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The impact of local taxes on plants location decision

Abstract

Determinants of plant locations are known to be multiple. Locations of partners and competitors are crucial, as well as the territory's local characteristics. Some local characteristics can be natural. Others, like local taxes, reflect local agents' decisions. To what extent are local taxes taken into consideration during the plant location process? We build a Poisson model to explain the number of firm creations observed in a given municipality in a given year. Correlations and first results tend to show that there exists some unobserved attractivity factors correlated with the level of local taxes. To deal with endogeneity, we present an approach close to the Regression Discontinuity Design. Finally, we find that, everything else being equal, higher local taxes actually deter firms from investing in a given zone.

Keywords: local attractivity, local taxes, plant location decisions, regression discontinuity design, Poisson regression, spatial economics

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Fiscalité locale et choix d'implantation des nouveaux établissements industriels

Résumé

Les déterminants de localisation des établissements sur le territoire sont multiples. La localisation des partenaires, des clients, des concurrents ou des éventuels autres établissements du même groupe sont d'une importance cruciale, tout comme les caractéristiques locales du lieu d'implantation (présence de main d'œuvre, d'infrastructure...). Parmi ces multiples facteurs, nous tentons d'isoler l'impact de la fiscalité locale (au travers de la taxe professionnelle) sur la probabilité d'implantation des établissements industriels de plus de dix salariés. Nous construisons d'abord un modèle théorique duquel découle un modèle Poissonien expliquant le nombre d'implantations dans une commune pendant une année donnée. Pour tenir compte d'éventuels problèmes d'endogénéité résultant d'une part d'une appréhension insuffisante des déterminants non fiscaux de l'attractivité des territoires (forces d'agglomération, accessibilité et niveau d'infrastructure...) et d'autre part de l'interaction entre les différentes collectivités locales, nous introduisons un cadre de Régression par Discontinuité, utilisant les frontières de départements et de régions pour identifier notre modèle. Nous en déduisons que la taxe professionnelle, si elle ne semble pas constituer un élément primordial pour les entreprises, a tout de même un impact significatif sur les décisions d'implantation.

Mots-clés : attractivité locale, fiscalité locale, décisions d'implantation des entreprises, régression par discontinuité, régression de Poisson, économie spatiale

Classification JEL : C21, C25, C33, R12, R15

Contents

1 Introduction

1.1 General background

Understanding firms' location decisions is a key issue for regional policy and planning. The literature on this topic mainly emphasizes the role of agglomeration effects. Guimarães, Figueirdo, and Woodward (2003), Crozet, Mayer, and Mucchielli (2004) or Cohen and Paul (2005) seek to model and estimate these spillover effects: firms tend to set up plants in locations where other plants are already present as they expect positive externalities. Some works, e.g. Baldwin and Krugman (2004) or Charlot and Paty (2006), even show that local authorities benefit from these situations and raise taxes in locations in which many plants are set up: they call this phenomenon an agglomeration effects' taxable rent.

Facing a geographical, economic, social and financial situation, a local authority decides on the tax rate on plant activity and bears its consequences in terms of employment as well as tax revenues. Setting the right tax rate to reach the right business attractivity is a crucial matter for most of local authorities. France is divided into 36,600 municipalities[1]. Each of them is allowed to choose a specific tax rate that operates directly on a tax base. The 36,600 municipalities are grouped into 96 departments, which are themselves subdivisions of 22 regions. Both departments and regions have the right to raise taxes on the same base as municipalities. These local authorities constitute the French local executive power which makes decisions according to the subsidiarity principle: any decision relating to only one level is taken at the appropriate level. At each level, there potentially exists some competition between the different authorities as they all generally aim at attracting new plants to their territories (both for employment and tax revenue reasons). Vertical and horizontal tax competition can be modelled and observed, as explained in Andersson and Forslid (2003), Madiès, Paty, and Rocaboy (2004) or Riou (2006), and may interact with economic choices of other agents.

To increase its attractivity, a local authority can either cut its tax rate or invest in new infrastructure (at least partly, as larger infrastructure, such as highways, is financed jointly by municipalities, departments, regions, and the State). We assume, hereafter, that a given territory

[1]Hereafter, we use the English term of "municipality" for the French "commune". It is the smallest administrative unit to which some of the State's regalian powers is delegated. Notably, municipalities are allowed to raise taxes.

is characterized by an "absolute attractivity" that is reflected by the average plants' setting-up process in this territory. See annex A for a formalization on the notion of attractivity.

The goal of this paper is to quantify the impact of local determinants on firms' decision to set up a new plant and, especially, local taxes. We choose to focus on establishments that are not entirely dedicated to a very local market, since, in this case, agglomeration spillovers and local market power are the main determinants of firms' decisions. We restrict our interest to establishments of moderate or large size (at least 10 employees the year after creation) and we exclude the retail-trade sector (e.g., supermarkets, bank offices...).

In 2004, local taxes on plants and establishments amounted to 9% of government tax income. Together with taxes on properties and inhabitants, local taxes represent much more than 20% of the French tax income (social contributions excluded). Their economic effect is far from negligible. Of course, many economists have paid attention to this issue. To our knowledge, Bartik (1985) is one of the first attempts to estimate local determinants of plants' location decisions. In the French case, one should mention Schneider (1997), who gives an overview of the tax on plants and establishments, concluding that this tax does not play a notable role in firms' location decisions. Houdebine and Schneider (1997) focus on the issue of municipalities' tax competition, deriving a model of location choice and its connection to the flexibility of the local tax rate that could derive from tax competition. Holmes (1998) deals with the effects of State policies on manufacturing firms locations, in the case of the United States. Interestingly, he uses a regression discontinuity design to solve endogeneity problems. More recently, Duranton, Gobillon, and Overman (2006) estimate the impact of local taxes on local employment. Their results suggest that, once geographical heterogeneity is taken into account, taxes have a significant negative impact on employment.

