PAPER

Title: Fiscal choices, market potential and fiscal Interactions across Spanish municipalities

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Subject area: Public sector and regional financing

Abstract: This paper presents a geographical economics model to analyse the relationship between business tax rates and agglomeration economies. The theoretical model predicts that in the presence of agglomeration economies, competition between different jurisdictions leads to a race-to-the top (jurisdictions with higher levels of agglomeration set up higher tax rates). Using data on the business tax rate (Impuesto de Actividades Económicas, IAE) for the case of the Spanish municipal system throughout the period 2005-2017, we analyse the theoretical predictions of the model regressing municipal business tax rates against municipal market potential using a fixed effects spatial panel data model. The results of the estimates conclude in favour of a positive and significant relationship between market potential are business tax rates. The results of our estimates are robust to the inclusion of electoral cycle dummies, "horizontal" and "vertical" fiscal interactions, and the use of different spatial weighting matrices.

Keywords: Geographical Economics, tax competition, market potential, taxable agglomeration rent, spatial dependence, vertical fiscal interactions, horizontal fiscal interactions

JEL codes: H2, H3, C23, R12

1. Introduction

The concentration of economic activity in certain areas of the territory is a secular trend that does not leave companies, workers, and governments indifferent. The theory of Geographical Economics has become the most fruitful theoretical framework to explain these patterns of concentration of economic activity based on general equilibrium models where the interaction between increasing returns to scale and monopolistic competition endogenously generates these core-periphery territorial dynamics. Since the pioneering works of Krugman (1980, 1991), the theory of Geographical Economics has experienced a very important growth not only in its theoretical contributions but also from the empirical point of view through the estimation of its main theoretical predictions (see Charlot & Paty, 2007; Head & Mayer, 2004; Lopez-Rodriguez et al., 2007).

Geographical Economics models explain the dynamics of concentration/dispersion of economic activity based on the tension and intensity that exists between centrifugal forces and centripetal forces. The main centripetal forces are the "*market access*" effect (companies tend to locate their production near large markets and export to small ones) and the "*cost-of-living*" effect (consumers tend to locate themselves where firms are located to enjoy lower prices and a greater variety of goods they demand). The main centrifugal force is the so-called "*market-crowding*" effect (tendency of firms to locate in regions with few competitors). The predominance and intensity of one or another type of forces allow the endogenous generation of situations in which economic activity can end up being concentrated in a few locations in space, giving rise to core-periphery patterns in the distribution of economic activity. These concentration patterns constitute one of the most outstanding characteristics of the spatial configuration of economic activity.

The central idea of the Geographical Economics models applied to the fiscal field focuses on the role of agglomeration forces as factors that are capable of transforming foot-loose production factors into "quasi" fixed production factors, giving governments room to set higher tax rates in locations with higher density of economic activity. Consequently, in the Geographical Economics models, governments are able to extract fiscal rents derived from agglomeration what is refer to as "taxable agglomeration rents" (Andersson & Forslid, 2003; Krogstrup, 2008).

The main goal of this paper is to contrast the theoretical predictions of the Geographical Economics models in relation to the impact of agglomeration economies on the setting of tax rates. Specifically, we will try to answer the following question: Do local governments take into account that the mobility of their tax bases depends on the agglomeration economies? and, if so, do they choose tax rates in accordance with these considerations? To answer this question, we first present a geographical economics model which allows us to ground our econometric specification relating local tax setting to the relative size of the local demand which is proxied by market potential. Then, we estimate this specification (fixed-effects spatial panel data model) for a sample of 7258 Spanish municipalities for 2005-2017 finding a significant role for market potential. Robustness test controlling for potential cofounding factors that affect local tax setting (vertical tax interactions, horizontal tax interactions, electoral cycle, etc.) do not alter our main finding.

The rest of the paper is structured as follows: Section 2 introduces the Geographical Economics model that grounds our empirical estimations. Section 3 deals with the empirical strategy. Section 4 describes very briefly the Spanish municipal tax system and the data used. Section 5 presents the results. Finally, the last section contains the main conclusions.

2. Theoretical model: Agglomeration economics and tax setting

2.1 Assumptions

The model is 2x2x2x2 linear foot-loose capital (FC) model with no income effects: Two regions (North- *N* and South-*S*), two factors of production (L- and K-factor owners which are geographically immobile with the key feature that the services of L are embodied in its owners whereas the services of K are provided wherever convenient implying *de facto* mobile capital and immobile labour), two private sectors (Agricultural sector which employs only labour to produce a freely tradable homogenous good (A) under constant return to scale (CRS) and perfect competition and a manufacturing Dixit-Stiglitz sector

(M) producing $N = n_N + n_S$ non-freely tradable industrial varieties of a horizontally differentiated M-good under monopolistic competition and increasing returns to scale (IRS) employing labour and capital. Shipping a unit of an industrial variety costs τ units of the A-good) and two local governments which tax the returns on local capital-by playing Nash relative to other jurisdictions- to supply local public goods.

2.2 Production technologies

The A-sector operates under CRS employing a_a units of L per unit of A. Therefore, the total unit costs of producing q_0 units of the A-good are:

$$TC(q_0) = a_a \omega_L q_0 \qquad [1]$$

where $\omega_L$is the wage and a_a the units of L per unit of A-good

The M-sector operates under IRS producing the M-good using labour (L) and capital (K). IRS are featured through a linear cost function with fixed and variable costs. We assume that F units of capital (fixed cost) are needed to produce one variety of the M-good and a_m (variable cost) units of L per unit of output (variety). Therefore, the total costs face by a representative North region firm to produce q units of a variety i are:

$$TC_N(q(i)) = r_N F + a_m \omega_L q(i) \qquad i \in [0, N] \qquad [2]$$

where r_N is the nominal capital reward in region N and a_m the units of L per unit of output.

