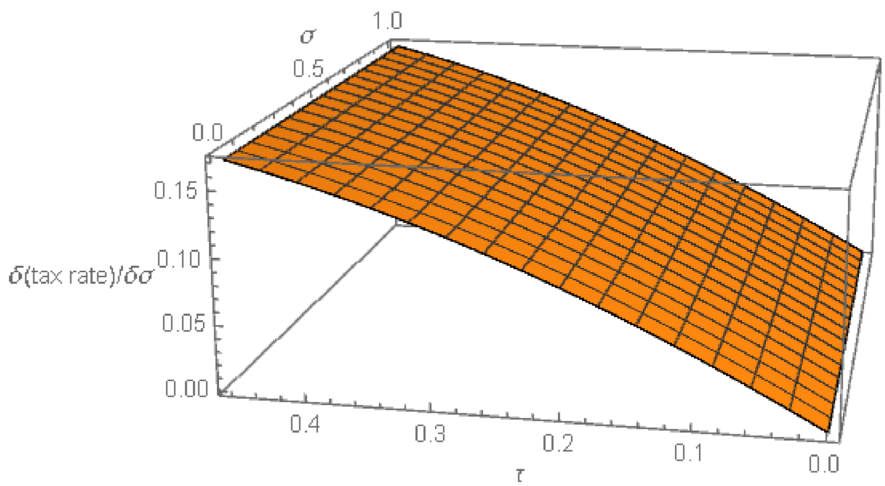
The first interval, very short in size, is related to the "race-to-the-bottom" in local jurisdictions tax rates. In this interval, the size of municipalities is small enough to highlight the competition for capital as a key factor in tax decisions. The similarities across jurisdictions in this group are strong enough to pay special attention on fiscal competition. Note that the variable we have used in the previous empirical part of the paper to proxy agglomeration is market potential, measured as the sum of the market potential on the the own jurisdiction plus the market potential created by the economic activities in neighbouring municipalities.

Regarding this, it can be said that the standard result from the typical economic geography models (with taxation on agglomeration rents) do not appropriately fit for explaining the "race-to-the-bottom" we have found in this group of jurisdictions. It therefore makes sense that the optimal strategy to follow by the smallest jurisdictions is to compete for attracting very elastic supply of capital. This is the clear outcome from tax competition models (Wilson, 1986; Zodrow and Mieszkowski, 1986; Wilson, 1991; Bucovetsky, 1991). However, as the levels of agglomeration increase and the municipalities become greater, the competition for capital is less crucial. The most important part of the influential agglomeration comes then from the own size of the jurisdiction and the neighbouring municipalities as well. Attracting capital from other locations by taking tax decisions plays therefore a very secondary role.

In a sense, what we see here is a kind of evolution from a context of fiscal competition to other of taxation of agglomeration rents. As the agglomeration in the jurisdiction N becomes more important, the optimal tax strategy based on setting low tax rates is progressively deactivated. Higher levels of agglomeration then lead to higher tax rates, pursuing the appropriation of rents. Therefore, we have connected our previous rich empirical findings, in which both tax competition and taxation on agglomeration rents are simultaneously present, with a theoretical framework in which both options are feasible as well. Moreover, we have featured tax setting using an approach with the usual ingredients of economic geography models, namely, imperfect competition, trade cost and agglomeration forces. And despite that, there is also scope for tax competition, which is usually obtained under quite different assumptions.

However, this is not the case when the social welfare functions (17) and (19) are taken into consideration. As we have already pointed out, the derivative of t_N with respect to σ is in turn independent of σ. To show this from an additional approach, a similar representation of such a derivative is provided in Figure 6, once an identical numerical evaluation to the previous one has been carried out. It shows that the value of the derivative keeps unchanged when σ varies, given a determined value for the trade cost τ. There is no scope for differential strategies by setting different business tax rates depending upon the level of agglomeration.