1.2 The data used

We use an exhaustive data set of local tax rates on plants from 1993 to 2002, as well as a local public finances dataset from which we extract the Self-Financing Capacity per Capita [2] (SFC). The main tax base for the French local taxes on plants and establishments corresponds to the

[2]The self-financing capacity per capita is defined as the difference between revenues (essentially taxes and subventions) and expenses (including the interests of the current debt) for a given local zone, divided by the number of its inhabitants.

value of tangible fixed asset. For large establishments, this includes in particular the value of the machines used in the production process. Thus, the local tax appears as a tax on capital. The amount of tax paid by a company is bounded by a two-sided mechanism based on the total value-added of the company:

1. the tax amount must not exceed a ceiling (which is between 3.5 and 4.0% of the value added); the top-grading rate depends on the holding sales turnover (3.5% for firms whose turnover is smaller than 21 million €, and 4.0% for a sale turnover larger than 76 million € net of taxes); this last rate has been standardized to 3.5% since 2006 ; the municipality tax rate variation is also much more constrained after 2004.

2. since 2001, a threshold of 1.5% (versus 0.35% in 1998) has been fixed for the fraction of tax in the value-added for companies whose sales turnover is larger than 7.6 million €. The latter boundary is computed with respect to the tax base of the main establishment.

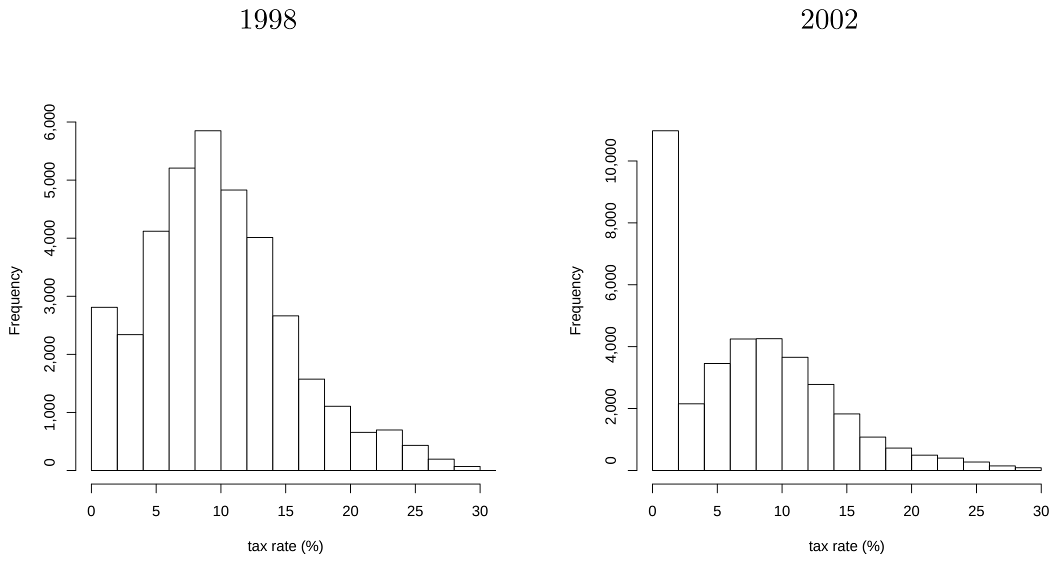
Local authorities may also decide a two-year tax exoneration for a specific new establishment, if the latter is located in a zone selected by the Government to benefit from this kind of measure. The zones which are selected for this kind of advantage are generally challenged zones (suffering either from high unemployment or low investment) where new plants are particularly welcome.

Finally, one should mention the existence of an equalization mechanism aiming at reducing competition between municipalities: if a municipality tax rate is significantly lower than the national mean tax rate, then establishments located in that municipality must pay an additional tax to an equalization fund. The product of the fund is shared according to the tax levels of the local authorities. Moreover, municipalities are allowed to tax inhabitants and may substitute the tax on establishments by inhabitant taxes. This possibility is strictly limited to a proportionality mechanism with respect to past rates.

Figure 1 shows the distribution of tax rates over the 36,600 French municipalities. Its evolution between 1998 and 2002 stems from the development of municipalities associations[3]. The law of July 12$^{\text{th}}$, 1999 allows municipalities to gather and share their tax policies. By way of compensation, municipalities associations gained higher decision-making power over urban or rural planning. They benefit from increased bargaining power and are more credible actors on the local political scene.

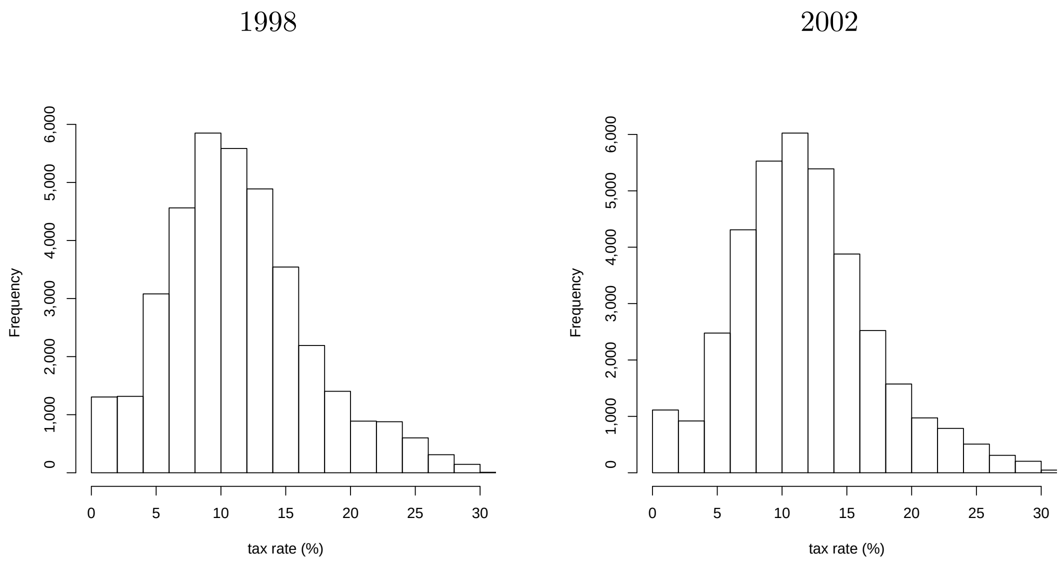
[3] *Intercommunalité* in French.