We assume that physical capital moves freely across locations and capital flows are driven by nominal rather than real rewards since capital income is sent to the owner´s capital regardless of where capital is employed.

2.3 Preferences, endowments and normalizations

Consumers are endowed with one unit of labour (L) and $\bar{q}_0$ units of the A-good. Consumer preferences are identical and are defined over the consumption of a homogeneous A-good and the consumption of the different varieties of the M-good. The utility function which

consumers localised in region North maximise is assumed to take a quasi-linear quadratic form:

$$U_N\big(q_0, q(i)\big) = \alpha \int_{i=0}^{n_N+n_S} q(i)di - \frac{\beta - \nu}{2}\int_{i=0}^{n_N+n_S} [q(i)]^2 di - \frac{\nu}{2}\left[\int_{i=0}^{n_N+n_S} q(i)di\right]^2 + q_0 \quad [3]$$

Where $q(i)$ represents the consumption of variety i of the M-good, q_0 represents the consumption of the A-good, $N = n_N + n_S$ the number of available varieties of the M-good. We assume that the amount of q_0 produced in the economy is sufficiently large to warrant that all consumers have access to consume $q_0 > 0$.

Supplies of K_N, K_S and L_N and L_S across the two regions are fixed, with the total endowment of the two regions denoted as L and K. We have to distinguish between the share of world capital (K) *owned* by residents located in region N (we denote it by $\sigma = \frac{L_N}{L} = \frac{K_N}{K}$ which is equal to the share of total labour in region N) from the share of world capital *employed* in region N (we denote it by $\gamma \in [0,1]$).

We consider the A-good as the numeraire (P_A=1) and $a_a = 1$, so the total unit costs of producing each unit of the A-good are equal to the wage (ω_L). In the M-sector each industrial firm requires one unit of K (F =1) to produce one variety, a_m are the units of labour needed to produce any amount of a variety, which implies that the marginal cost of production of a variety is set equal to zero[1]. Therefore, the implied cost function for firm located in the North region to produce any amount of a variety (i) is:

$$TC_N(q(i)) = r_N + a_m \quad i \in [0, N] \qquad [4]$$

2.4 General equilibrium

2.4.1 Consumer equilibrium (demand side)

Consumers maximize their utility function subject to the budget constraint which yields a linear demand for the quantities of a variety (i) of the M-good as:

[1]This simplifying assumption is standard in many models of industrial organization

$$q(i) = a - bp(i) + c\int_{i=0}^{i=n_N+n_S}[p(j) - p(i)]dj \qquad [8]$$

In this demand function $p(i), p(j)$ are the prices of variety i and j. The consumption of q_0 of the A-good is determined as a residual.

2.4.2 Producer Equilibrium (supply-side)

In the A-sector, perfect competition, profit maximization and constant returns to scale imply that price equals marginal costs of production (marginal costs pricing). This means that: $P_A^N = w_L^N$ and $P_A^S = w_L^S$ and free trade in the A-sector between the two regions means that L wage is equalize across the two regions. Moreover, taking into account our normalizations and choosing the A-good as numeraire gives: $P_A^{\mathrm{N}} = w_L^{\mathrm{N}} = P_A^{\mathrm{S}} = w_L^{\mathrm{S}} = 1$.

In the manufacturing sector a firm producing variety i in the N region maximizes the following profit function:

$$\Pi_N(i) = p_{NN}(i)q_{NN}(i)\,\sigma L + [p_{NS}(i) - \tau]q_{NS}(i)(1-\sigma)L - r_N \qquad [12]$$

where p_{NN} and q_{NN} represent the prices and quantities of the i variety sold in the domestic market and p_{NS} and q_{NS} are the prices and quantities (exports) sold in region S. r_N represents the capital rewards in region N.

Assuming firms compete in prices, a firm in region N will charge the following consumer prices:

$$p_{NN}^{*} = \frac{1}{2}\frac{2a + \tau c n_S}{2b + cN} \quad \text{and} \quad p_{SN}^{*} = p_{NN} + \frac{\tau}{2} \qquad [13]$$

Where symmetric equations holding for the S region. These pricing strategies imply that a) prices charge in region N by domestic and foreign firms increase when trade costs increase; b) these price increases in the local market get larger when more competitors are located in the other market (large n_S); and c) prices decrease with increases in the total number of firms.

2.4.3 Equilibrium rental rates (supply-side and long-run equilibrium)

The equilibrium value for the firms´ capital reward (rental rate) in the N region can be determined by imposing the condition of zero benefits in expression (#12) based on the fact that in the long-run, firms 'free entry and exit into the M-sector implies that $\Pi_N(i) = 0$.

$$r_N^*(n_S) = \frac{b + cN}{4(2b + cN)^2}\{[2a + \tau c n_S]^2 \sigma L + [2a - 2\tau b - \tau c n_S]^2 (1 - \sigma) L\} \qquad [16]$$

2.4.4 Equilibrium capital location

In the model, in the long-run, physical capital moves freely across the two regions seeking the highest rewards. Considering that the capital employed in each region is given by the parameter $\gamma \in [0,1]$, the arbitrage condition stablishes that in equilibrium capital rewards must be the same in the two regions.