Figure 6: The impact of agglomeration on changes in tax rate: Numerical simulation with (17)



Note : Own elaboration

The reasons why, with the same model, the use of different social welfare functions leads to different outcomes in terms of the linearity (or not) of the relationship between tax rates and agglomeration deserves a further discussion. Indeed, the sensitivity of the results to the form of the function to be optimized by the jurisdictions was already pointed out by Baldwin and Krugman (2004). And the theoretical approach sketched in this paper just allows us to outline a potential explanation.

Note that a clear distinction between both the social welfare function by Baldwin and Krugman (2004) and by Ottaviano and van Ypersele (2005) lies in the presence of public spending G in the former. Using a very simple specification, the tax revenue is completely sent back to the consumers, entering as argument into the function to be optimized by the local governments (17) and (19). However, with a social welfare function à la Ottaviano and van Ypersele (2005), the tax revenue collected by capital and labour income taxes are not directly back to the economy and that matters when both different social welfare functions are compared.

There are several ways for dealing with these tax revenues not coming back to consumers. One is assuming that $G^* = 0$ and some taxes (say, tax on capital) become negative (i.e., subsidy) to outweigh the collection from others (say, tax on labour). An alternative option is to devote part of the tax collection to finance productive public spending directly impacting on firm productivity and, consequently, not directly enjoyed by the consumers as public spending (Lopez-Rodriguez et al. (2022b)).

Whichever the scenario is, an important implication can be drawn. The decisions on businesses taxes and their relationships with agglomeration issues is not just a matter of taxes but some considerations on the use given to the tax revenues should be taken into account as well. Whether the social welfare is defined or not in terms of public spending crucially affects the optimal determination of taxes on capital income when agglomeration forces are present.

Under both scenarios, however, the effect of trade cost, τ, on the relationship between agglomeration, σ, and the derivative of tax rate with respect to this agglomeration is the same. The lower the trade cost, the lower the impact of σ on the changes in the tax rates as a result of variations in turn of agglomeration. This decreasing impact keeps the pattern, if linear or nonlinear, previously stated between the variables at play. And in the limit, when the trade cost, τ, is close to zero, the effect of agglomeration on the changes in tax rates tends to zero too. No trade cost leads to a negligible impact of σ on the determination of local tax rates.

Put differently, when the trade cost increases, the effect of agglomeration on the tax rate in the jurisdiction N goes up. We could even claim that the positive (and increasing with social welfare functions à la Ottaviano and van Ypersele (2005)) effect of agglomeration on local tax rates is reinforced as trade costs increase. The latter is a well-known result from the geographical economics literature (see for instance Baldwin et al. (2011)). This is most easily seen for the cost-of-living effect. If the regions are very open in the sense that trade costs are low, then there will be very little difference in prices between the two regions whatever the spatial allocation of production is. Thus, shifting industrial production has only a minor impact on the relative cost of living. However, if trade is very costly, the share of varieties produced locally will have a big impact on price indices. Similar reasoning shows that the market potential advantage is strongest when trade costs are high. And this is the scenario where we are in; recall that to make possible the trade between jurisdictions, we have established a maximum bound for the trade cost $\tau < \tau_{trade} = \frac{2a}{2b+cN}$. Therefore, our results are also aligned to the standard outcome of literature regarding the links between trade cost and agglomeration and, additionally, we have fitted them to our discussion on local tax rates setting.

7. Conclusions

This paper has moved between models with taxation on agglomeration rents and models leading to "race-to-bottom" scenarios in the context of tax competition. Whereas in the former the agglomeration forces guide the tax rates setting, in the latter what the neighbouring jurisdictions do plays an important role. Moreover, we have also paid attention on how the relationship between agglomeration and local tax rates is, if linear or non-linear. With this aim in mind, we have focussed on the Spanish case, where a vast sample of municipalities over the period 2005-2017 has been exploited.

Among the novelties included in the paper we would highlight the use of advanced semi-parametric econometrics, not previously employed in this type of studies. On this basis, we have controlled for the potential non-linearities existing among the variables involved without imposing unlikely assumptions on the variables and their mechanics at play. For sure, other circumstances that usually are present in this analyses, such as endogeneity, spatial dependency and unobserved heterogeneity across jurisdictions have been also taken into consideration.