Figure 1: Histograms of municipality tax rates (in %) by municipality



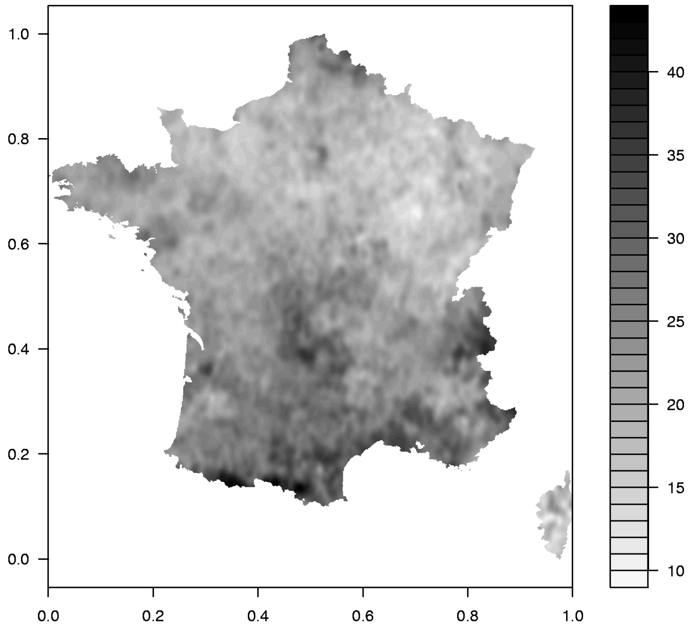
Taking into account the total tax rate that affects the establishments located in a given municipality gives one a rather different picture. This total tax rate is the sum of the municipal rate plus those of the association of municipalities, department and region. The corresponding histograms are given in Figure 1.2.

Figure 2: Histograms of total tax rates (in %) per municipality



Here, the two histograms of 1998 and 2002 look quite similar. The development of municipality associations, thus, has resulted into a tax transfer rather than into rate cuts. Figure 1.2 shows the total tax rate that affects establishments located at any given spot within the French territory (after a kernel smoothing).

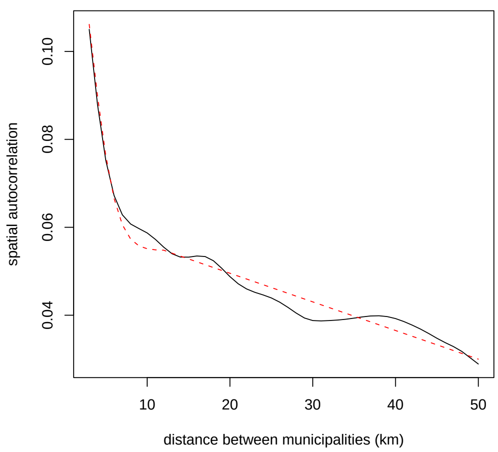
FIGURE 3: Smoothed total tax rate



Notes: This figure shows the average total tax rate in a given municipality, smoothed with a 20 km-window kernel. The total tax rate is the sum of all components of local tax rates: the sum of the municipality, local association, department and region tax rates. In the legend, tax rates are in percentage points. As indicated in the legend, the darker the area, the higher the average local tax rate. The fact that some contrast appears in this map can be interpreted as the evidence that some spatial correlation between local tax rates exists: when the total tax rate is high in a municipality, it is likely that the total rates in neighboring municipalities are also high.

It shows an interesting pattern: in some areas, such as the Central East of France, tax rates are very low, whereas in some others, like the Mediterranean coast, tax rates are higher. This suggests that there is probably a significant correlation between the nested structures that contribute to the tax rates applied in a given municipality. Apart from the correlation between various tax rates, one can show that the “tax rate” process is spatially stationary around a deterministic mean. Figure 1.2 shows the kernel estimation of the (isotropic) autocorrelation function computed according to the methodology of adaptive bandwidth of Silverman (1986).

FIGURE 4: Sum of the municipality and community tax rates: observed rate autocorrelation (straight line) and estimated autocorrelation (dotted line) $R(\tilde{\tau})$ according to footnote 4 formula



This figure suggests that the tax rate autocorrelation vanishes at a distance of about 6.3 km[4]. Since the mean diameter of a municipality equals 4.4 km, one can, therefore, say that the local tax rate adopted by a municipality is, on average, correlated with the tax rates of the closest neighbors.

Beside these local data on tax rates, we use individual information on plants and firms from the “SIREN firms directory” database, available at INSEE, and the DADS (“Déclarations annuelles de données sociales”). The first database is the official register of French firms and firm-owned plants. For each plant, it provides its national identification number (SIREN number) and location municipality, as well as its creation date. The DADS are administrative declarations used to

[4]Estimating a model for the autocorrelation function leads to the following form, with δ_0 the Dirac delta-function and r the radius of the isotropic function in kilometers.

$$R(r) = 0.86 \times \delta_0(r) + 0.10 \times \exp\left[-\left(\frac{r}{4.0}\right)^2\right] + 0.041 \times \mathbf{1}(r \in [0,50]) - 4.5\ 10^{-4}(r-12) \times \mathbf{1}(r \in [12,50])$$

We consider that the autocorrelation is negligible when $R(\tau) < 0.05$. Given our estimation, this is true for $||\tau|| > 6.3$km.

record workers' pension rights. database was developed to ease the collection of labor taxes. It contains information on employees: their wages, the plants they belong to and the yearly numbers of working hours. This database makes it possible to accurately compute a yearly full-time equivalent number of employees per establishment. The stock of establishments located in a given municipality is published by INSEE, as well as the number of establishments created each year between 1993 and 2002. Among all the created establishments, we select those whose size expressed in terms of the number of employees is larger than 10 one year after their creation. We keep several activity sectors in our sample (see annex B). The selected sectors account for 45 % of total unemployment in France in 2000. Holmes and Stevens (2004) underline that the plant size is an important characteristic to understand which determinants drive location decision. As our limit at 10 employees may seem *ad hoc*, we test the robustness of our results, changing the limit from 10 to 5 employees. For activity sectors and plant size, we run some sensitivity analyses (see below).