Equation (#16) implies three potential "location conditions" depending on the values of the parameter γ: Non-catastrophic agglomeration of industrial firms for $\gamma \in (0,1)$ ($r_N(\gamma) = r_S(\gamma)$) and two catastrophic agglomerations either in region N or regions S $\gamma = 1 \rightarrow r_N(1) \geq r_S(1)$ and $\gamma = 0 \rightarrow r_N(0) \leq r_S(0)$

Considering initial asymmetric regions, $\sigma > 1/2$, (region N being better endowed), it can be shown that $r_N(\gamma)$ is a decreasing function of γ. Using the arbitrage condition (#16) and solving the location condition for the geographical division of physical capital between the two regions, we get:

$$r_N(\gamma) = r_S(\gamma) \rightarrow \gamma^M = \frac{1}{2} + \frac{2(2a + \tau b)}{\tau c K}\left(\sigma - \frac{1}{2}\right) \qquad [17]$$

This close-form solution for the spatial division of industry depends among other factors on the trade costs τ and factor endowments K. Moreover, considering the asymmetric case, $\gamma^M > \sigma > 1/2$ which implies that the number of industrial firms located in the N region is more than proportional to the capital owned in that region (Home market effect, Helpman & Krugman, 1985).

2.4.5 Local governments´ behaviour and tax competition

In our model, there are two local governments which maximize a social welfare function and tax local capital. Governments play a Nash game which is structured in two steps. In the first step, governments choose simultaneously the tax rates that maximize their social welfare functions; in the second step, consumers and firms maximize their utility and profit functions given the tax rates established in the first step.

The Nash game is solved by backward induction, starting by the second step where firms and consumers maximize their utility functions. In this step neither equilibrium prices, nor capital rewards experience changes when tax rates are introduced. The main change operates in the equilibrium capital location since the new arbitrage condition takes into consideration the net capital rewards (capital rewards after tax rates). The new arbitrage condition is given by:

$$r_N(\gamma) - t_N = r_S(\gamma) - t_S \qquad [19]$$

Assuming non-catastrophic agglomeration, the new location condition for the geographical division of physical capital considering tax rates set by the different governments are:

$$\gamma(t_N, t_S) = \gamma^M - 2\frac{t_N - t_S}{\tau^2}\frac{(2b + cK)}{cKL(b + cK)} \qquad [20]$$

In the first step of the game, governments maximize the following social welfare function. For the N region the W_N function is given by the following expression:

$$W_N = S_N(\gamma)\sigma L + \sigma L + \gamma r_N(\gamma)K - (\gamma - \sigma)\rho K \qquad [21]$$

Where $S_N(\gamma)$ represents individual consumer surplus in region N, σL represents total wages paid in region N to labour, $\gamma r_1(\gamma)K$ represents total capital rewards in region N in the M-sector, $(\gamma - \sigma)\rho K$ represents the net contribution of capital located in region S where ρ encapsulates the arbitrage condition given by equal after-tax capital rewards (net capital rewards) in the two regions $\rho = r_N(\gamma) - t_N = r_S(\gamma) - t_S$).

Governments maximize W_N subject to the following budget constrain:

$$G_N = t_N\gamma K + t_N^L\sigma L \qquad [22]$$

Where G_N represents the amount of government spending which is exogenously given (we assume budget balance); t_N is the tax on capital and t_N^L is the tax on labour.

Solving the game, the following equation for the tax rate gap between the two regions is given by:

$$t_N^* - t_S^* = \frac{\tau L(2\sigma - 1)(b + cK)[6a - \tau(3b + cK)]}{2(12b + 5cK)} \qquad [23]$$

For similar size regions ($\sigma = 1/2$), equation (#21) shows that the Nash solution of the game gives identical tax rates in N and S regions. In this case, a race-to-the-bottom kind of tax competition arises based on similarity of regions, preference for diversity and integration across regions (Baldwin & Krugman, 2004). However, for initially asymmetric regions (N region better endowed than S region, $> 1/2$) the Nash solution of the game shows that the tax rate set in the N region is greater than the tax rate set in the S region.

Differentiating this tax-rate gap with respect to capital owned in the N region for initial asymmetric factor endowments ($\sigma > 1/2$) we get:

$$\left.\frac{\partial(t_N^* - t_S^*)}{\partial\sigma}\right|_{\sigma>1/2} = \frac{2\tau L(b + cK)[6a - \tau(3b + cK]}{2(12b + 5cK)} > 0 \qquad [25]$$

Since σ represents the share of labour and capital owners in the N region (and therefore the share of total demand in the N region), Equation (#24) shows that the gap between the optimal tax rates set in N and S increases in the relative size of the local demand. This effect gets larger the higher the trade costs. Therefore, we can conclude that there is a taxable agglomeration rent for large regions that governments can exploit without risking capital outflows to smaller regions.

3. From theory to empirics

Our objective from an empirical point of view, following the line of different studies carried out on the relationship between tax setting and agglomeration economies (Charlot

& Paty, 2007), is to contrast the theoretical prediction determined by the expression (#25) of our theoretical framework using information about the Spanish municipal tax system.

3.1 Baseline model

To contrast the existence of a taxable agglomeration rent associated with the effect of the "Market Potential" we initially estimate a simple model (Baseline model, #26) in which we regress the municipal business tax rates based on municipal market potentials:

$$t_{i,t} = c_i + \rho W t_{j,t} + \beta_1 MP_{i,t} + \varepsilon_{i,t} \qquad [26]$$

where $t_{i,t}$ is the business tax rate set by municipality i in year t; $t_{j,t}$, the business tax rate established by the rest of the municipalities $i \neq j$ in year t; W, the weight matrix; $MP_{i,t}$ is the market potential of municipality i in year t , c_i represents the municipal fixed effect that captures the potential unobservable municipal heterogeneity that remains fixed over time and $\varepsilon_{i,t}$ the error term.