Our approach has begun on the empirical ground to continue then with the fit of findings into standard theoretical models. The point is that our empirical results show evidence in favour of both approaches, the one dealing with taxable agglomeration rents and the standard one compatible with tax competition models. Indeed, the best model obtained after applying the semi-parametric techniques and a number of precautions supports the hypothesis of fiscal competition when the levels of agglomeration are small enough. But when the market potential, that is, our proxy of agglomeration, increases the outcome is clearly aligned with heavier taxation of agglomeration rents.

Moreover, the intensity of such effect of agglomeration on local tax rates depends in turn upon the levels of agglomeration. This is specially true when agglomeration overcomes medium size values ($\sigma > 0.5$) and the biggest jurisdictions take advantage of their ability to attract rents without lowering tax rates. There is therefore evidence of non-linearities, which is an outcome not previously found in the literature.

Both empirical results have been interpreted in light of theoretical models based on the standard assumptions of economic geography models (imperfect competition, increasing returns to scale and trade costs). Starting from a social welfare function á la Ottaviano and van Ypersele (2005), with the consumers' surpluses and capital income as arguments, we reach a stylized characterization of the relationship between local tax setting and agglomeration well aligned to the empirical results found. That is, non-linear and compatible with tax competition at low levels of agglomeration and increasingly tax rates at higher levels of agglomeration.

A quite different result (linear relationship between local tax rates and agglomeration and no scope for tax competition) is found by considering a social welfare function à la Baldwin and Krugman (2004). As is well-known, such functional specification includes the public spending as argument. And we guess that this makes the difference. Although the issue deserves a further investigation, we draw that removing the simple assumption used in Baldwin and Krugman (2004), consisting of the devolution of tax revenues as a whole to consumers, plays a crucial role. Indeed, things are not so straightforward in the real world. By contrast, it is not difficult to find cases in which part of the tax revenues are devoted to improve firm productivity instead of sending all of them to the consumers (Lopez-Rodriguez et al. (2022b)) or just wasted in political/electoral activities with no direct effects on consumers' welfare.

Having arrived at this point, at least a couple of avenues for further research arise. One is precisely motivated by the theoretical fit of the above empirical findings we already did in the previous section. Although we have some understanding on the facts behind the presence of a non-linear relationship between the local tax rates and the agglomeration, other factors deserve a further reconsideration. Particularly, we are referring to those involved in political economy extensions such as those coping with median voters or governments interested in maximizing the voters they receive in local elections.

Alternatively, we are also wondering on how our results might be modified if the jurisdictions play a different game. Instead of the Nash scheme we have followed here, what would it happen if one of the local governments behaves as a Stackelberg leader when sets its tax rates. Given a determined level of agglomeration, what would the optimal behaviour of the other (follower) jurisdiction be?

On the empirical ground, a straightforward extension of this paper includes considering alternative agglomeration measures to market potential (Balassa indexes, Employment density). Other potentially fruitful avenues for further inquiry could include studying the effects of localization economies as oppose to the urbanization ones (the ones dealt with in this paper) based on the fact that in some industries firms tend to locate in a few areas creating highly specialized economic clusters.

In terms of policy implications some lessons can be drawn from the analysis carried out. First, in line with what we have claimed in the previous section, the use given to the tax revenues matters. Whether they come back to the consumers or, alternatively, they are used for (un-)productive public spending has implications on the effect of agglomeration of local tax setting. In other words, both sides of the public intervention in the economy, taxes and public spending, must be taken into consideration in public policies aimed at impacting firms' location.

Second, the position of the jurisdiction when agglomeration is at play becomes crucial to take decisions on local taxes. If the local economy is small in terms of agglomeration, the optimal strategy should consist of setting low tax rates, even in the presence of monopolistic competition, sectors with increasing returns to scale and trade costs. This is a breaking result as long as, with such as assumptions, the standard recommendation based on the stylized performance of economic geographic models, was to increase tax rates to capture agglomeration rents. However, we have shown here that fiscal competition might well be optimal with agglomeration forces.

Acknowledgements

To be completed

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Appendix

To be completed if any.