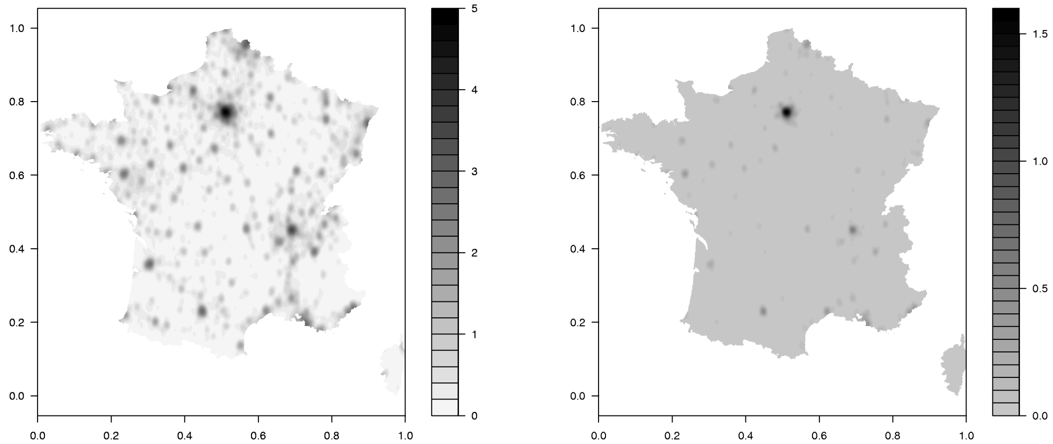
We apply the same sector-size selection to the plant stock than to plant creations. We are provided with data for annual stocks between 1992 and 2002. Figure 1.2 shows a smoothed spatial repartition of the establishment stock in 2001 and the establishment creations for the year 2002. The dominant effect is agglomeration as, at first sight, the distributions of the stock and the creations look similar. The common pattern is the same: at a national scale, both distributions reflect some intrinsic attractivity.

2 Theoretical framework

In this paper, attractivity is defined as the capacity of some spot on the territory to attract plant creations[5]. Attractivity is assumed to be split up into two parts. First, a firm broadly decides on some large area where a new plant is to be settled. This first choice depends on strategic factors, *i.e.* the locations of their suppliers, partners and customers and those of existing plants, repositories, offices belonging to the same firm or the same group. We consider this first stage as a long-range one and decide not to focus on this side of the problem. Once the area is broadly selected, local characteristics may play a role to determine where, exactly, the plant will be set up. At this second stage, taxes are likely to be taken into account by firms as well as local

[5]Other definitions of attractivity include attractivity towards workers, investments, or even inhabitants. Our measure is related to the direct count of new plants setting-up.

Figure 5: Spatial intensity of the stock of establishments in 2001 (left); Spatial intensity of newly created establishments in 2002 (right) larger than 10 employees the year after creation



infrastructure or other determinants of local attractiveness. This paper aims at identifying these second-stage determinants, and focuses on the relevance of taxes.

This section presents a model describing the way firms decide to locate a new plant. This leads to introduce a spatial intensity characterizing the spatial distribution of firm locations and the probability for a new plant to be located at some point in space.

Let $i \in \mathfrak{C}$ refer to a firm willing to set up a new plant in an Euclidean space $\mathfrak{F} \subset \mathbb{R}^2$. Firm i and its associated to-be-created plant have some intrinsic characteristics (e.g., plant size, group size, nationality...) expected to induce specific behaviors. For this reason, we split the total set of firms $\mathfrak{C}$ into homogenous subsets $\{\mathfrak{C}_m\}_{\{m=1\ldots M\}}$.

For strategic reasons (which could be the proximity of providers or customers or other plants of the same group or the existence of a pool of skilled workers), firm i selects an ideal spot $\mathbf{s}_i^* \in \mathfrak{F}$ for the new plant. However, this strategically ideal spot may not be the best for the firm as other location-dependent factors Z (for example local taxes) may influence the final decision. We call $U_m(\mathbf{s}_i^*, \mathbf{s})$ the utility of a firm $i \in \mathfrak{C}_m$ to settle on a spot $\mathbf{s}$ when its strategically ideal spot is $\mathbf{s}_i^*$. Let us assume that:

$$U_m(\mathbf{s}_i^*, \mathbf{s}) = u\left(d(\mathbf{s}_i^*, \mathbf{s}), h_m(Z(\mathbf{s}), Z(\mathbf{s}_i^*)\right).$$

$d(a,b)$, with $(a,b) \in \mathfrak{F}^2$, is the Euclidian distance between spots a and b, $h_m(z_1, z_2)$ is the aggregating function of spatial factors z_1 and z_2 and u is an aggregating utility function. $h_m(z_1, z_2)$ may depend on which partition $\mathfrak{E}_m$ the firm i belongs to. More informally, this utility function can be seen as a way to weigh two criteria: going further from the ideal point $\mathbf{s}_i^*$ is a loss that must be compensated by a gain of choosing a spot with better factors Z. Weights on these criteria are allowed to be heterogenous across the partitions $m = 1 \dots M$.

Therefore, location $\tilde{s}_i$ that firm i will ultimately prefer for its new plant is such that:

$$U_m(\mathbf{s}_i^*, \tilde{s}_i) = \max_{\mathbf{s}} U_m(\mathbf{s}_i^*, \mathbf{s}).$$

We, then, define an application $t_{U,m} : \mathfrak{F} \to \mathfrak{F}$ such that:

$$t_{U,m}(\mathbf{s}^*) = \operatorname*{argmax}_{\mathbf{s}} U_m(\mathbf{s}^*, \mathbf{s}).$$

$t_{U,m}(\mathbf{s}^*)$ is the maximizing-utility location for a firm belonging to group m and whose strategically ideal location is $\mathbf{s}^*$. We assume that the $\{\mathbf{s}_i^*\}$ are distributed along a spatial distribution g_m, which may differ across the partitions of $\mathfrak{E}$.

Let A be a subset of $\mathfrak{F}$. Defining $t_{U,m}^{-1}(A) = \{\tilde{\mathbf{s}} \in \mathfrak{F} | t_{U,m}(\tilde{\mathbf{s}}) \in A\}$ we obtain:

$$\begin{aligned} \mathrm{P}\{t_{U,m}(\mathbf{s}^*) \in A\} &= \mathrm{P}\{\mathbf{s}^* \in t_{U,m}^{-1}(A)\} \\ &= \int_{t_{U,m}^{-1}(A)} g_m(\mathbf{s}) d\mathbf{s} \end{aligned}$$

This defines the probability that a firm decides to settle a plant in area A. We assume that this probability derives from a distribution φ_m such that:

$$\int_A \varphi_m(\mathbf{s}) d\mathbf{s} = \int_{t_{U,m}^{-1}(A)} g_m(\mathbf{s}) d\mathbf{s}$$

Thus, assuming that the first-stage process g_m is exogenous but that, at a second stage, firms trade off proximity from their ideal point against better local characteristics, there exists an underlying density φ_m of new plants creations (for type-m firms).