3.2 Controlling for electoral cycle

To control for the electoral cycle, we introduce dummies into our baseline model to try to capture the tendency of municipalities to set lower tax rates before the elections and higher once they are held (#27).

$$t_{i,t} = c_i + \rho W t_{j,t} + \beta_1 MP_{i,t} + \beta_2 dce_{i,t-1} + \beta_3 dce_{i.t} + \beta_4 dce_{i,t+1} + \varepsilon_{i,t} \qquad [27]$$

where $dce_{i,t-1}$ is a dummy variable that takes the value 1 in the year prior to the municipal elections; $dce_{i,t}$ takes the value 1 in the year of holding municipal elections and $dce_{i,t+1}$ takes the value 1 in the year after the municipal elections.

3.3 Controlling for vertical fiscal interactions

The presence of these "vertical externalities" is a phenomenon that has been studied in the publics economy literature by different authors (see Keen & Kotsogiannis, 2002).

In the case of Spain, there are tax concepts on which the different levels of government apply different tax rates. On the one hand, in the personal income taxes there is a state rate in addition to the rates applied by the different Autonomous Communities. In the case of the economic activities (business) tax (IAE), in addition to the municipal tax, an additional tax rate called "IAE provincial surcharge" is also established at the provincial level.

Our model allows not only the possibility of controlling for "horizontal" type of fiscal interactions between the different municipalities through the W matrix, but we will also take into account the possibility of "vertical" type fiscal interactions. Therefore, equation #27 is expanded as follows (#28):

$$t_{i,t} = c_i + \rho W t_{j,t} + \beta_1 MP_{i,t} + \beta_2 dce_{i,t-1} + \beta_3 dce_{i,t} + \beta_4 dce_{i,t+1} + \gamma t_i^p + \varepsilon_{i,t} \quad [28]$$

Where t_i^p represents the tax rate of the province to which the municipality belongs.

3.4 Econometric procedure

Equations (#26) and (#27) take into account the simultaneous presence of horizontal fiscal interactions, as well as the presence of spatial interactions, while equation (#28) also includes the presence of vertical fiscal interactions. The spatial dependence reflected in equations (#26-#28) is that of a spatial autoregressive process commonly known in the spatial econometrics literature as the SLM model (Spatial Autoregressive Model/Spatial Lag Model). The potential presence of these spatial dependency patterns in our data makes Ordinary Least Squares (OLS) estimates inappropriate. This estimation procedure provides biased and inconsistent estimators because we are dealing with a spatio-temporal model that causes the existence of autocorrelation and, probably, heteroscedasticity (Anselin, 1988; Anselin & Hudak, 1992).

Following Baltagi (2001), when the regression analysis is limited to a predetermined set of jurisdictions as is our case the appropriate model is an autoregressive spatial model with fixed effects. The estimation of the different proposed models will be carried out through Maximum Likelihood (ML).

4. Data

4.1 Spanish municipal system and municipal selection

The organizational model of the Spanish State, also known as *Estado de las Autonomías*, necessarily implies the creation of an adequate financing structure that provides sufficient resources at each level of government to meet the expenditure needs. This organizational form, in which the central government delegates powers to regional or local governments, is called fiscal federalism.

The level of local/municipal disaggregation in Spain according to the European territorial classification is referred to as NUTS-4 and consists of a total of 8131 municipalities. In our sample set we exclude from the analysis the municipalities that belong to: a) the two archipelagos; b) the autonomous cities of Ceuta and Melilla and; c) the so called "régimen foral" (Basque Country and Navarra). With these adjustments, the number of remaining municipalities is 7258 that will be analysed for the period 2005-2017.

There are three mandatory taxes and two taxes of voluntary establishment by municipalities. The compulsory levying taxes are the Real Estate Tax (IBI), the Economic Activities Business Tax (IAE) and the Mechanical Traction Vehicles tax (IVTM). The other two voluntary taxes are those applied to the increase in the value of urban land and to request a license to build or repair a premise.

4.2 Construction of variables

When approximating the variable municipal business tax rate, $t_{i,t}$, it is necessary to make an approximation to the relevant tax rates that affect the location decisions of the mobile factor (capital) when agglomeration economies at the local level are present. The local figure that taxes mobile capital in our municipal system is the so-called economic activities tax or business tax. The business tax is computed from coefficients that are applied considering the geographic locations of corporations within the municipality. Following the methodology used by Portillo Navarro (2018), we calculate the average of the maximum and minimum location coefficients of the IAE for each municipality. This business tax presents a full exemption for all those economic activities with a turnover less than one million euros.

On the other hand, the Real State tax (IBI), Mechanical Traction Vehicles tax (IVTM), Increase in Value of Urban Land tax (UL) and Constructions, Installations and Works tax (ICIO) are taxes that influences the location decisions of firms. Therefore, another alternative that we will use to approximate the variable $t_{i,t}$ consists in calculating the share of municipal revenues collected through these taxes over the municipal gross income (fiscal burden).

The Market Potential (MP) variable 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. For its calculation, different indicators were used both for the volume of economic activity $Act_{j,t}$ and the distance between municipalities d_{ij}. The general expression used to calculate the Market Potential is given by expression (#30)

$$MP_{i,t} = \frac{Act_{i,t}}{d_{ii}} + \sum_{j \neq i} \frac{Act_{j,t}}{d_{ij}} = DMPit + FMPit \qquad [30]$$

The first term of expression (#30) refers to the *Domestic Market Potential* (DMP) of jurisdiction i, that is, the contribution of jurisdiction i, to the total Market Potential faced by jurisdiction i. The second term refers to the *Foreign Market Potential* (FMP) of jurisdiction i that represents the contribution of surrounding municipalities to the total Market Potential of jurisdiction i.