Annex C shows how our theoretical framework can be adapted into an estimation framework. From binomial distributions at each spot, Poisson distributions on areas are derived by applying the Poisson theorem. Then, the likelihood of the Poisson model is deduced. In the next section, we investigate the estimation strategies allowed by this framework.

3 Estimation strategies

3.1 Municipal factors and local factors

According to annex C, the probability that n type-m plants are created in area k during period t is a function of area k's long-range (or strategic) attractivity $\Lambda^0_{k,m}$ and the intrinsic characteristics (observable or not) involved in short-range attractivity $x_{k,m}$. In what follows, the studied areas A_k are municipalities.

$$P\{N_{m,t}(A_k) = n\} = \frac{\left(\Lambda^0_{k,m,t}.\exp\left[x_{k,m,t}.\beta\right]\right)^n}{n!}\exp\left(-\Lambda^0_{k,m,t}.\exp\left[x_{k,m,t}\beta\right]\right)$$

where β is an unknown parameter. The expected number of type-m plants setting up in municipality k is:

$$\Lambda_{k,m,t} = \Lambda^0_{k,m,t}.\exp\left[x_{k,m,t}.\beta\right]$$

For the sake of simplicity, we remove hereafter the subscript m, assuming that there is only one type of firm, and subscript t, assuming independence across periods. The relevance of the first assumption is analyzed in annex F), where we run different regressions according to plants sizes and sectors.

The parameter of interest is β. The relative relevance of local characteristics in impacting attractivity and average partial effects can be derived from it.

We would like to distinguish between the covariates x on the following ground. First, as we already discussed, distinction has to be made between long-range and short-range covariates. This was done by separating Λ^0 from the exponential part of Λ. Second, among the short-range covariates, there are some whose effect depends on the Euclidean distance from a given spot and others that correspond to a precise zone, circumscribed by precise administrative boundaries. For example, the presence of a highway access road belongs to the first category, as the attractiveness of such an asset decreases with the distance to it. On the other hand, municipality tax rate is a pure municipality variable (a zone variable), as it does not depend on the location inside the municipality but rather on which municipality the plant is located. We denote by ℓ (for local) the covariates belonging to the first category, by $\mathfrak{m}$ (for municipality) those belonging to the second one.

Based on this decomposition, the expected number of plants setting up in municipality k during year t is:

$$\Lambda_{kt} = \exp\left[\lambda^0_{kt} + x^{\ell}_{kt}\beta^{\ell} + x^{\mathfrak{m}}_{kt}\beta^{\mathfrak{m}}\right] \tag{1}$$

To be precise, we assume that x^{ℓ}_{kt} may contain local investments whose use is not limited only to the municipality inhabitants (like swimming-pools, parks, etc.). $x^{\mathfrak{m}}_{kt}$ may contain local tax rates as well as local infrastructure whose use is limited to the municipality inhabitants (like primary schools, municipality libraries, kindergarten, etc.). Among the covariates present in equation 1, some are observed, others are not. Our observed covariates, that we denote $\tilde{x}$ are, to start with, the tax rates at the region, the department and the municipality levels. All these observed covariates belong to the $\mathfrak{m}$ covariates' set.

The first two estimation strategies are driven from two alternative assumptions.

1. We estimate the model:

$$\Lambda_{kt} = \exp\left[\lambda^0_{kt} + \tilde{x}_{kt}\tilde{\beta}\right] \tag{2}$$

   If we assume that the observed covariates $\tilde{x}$ are orthogonal to the unobserved ones, this estimation will provide consistent estimates for parameters $\tilde{\beta}$ relating to the observed covariates.

2. As this orthogonality condition is strong, we replace it with a time-regularity assumption: all the unobserved variables are assumed to be captured by a time-invariant fixed effect ε_k([6]). Hence, we estimate:

$$\Lambda_{kt} = \exp\left[\lambda^0_{kt} + \tilde{x}_{kt}\tilde{\beta} + \varepsilon_k\right] \tag{3}$$

Specification (3) relies on the assumption that unobserved determinants are more sluggish than tax rates, or are decorrelated from them. For the municipality tax rate, it is a very strong assumption, for at least two reasons. First, municipalities can modify the tax rate to offset either attractivity gains or losses due to other factors. Second, tax competition between municipalities is very likely to occur and difficult to detect, as is shown in Houdebine and Schneider (1997). Therefore, the municipality tax rate is very likely to suffer from endogeneity problems. In the specifications presented in the next section, we separate the municipality rate from the other

[6] This model is sometimes denoted Fixed-Effect Poisson model, as in Wooldridge (2002). A seminal work on this model is Hausman, Hall, and Griliches (1984). Let us also mention more recent works such as Blundell, Griffith, and Windmeijer (1997) and Crépon and Duguet (1997).

(department and region) rates to take these potential problems into account.

λ^0 can either be dropped or explicitly taken into consideration. In specification (3), one can assume that λ^0 is sluggish and can be caught by the fixed effects. In specification (2), omitting a proxy variable is even more problematic as it leads to implicitly assuming that there is no significant spatial pattern for long range effects: two spots where the observed variables are equal are, thus, assumed to have equal attractivity. One way to remedy this is to introduce a variable to proxy long range attractivity. Let z denote this proxy variable and γ its associated parameter. In some specifications, we chose to introduce the lagged plant stock in the given municipality in this purpose.

Merging all these terms in a compact expression, we obtain the equation that we will actually estimate:

$$\Lambda_{kt} = \exp\left[z_{kt}\gamma + \tilde{x}_{kt}\tilde{\beta}\right] \text{ or } \Lambda_{kt} = \exp\left[z_{kt}\gamma + \tilde{x}_{kt}\tilde{\beta} + \varepsilon_k\right].$$

whether fixed-effects are introduced or not.

The assumptions that are necessary to obtain unbiased estimations of our parameters of interest are very strong, and one can doubt their validity. In the next section, we propose another framework correcting most of the endogeneity problems as well as taking the uncertainty about long-range attractivity into account.