The proxies for economic activity ($Act_{i,t}$) used to calculate the Market Potential for each of the Spanish municipalities are three: a) The population of each municipality; b) the Municipal Gross Income and; c) Municipal disposable Income.

The data sources that we use to obtain these indicators are the Spanish national institute for statistics (INE) for the municipal population data and information provided by the Spanish Tax Agency for the data referring to the two economic indicators of income. The information provided by the Spanish Tax Agency is only available for municipalities with more than 1.000 inhabitants. For municipalities with a population less than or equal to this figure we use provincial income data, through which an approximation of the municipal income values is obtained by distributing the provincial aggregate income of all municipalities with a population figure below 1.000 inhabitants based on the percentage of population that each municipality represents over the total population of that group within the province.

Such that the subscript i represents the municipality for which the income is imputed and j represents the set of municipalities with a population of less than 1.000 inhabitants within the province to which municipality i belongs.

The distance variable d_{ij} that appears in the denominator of the Market Potential (#30) represents, on the one hand, the distance within each municipality and the distance from each municipality to the surrounding municipalities. The internal distance within each municipality is estimated assuming that the geometric shape of the municipality is a circle, and, from the area data, the radius of the circle is calculated. The radius is multiplied by a coefficient λ (see Crozet, 2004; Head & Mayer, 2011) obtaining the theoretical intra-municipal distance (km) between two points in the municipality for different values of λ coefficient (#32).

$$d_{ii} = \lambda\sqrt{\frac{area_i}{\pi}}, \quad where\ \lambda = \left\{\frac{1}{3}, \frac{1}{2}, \frac{2}{3}\right\} \qquad [32]$$

This intra-municipal distance has also been calculated in travel times distances (minutes). For this, an average speed of 20 km/h, 30 km/h and 50 km/h has been assigned depending on whether the municipality is classified as urban, intermediate, or rural respectively. The classification of municipalities into urban, intermediate, and rural has been carried out based on population criteria combined with density and number of inhabitants (OECD, 1994).

The estimation of the inter-municipal distance (d_{ij}) has also been carried out both in km and in travel times (minutes). The estimation in km between each municipality and the surrounding municipalities was made considering the Euclidean distance between the centroids of each municipality. To calculate the inter-municipal distance in minutes, the open source database *Open Street Maps (OSM)* and the statistical package OSRM (Giraud et al., 2020) was used. The advantage of this second metric for calculating the distance between municipalities is that it allows controlling for the quality of the infrastructure.

Finally, in our model (#29), the spatial weight matrix (W) captures the impact of potential horizontal tax interactions in setting municipal tax rates. Municipalities when making their tax decisions can take into account the decisions made on the same issues by the "neighbouring" municipalities.

The coefficient associated with the weight matrix (ρ) determines the spatial dependence and allows analyzing the intensity of the municipal interaction when setting tax rates. A positive and significant coefficient indicates that there is a “tax mimicking” between municipalities when setting their tax decisions. Authors such as Solé Ollé (2003) predict the existence of tax mimicking across regional entities, so that, if a municipality sets a high level of taxes, it is likely that nearby municipalities develop the same strategy. This causes the coefficient associated with the autoregressive term (ρ) to take a positive expected value. The higher the value of the coefficient, the greater influence the nearby municipalities have in the strategic decision of each municipality. The concept of "nearby municipality" will vary depending on the specific way in which the matrix (W) is constructed. Initially, we will use as a neighbourhood criterion the by road 5 nearest neighbours. The W weight matrix will be row-standardized to suppress any type of distortion generated by the measurement units used (Kelejian & Prucha, 2010).

4.2.1 Robustness tests for W

Given the wide variety of ways in which the "neighbourhood" criterion can be defined, we enrich the model by specifying alternative definition for the spatial weight matrix (W). The road distance between municipalities criteria have been considered.

Road distance was estimated using an open source database (Open Street Map, OSM). Each element of the matrix (w_{ij}^{d}) is estimated using the expression (#34) where the distance decay parameter α takes the values -1 (the influence/interaction between municipalities decays with distance linearly) and -2 (the influence /interaction between municipalities decays with the square of the distance, similar to Newton's gravity model).

$$w_{ij}^{d} = \frac{d_{ij}^{-\alpha}}{\sum_j d_{ij}^{-\alpha}} \quad where\ \alpha = -1\ or\ \alpha = -2 \qquad [34]$$

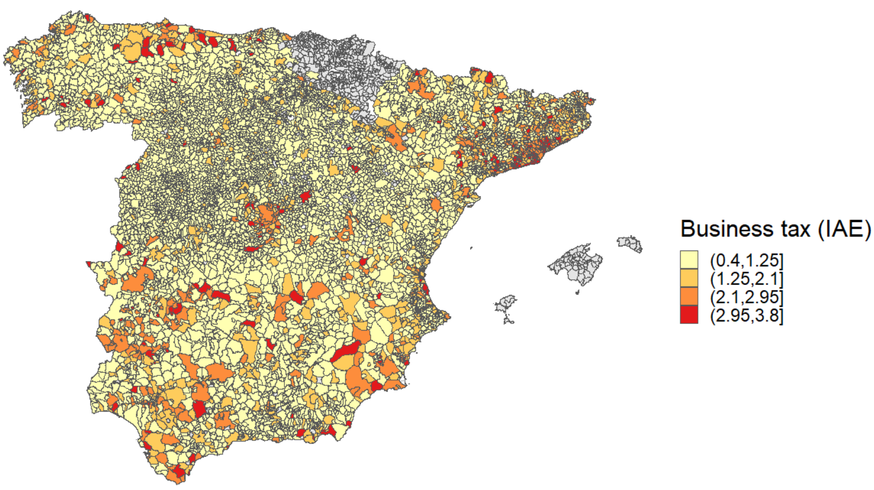
5. Results

5.1 A first approach to the relationship between business tax rates and market potential

Figure 2 depicts the distribution of the business tax (IAE) across the Spanish municipalities for the year 2017. At first sight, municipalities located in the most densely populated parts of Spain (from Madrid towards the South jointly with the Northeast) as well as municipalities in regions with above national average economic indicators (Asturias and Cantabria) feature higher business tax rates.