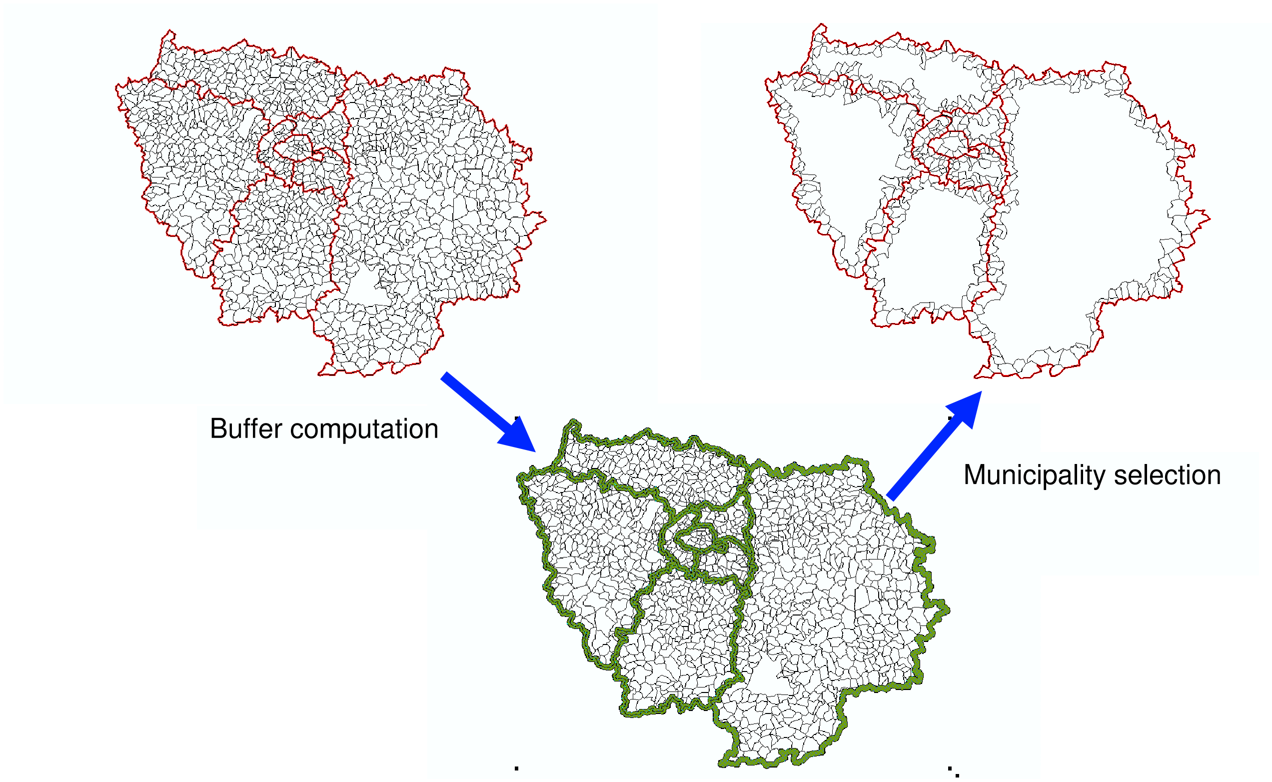
3.2 A regression discontinuity design

Administrative boundaries are appealing discontinuities to try to disentangle local effects from zone effects (as we named them in the former subsection). The framework presented in this subsection is close to the regression discontinuity design[7]. Considering a boundary j separating two departments, we build a sample of municipalities belonging to a narrow ribbon S_j around boundary j. The ribbons and all the concerned municipalities are computed using a Geographic Information System (GIS — Map Info) and a geographic database (Route 500 from Institut Géographique National) where all the administrative contours of regions, departments and municipalities are given. Figure 3.2 illustrates the construction of the ribbons[8], for the Parisian

[7] Black (1999) is an application of the regression discontinuity design to estimate parents' valuation of elementary education quality. The regression discontinuity design has, then, been formalized in Hahn, Todd, and Van der Klaauw (2001).

region. As will be shown, subsampling this way allows us to get rid of both long-range and short-range attractivity determinants. Only remains the municipality-zone component.

Figure 6: Ribbon selection: Example of a 1km width buffer computed around the department boundaries of the Parisian region and the subsequent selection of municipalities which intersect the buffer



Let us consider the decision of a firm i to locate its new plant in municipality k, which is itself located on one side of the boundary j or the other (but always on the ribbon S_j). We can model this decision through a binary variable Z_{ijt} which takes value 1 if plant i chooses to set up in a municipality situated on the side where the sum of department and region tax rates are the lowest and 0 otherwise.

[8] Around each boundary j, we build a narrow buffer of width 1km (thus 500m inside each department). When the buffer intersects a municipality, the municipality is selected in the ribbon S_j. When the intersection of the 1km-width buffer and a municipality is null, then this municipality is not selected in the subsample.

This leads to a binary discrete-choice model:

$$\begin{cases} \Pr(Z_{ijt} = 1 | X^d_{ijt}) & = & \Phi(X^d_{ijt}\beta) \\ \Pr(Z_{ijt} = 0 | X^d_{ijt}) & = & 1 - \Phi(X^d_{ijt}\beta) \end{cases}$$

where $\Phi(.)$ is the chosen cumulative distribution function (we will use the logistic function in most regressions). The dependent variable is the Z_{ijt} binary variable. Among the regressors X^d_{ijt}, the variable corresponding to the department and region tax rate (the sum of department rate and region rate) is built in a way that allows the possibility of a non linear dependency of the dependent variable with respect to local taxes. Let ΔDRT_{jt} denote the gap between the department and region tax rates over the two sides of boundary j. We build ΔDRT_{jt} so that it is always positive. A set of four dummies $(\delta^k_{jt})_{k\in\{1,2,3,4\}}$ is defined such that:

$$\begin{aligned} \delta^1_{jt} &= \begin{cases} 1 \text{ if } \Delta DRT_{jt} \leqslant Q_{25\%} \\ 0 \text{ otherwise} \end{cases} \\ \delta^2_{jt} &= \begin{cases} 1 \text{ if } Q_{25\%} \leqslant \Delta DRT_{jt} \leqslant Q_{50\%} \\ 0 \text{ otherwise} \end{cases} \\ \delta^3_{jt} &= \begin{cases} 1 \text{ if } Q_{50\%} \leqslant \Delta DRT_{jt} \leqslant Q_{75\%} \\ 0 \text{ otherwise} \end{cases} \\ \delta^4_{jt} &= \begin{cases} 1 \text{ if } \Delta DRT_{jt} \geqslant Q_{75\%} \\ 0 \text{ otherwise} \end{cases} \end{aligned}$$

where the values of the Q_α correspond to the quartiles of the empirical distribution of $(\Delta DRT_{jt})_{j,t}$. Table 3.2 shows the values of the Q_α as well as some additional statistics relating to the sample of observations used in the RD framework.