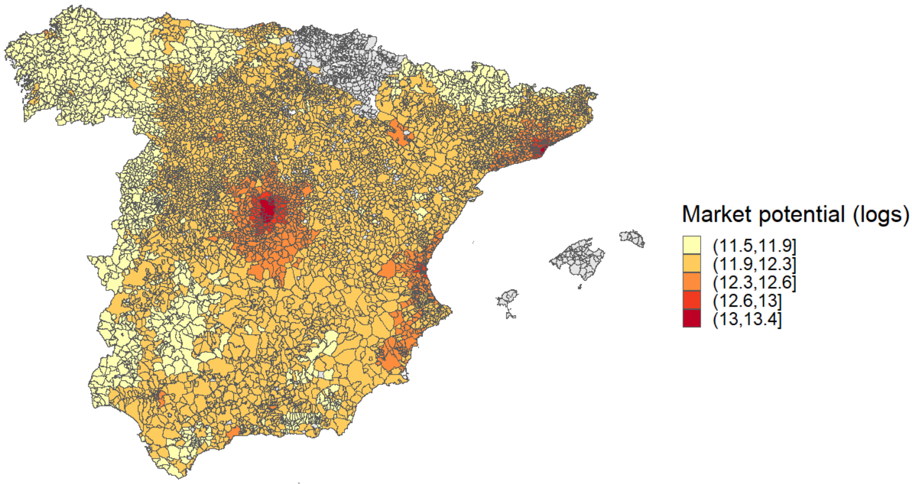
Figure 3 plots the spatial distribution of market potential across municipalities. The map is depicted using a red colour with different intensities to approximate the different municipal market potential values. The reddish the shade the higher the market potential value. It can be seen that the spatial structure of municipal market potentials takes its highest values for the municipalities located in the center of the peninsula and in general in the Eastern part of Spain (in the Northeast towards the Autonomous Communities of Aragon and Catalonia, and in the center and South towards the Autonomous Communities of Andalusia, Valencia and Murcia.

Figure 2: Business tax across Spanish municipalities (2017)



Source: Own elaboration based on data from the National Institute for Statistics (INE)

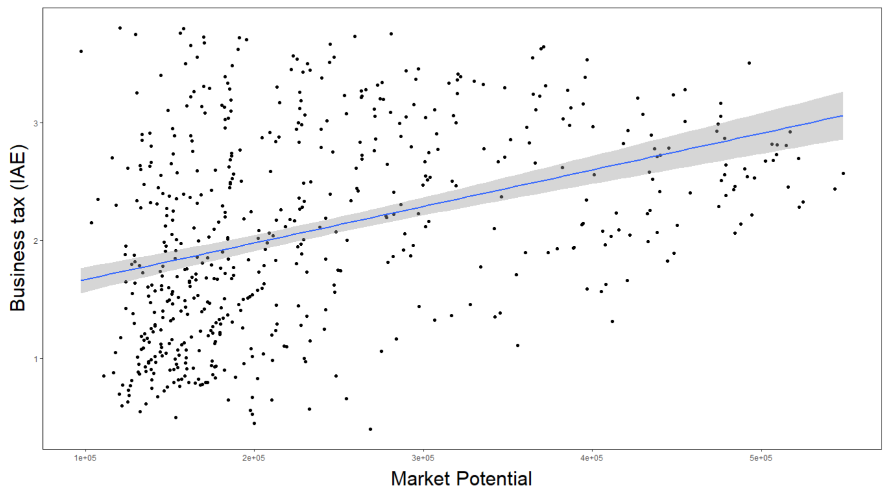
Figure 3: Market potential across Spanish municipalities (2017)



Source: Own elaboration based on data from the National Institute for Statistics (INE)

Figure 4 combines in a graph business tax (IAE) at local level and municipal market potential for the year 2017. As can be seen, the graph shows a positive relationship between the municipal market potential and the corresponding business tax rate, that is, municipalities with high market potential are also the municipalities that set higher business tax rates. This first approach is in line with the theoretical predictions of the geographical economics model, where local governments consider the existence of economies of agglomeration when deciding the tax rate on mobile factors.

Figure 4: Market potential and Business tax (IAE)



Source: Own elaboration based on data from the Treasury Ministry (MHAP), INE and Open Street Maps

5.2 Econometric results

5.2.1 Geographical Economics and local tax setting: Preliminary estimates

Table 3 shows the descriptive statistics of the main variables used in our econometric estimates. To build the database, data from the Spanish national institute for statistics (INE), Treasury Ministry (MHAP), Spanish Tax Agency (AEAT) and the Social Security (SS) were used. We use a strongly balanced data panel with 94.354 observations corresponding to 7.258 Spanish municipalities observed throughout the period 2005-2017.