Annex D details the complete set of assumptions used to identify the effect of the department and region tax rate differences on the decision taken by the firm.

The other covariates of the logistic regression require more attention. In order to identify the parameters of interest (i.e. the coefficients of the δ dummies), one has to control for infra-departmental properties. Notably, municipality tax rates have to be controlled for. It is possible that municipalities experiencing a higher department rate might try to offset it by cutting their own rates. We also include the presence of an activity zone in the municipality where the plant is settled. An acceptable RD estimate has to deal with this issue. Formally, let A_{ij} be some variable characterizing the municipality situated in ribbons j where the plant i actually settles.

Table 1: Some statistics about the sample used in the RD framework

Variables	Values
number of municipalities	7,408
number of municipalities where there is at least one creation over the sample period	2,904
number of creations in 1993	646
number of creations in 1994	571
number of creations in 1995	539
number of creations in 1996	610
number of creations in 1997	558
number of creations in 1998	575
number of creations in 1999	624
number of creations in 2000	672
number of creations in 2001	647
number of creations in 2002	564
$Q_{25\%}(\Delta DRT)$	0.48
$Q_{50\%}(\Delta DRT)$	1.12
$Q_{75\%}(\Delta DRT)$	2.19

Here, A_{ij} may be a continuous (like municipality tax rate) or a binary (like the existence of an activity zone) variable. A_{ij} cannot be directly introduced in the regression as the municipality considered on each side of the boundary j (that is, whether $Z = 0$ or $Z = 1$) is not the same. Thus, we try three competing specifications for introducing A_{ij} in the regression. We denote $\bar{A}$ the average value of A_{ij} over the municipalities belonging to all ribbons.

1. The first way consists in introducing $Z_{ij}(A_{ij} - \bar{A})$ and $(1 - Z_{ij})(A_{ij} - \bar{A})$ in the set of covariates.

2. The second way requires the computation of A_{ij}'s averages on each side of every ribbon. Then, instead of computing the difference between A_{ij} and $\bar{A}$, we compare A_{ij} to a proxy of its counterfactual: the average level of A on the opposite side of the same ribbon S_j.

3. The third way consists in computing $Z_{ij}(A_{ij} - \tilde{A}_{ij})$ and $(1 - Z_{ij})(A_{ij} - \tilde{A}_{ij})$ where $\tilde{A}_{ij}$ is a counterfactual of A_{ij}, measured in the closest municipality located on the other side of ribbon S_j. Thus, the probabilistic model of the firm decision specifies that the plant might be located on one side or the other of the boundary j in a neighborhood containing two municipalities: the one actually chosen and an alternative located on the other side of the ribbon.

4 Applications

We apply the models presented in the previous sections to explain the attractivity of French municipalities by our chosen covariates[9]. We measure the number of plants created in each municipality and we explain this number by local taxes on economic activity and Self-financing capacity per capita (SFC). We assume that SFC is a proxy of the quality of the local finances management. In addition to this, we have to control for the impact of local attractivity independently from local taxes. There might be some endogenous adaptation of local taxes to correct a low attractivity level or, on the contrary, to benefit from high attractivity. We, therefore, introduce some explanatory variables that describe the local level of infrastructure, such as the existence of a primary school, a nursery, a library or a swimming pool. We also introduce some variables that describe the connection of municipalities to the national road network. Table 4

[9] Most of our computations, maps, correlations, estimations were performed using the software `R`, and its contributed packages `maps`, `spdep`, `RArcInfo` and `stats4`. See R Development Core Team (2005), Becker, Wilks, Brownrigg, and Minka (2005), and Gómez-Rubio (2005). Ribbon selection was carried out using `MapInfo`, and some regressions were computed with `SAS` and `Stata`.

provides some summary statistics for the main covariates.

Table 2: Some statistics about the regression variables

	Min	$Q_{25\%}$	Med	$Q_{75\%}$	Max	Mean
Department and region tax rate	0.0	8.3	9.1	10.3	16.7	9.3
Municipality tax rate	0.0	7.9	11.0	14.6	26.9	11.6
Department and region SFC (in thousands of € per inhabitant)	-0.3	0.4	0.5	0.7	1.5	0.5
Municipality SFC (in thousands of € per inhabitant)	-0.3	0.5	0.8	1.3	6.5	1.1

Number of plants	Creations	Stock of plants
Annual mean between 1993 and 2002	3,201	133,000
Number of municipalities with at least 1 creation or 1 existing plant over the whole sample	5,945	18,083
Number of plants per municipalities		
$Q_{25\%}$	1	6
$Q_{50\%}$	2	12
$Q_{75\%}$	4	34
$Q_{95\%}$	19	223
Max	488	11,838

Notes: Q_α is the α quantile of the plant creation or plant stock distributions; the quartiles on the left hand-side table refer to the 1993-2002 distribution for tax rates and to the year 2000 for SFC. These quartiles refer to municipalities where the stock of plants is greater than 0. Paris is excluded from the statistics.

We recall the intuition behind our theoretical model. A firm willing to settle a new plant will, first, take into account several factors such as the locations of economic partners (suppliers or customers) or the locations of other plants belonging to the same firm. This is a first stage that we want to purge out. After having selected a wide area, the firm takes local characteristics into consideration in order to choose in which municipality in particular the plant will be established. We concentrate our analysis on this second stage. In other words, we focus on local attractivity at the scale of municipalities, assuming that the main impact of local taxes is local. We, also, assume that companies make their decisions upon some inter-temporal expectation of their profits, taking the ability of local authorities to manage local finances into account.

We propose two methods to estimate our key parameter: the coefficient on departement and region tax rate. A first way is to run the spatial regression, detailed in subsection 3.1. These regressions are presented in section 4.1.