Table 3. Descriptive statistics

Variable	N	Mean	St. Dev.	Min	Max
Provincial surcharge IAE (%)	94354	30.70	9.20	0.00	40.00
Business tax (IAE)	94354	1.17	0.50	0.40	3.80
Market potential	94354	174966	43596	95322	630856
Share municipal tax revenue over municipal income (%)	94354	3.80	3.5	0.83	9.94

Source: Own elaboration based on data from the Treasury Ministry (MHAP), INE, AEAT

Table 4 shows the results of the estimation of our baseline model (#26). Columns 1 and 2 present the results of the estimations of the fixed effects spatial panel data model where the dependent variable is the business tax rate (IAE). Columns 3 and 4 present the results of the estimation when the dependent variable is defined as the share of municipal tax revenue over municipal gross income (approximation to the municipal tax burden). Columns 1 and 3 use the 5-nearest neighbours as the spatial weight matrix, while as a robustness test in columns 2 and 4 we use as the approximation to the municipal neighbourhood criterion the inverse of the distance between municipalities under the assumption that the interaction between municipalities decays with the square of the distance ($\alpha = -2$); W_2^d.

The results of the estimates clearly show that the market potential has a positive and statistically significant effect on the municipal tax rates. Therefore, the estimates of this "baseline" model are in line with the theoretical predictions of the Geographical Economics model. On the other hand, the results also show the existence of strong "horizontal" fiscal interactions between neighbouring municipalities, where the estimates of the horizontal tax interaction parameter ranges between 0.290 and 0.462 when the dependent variable is the business tax (IAE) and between 0.407 and 0.567 when the variable is the municipal tax burden. This implies that if we double the neighbouring municipalities business tax rate or the fiscal burden, it induces an increase in the business tax rate (IAE) or fiscal burden that ranges between 29% and 46% for the IAE and between the 40% and 56% for the tax burden. This result suggests that municipalities look at their geographical neighbours to set their tax rates; there is a "tax mimicking" behaviour across Spanish municipalities when setting tax rates. These results were also obtained for other countries such as France (Charlot & Paty, 2007, 2010) and the USA (Ladd, 1992) and are in line with the predictions of standard tax competition models.

Table 4: "Baseline model". Estimation results of the model with spatial fixed effects

Dependent Variable	**Business tax (IAE)**		**Fiscal burden (%)**	
	(1)	(2)	(3)	(4)
Estimation method	ML	ML	ML	ML
Weighting matrix	W^{05}	W_2^d	W^{05}	W_2^d
ρ	0.141** [0.005]	0.398** [0.010]	0.555** [0.004]	0.862** [0.006]
Market potential (Travel times, Pop, $\lambda = 1/3$)	0.566** [0.013]	0.405** [0.014]	2.373** [0.042]	0.758** [0.049]
R^2	0.935	0.936	0.809	0.831
Log-likelihood	102810	103350	-4061	2746
Observations	94358	94358	94358	94358

Note: all variables are log–transformed. * p-value < 0.05; **p-value < 0.01. The estimated standard deviation of each estimator is shown in square brackets.

Source: Own elaboration

5.2.2 Geographical Economics and local tax setting: Preferred specification

We now present the preferred specification of the relationship between geographical economies and local tax setting, where we introduce different measures of market potential, we break down the total market potential in its domestic and foreign component, we introduce different neighbourhood criteria and we also control for the effects that both the municipal electoral cycle and the potential existence of "vertical" fiscal interactions may have on municipal business tax rates.

The first set of controls are in columns 2-4 of table 5 where in column 2 the scale factor for the internal distance across municipalities is set as 2/3. The results for the market potential coefficient estimate are roughly the same as in the baseline model. In column 3 we use as a proxy for economic activity the level of municipal income (scale factor for intra-municipal distance set as 1/3). The coefficient estimates for market potential drops quite substantially but it is still in line with the theoretical predictions of the model. In column 4 we breakdown the total market potential in its two components (domestic and foreign) and both components are positive and statistically significant. Columns 5 and 6 of table 5 report estimation results using alternative neighbourhood criteria as robustness test for our spatial weight matrix. In column 5 we use a weight matrix which considers distance in km between municipalities decaying with the square of it (expression #34) and in column 6 the road distance is weighted by population (expression #35). The findings are consistent with the other neighbourhood criteria use (5-nearest neighbours) and with the theoretical model presented above.

In columns 7 to 9, we control for the electoral cycle and for the presence of vertical fiscal interactions (column 9) by adding to the estimation of the previous models the estimated effects that the business provincial surcharge tax rate (*recargo provincial del IAE*), a tax rate set by the province to which municipality "i" belongs, have on the municipal business tax rates.

The most important result of these estimates is that the central conclusion of our baseline model continues to be maintained. Market Potential has a positive, statistically significant, and economically relevant effect on municipal business tax rates. Therefore, these alternative estimates controlling for the electoral cycle and the presence of vertical fiscal interactions are also in line with the theoretical predictions of the geographical economics literature.

The estimates of the three parameters that control for the electoral cycle (columns 7 to 9) show the "partial" existence of opportunistic behaviours in relation to the election period (electoral cycle). The estimated parameters for the dummies that capture the year elections are held and the year after the elections are all negative and statistically significant at the standard significance levels. On the one hand, the estimates for the electoral cycle dummies shown that at the time of elections the municipalities tend to set lower tax rates, although these rates also remain low in the year after elections are held. When we additionally control for the existence of "vertical" tax interactions through the provincial surcharge tax rate (recargo provincial del IAE) -column 9- the coefficient estimates are negative and statistically significant. This result suggests the existence of "vertical" tax interactions in setting the business tax rate between the municipality and the province to which the corresponding municipality belongs. That is, municipal tax rates are sensitive to the tax rates set on the same tax base by supra-municipal entities (in our case, the provinces). As the estimated parameter for the provincial business surcharge tax rate is negative, the result indicates that the municipal and provincial tax rates function as strategic substitutes. More precisely, an increase in the provincial business tax rate leads to a decrease in the business tax rate set by the municipality that belongs to that province. Our results are in line with those obtained for the Canadian case (Hayashi & Boadway, 2001) and contrast with those that are obtained for other countries that predict positive vertical interactions (Charlot & Paty, 2007) or a null vertical interaction between different jurisdictional levels (Revelli, 2001).

Following the methodology of Belotti et al. (2017) and Elhorst (2014), the econometric results of Table 5 are complemented by the computation of the marginal effects (table 6) which are broken down into direct, indirect and total effects (columns 1 to 3). Indirect effects for the main variables are shown to be of much lesser importance than the direct ones. Overall, the results are in line with those obtained in table 5.

Table 5: Estimation results of the model with spatial fixed effects, electoral cycle and vertical fiscal interactions

Dependent variable	Business tax (IAE)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimation method	MCO	ML	ML	ML	ML	ML	ML	ML	ML
Weighting matrix	-	W^{05}	W^{05}	W^{05}	W_d^2	W_d^{pop}	W^{05}	W_d^2	W^{05}
ρ	-	0.141** [0.005]	0.176** [0.005]	0.176** [0.005]	0.398** [0.010]	0.452** [0.013]	0.141** [0.005]	0.396** [0.010]	0.139** [0.005]
Market potential (Travel times, Pop, $\lambda = 1/3$)	0.414** [0.005]	-	-	-	0.402** [0.014]	0.199** [0.013]	0.570** [0.001]	0.409** [0.014]	0.549** [0.013]
Market potential (Travel times, Pop, $\lambda = 2/3$)	-	0.564** [0.013]	-	-	-	-	-	-	-
Market potential (Travel times, Income, $\lambda = 1/3$)	-	-	0.134** [0.005]	-	-	-	-	-	-
Domestic market potential (Travel times, Income, $\lambda = 1/3$)	-	-	-	0.025** [0.006]	-	-	-	-	-
Foreign market potential (Travel times, Income)	-	-	-	0.113** [0.007]	-	-	-	-	-
Elections year	-	-	-	-	-	-	-0.003** [0.001]	-0.002** [0.001]	-0.003** [0.001]
Year after elections	-	-	-	-	-	-	-0.002** [0.001]	-0.002** [0.001]	-0.003** [0.001]
Year before elections	-	-	-	-	-	-	-0.001** [0.001]*	-0.001 [0.001]	-0.002 [0.001]
Provincial business surcharge tax rate (%)	-	-	-	-	-	-	-	-	-0.014** [0.001]
Constant	-4.899** [0.056]	-	-	-	-	-	-	-	-
R^2	0.079	0.935	0.934	0.934	0.936	0.934	0.935	0.936	0.935
Log-likelihood	-	102801	102157	102169	103343	102890	102821	103356	102892
Observations	94358	94358	94358	94358	94358	94358	94358	94358	94358

Note: all variables are log–transformed. * p-value < 0.05; **p-value < 0.01. The estimated standard deviation of each estimator is shown in square brackets.

Source: Own elaboration

Table 6: Impact estimation results of the model with spatial fixed effects, electoral cycle and vertical fiscal interactions

Dependent variable	Business tax (IAE)		
	Direct (1)	Indirect (2)	Total (3)
Market potential (Travel times, Pop, $\lambda = 1/3$)	0.551 [0.014]	0.087 [0.004]	0.638 [0.017]
Elections year	-0.0030 [0.001]	-0.0005 [0.000]	-0.0035 [0.001]
Year after elections	-0.0029 [0.001]	-0.0005 [0.000]	-0.0033 [0.001]
Year before elections	-0.0019 [0.001]	-0.0003 [0.000]	-0.002 [0.001]
Provincial business surcharge tax rate (%)	-0.014 [0.001]	-0.002 [0.000]	-0.016 [0.001]

The estimated standard deviation of each estimator is shown in square brackets.
Source: Own elaboration

6. Conclusions

Geographical economics models have challenged the central conclusions of neoclassical models of tax competition. While the standard models (Zodrow & Mieszkowski, 1986; Wilson, 1986; Wildasin, 1988) predict that governments in their desire to attract mobile production factors will set low tax rates and a low level of public spending (harmonization of tax rates on mobile factors of production), geographical economics models predict that in presence of agglomeration economies governments can set high tax rates on the mobile factors since there are other advantages associated with agglomeration economies that would offset this higher tax burden. This paper attempts to test the hypothesis of the geographical economics literature using the Spanish municipal system as our testing ground. More specifically, we try to test the extent to which agglomeration economies generate what is known in the literature as a "taxable agglomeration rent".

To carry out our analysis, we built a database of the peninsular Spanish municipalities (except those of the so called foral regime) for the period 2005-2017. We use data on different municipality taxes, the business tax rate (IAE) at the municipal level, the provincial business surcharge tax rate (recargo provincial del IAE) and other municipal taxes that affect mobile production factors (Real state tax (IBI), Mechanical Traction Vehicles tax (IVTM), Constructions and works tax) to build two different dependent variables for our estimations. Moreover, we have computed different agglomeration proxies (Market Potential indexes) that are at the core or our estimations. The regression results of municipal business tax rates and municipal tax burdens against market potential using a fixed effects spatial panel data model (SAR-type) and controlling for the electoral cycle and for the presence of "vertical" tax interactions show that the results of the estimates are in line with the theoretical predictions of the Geographical Economics model. We have found that the market potential has a positive, statistically significant and economic relevant effect in relation to the municipal business tax rates and municipal fiscal burdens. On the other hand, the results also show the existence of both "horizontal" and "vertical" fiscal interactions, although in the case of the vertical ones it could be concluded that the different levels of government (municipalities versus provinces) act as strategic substitutes in relation to the local tax setting. Finally, it could be concluded that there is also "partially" an opportunistic behaviour of the electoral cycle in terms of municipal business tax setting.

7. References

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