A second approach is based on a regression discontinuity design, explained in subsection 3.2. Using the fact that, on both sides of a department boundary, the tax levels differ but the local attractivity is similar, we can identify the impact of taxes on firm behavior. These regressions are presented in section 4.2.

4.1 Spatial regression

According to the scheme presented in section 3.1, we compute the following set of regressions:

$$N_{kt} \sim \mathcal{P}[\exp(z_{kt}\gamma + \tilde{x}_{kt}\tilde{\beta})]$$

where N_{kt} is the number of plants created in municipality k during year t, while $\tilde{x}_{kt}$ are the covariates described in table 4.1 and z_{kt} is the proxy for global attractivity. In addition to these, time-dummies and dummies corresponding to the municipality infrastructure inventory are introduced (cf. annex E). We observe the number of plant creations during each year between 1993 and 2002 in each French municipality. Therefore, the number of observations amounts to $36,600 \times 10 = 360,000$ for each regression. Some observations are lost as some explanatory variables are not available in every municipality for the whole period. However, we checked that none of the municipalities where a plant creation occurred between 1993 and 2002 had been removed.

TABLE 3: Spatial Poisson regression

Covariates	Estimates - Panel 1993-2002				
	(1)	(2)	(3)	(4)	(5)
Intercept	-2.097^{**} (0.018)	-2.808^{**} (0.022)	-2.867^{**} (0.029)	-4.095^{**} (0.039)	-5.373^{**} (0.048)
Department & Region tax rate	-0.095^{**} (0.002)	-0.105^{**} (0.002)	-0.107^{**} (0.002)	-0.053^{**} (0.003)	-0.066^{**} (0.003)
Municipality tax rate	0.041^{**} (0.000)	0.041^{**} (0.000)	0.042^{**} (0.000)	0.033^{**} (0.001)	0.004^{**} (0.001)
Department & Region SFC	-	1.364^{**} (0.024)	1.363^{**} (0.023)	0.356^{**} (0.023)	0.541^{**} (0.022)
Municipality SFC	-	0.015^{**} (0.002)	0.015^{**} (0.002)	0.041^{**} (0.003)	0.060^{**} (0.001)
1993-2002 year dummies	-	-	yes	yes	yes
Stock (T-1)[1]	-	-	-	1	-
Municipal infrastructure inventory	-	-	-	-	cf. annex E
Nobs	365,679	365,430	365,430	117,113	361,567

Notes: 1 star means 95%-significant and 2 stars mean 99%-significant. Standard errors are in parentheses. ([1]) the stock variable is transformed into a Poisson intensity such that, if the distribution of new creations were the same as the one leading to the actual stock, all the other regression coefficients should be equal to zero. Its coefficient is constrained to be one.

The first three regressions are free from any attempt of controlling for “absolute attractivity”. It is highly probable that, since some variables are omitted, the regression coefficients are biased. For example, one can think that, if a municipality is more attractive everything else being equal, there should be a positive correlation between its tax rate and the residual (that includes the extra-attractivity component), since this municipality can attract new plants even if its tax rate (thus its revenue) is high. Therefore, even if the tax dependency of new plant creations should be negative, the previous endogeneity might lead to an apparent positive dependency. It is precisely what we observe in the first three regressions.

In the last two regressions, we attempt to control for absolute attractivity. First, in regression (4), we choose the lagged stock of plants as a proxy for absolute attractivity. Then, in regression (5), we include some explanatory variables relating to the level of local infrastructure in the considered municipality (cf. annex E). In this last regression, the municipality tax rate coefficient is significantly lower than when the absolute attractivity is not controlled for, but it is still positive.

In addition to tax variables, we have also introduced the SFC as a proxy for local public finances health. This variable, together with the tax rates, should be understood as a signal for plants of the stability of the future tax level: if the SFC is low, an economic shock is more difficult to absorb without increasing the taxes than if the SFC is high. This analysis is consistent with the estimated coefficients.

The results, however, suggest that there still exist some endogeneity. In fact, the coefficients associated with the municipality tax rate are positive. Therefore, the omitted variable of absolute attractivity may not be satisfactorily captured by the proxy variables. Hence, we need to improve the treatment of this endogeneity. A first approach consists in using the panel approach supposing that the probability of new plant creation is associated with a fixed effect removed by time-differentiation. Unfortunately, we cannot present the results for this approach as there are not enough remaining degrees of freedom to allow any inference. Another more convincing way to deal with the question is to use the regression discontinuity design (section 4.2).

4.2 Regression discontinuity

We adopt the framework explained in subsection 3.2. The regression is of logistic type, reproducing the binary decision taken by firm i to locate its new establishment on one side or the other of the boundary j. The observations are available for the whole period between 1993 and 2002 (index t).

Table 4.2 presents the estimation results. There are three columns, standing for the three methods used to build a counterfactual for each explanatory variable.

1. Regression (1) compares the observed value of the covariate in the considered municipality to its average in all municipalities present in the sample.

2. Regression (2) compares the observed value of the covariate in the considered municipality to its average level on the opposite side of the same ribbon.

3. Regression (3) compares the observed value of the covariate in the considered municipality to its level in the closest municipality on other side of the ribbon.

Note that the areas of the two Parisian airports (Roissy and Orly), as well as Cergy-Pontoise[10] were removed from the regressions, due to their strong specificity.

Each of the chosen specifications provides clear evidence for this fact: everything else being equal (especially the municipality tax rate), the level of tax rate applied on one side of the boundary with respect to the other side has the expected effect on firms' decisions. The probability of locating a new plant in the lower tax side is higher than the probability of locating it on the other side, everything else being equal. The relationship between the size of the tax gap and the probability for the firm to choose the lower tax side of the ribbon looks ambiguous. How can our estimates be interpreted? If we consider that the parameter of interest is around 0.3, the probability of locating the new plant on the lowest tax rate side is about $\exp(0.3)/(1+\exp(0.3)) \approx 57\%$ if all the other covariates are around their average values.

In annex F, we relax some of the hypotheses we have made so far. Our results still hold.

[10]Roissy and Orly belong to an area where urbanism rules are strictly constrained (through a mechanism called "procédure d'agrément" — agreement process — which is specific to the area around Paris). Cergy-Pontoise belongs to a specific category named "Ville Nouvelle" (New City) where urbanism rules are also heavily constrained.

Table 4: RD logistic regression

Covariates	Estimates - Panel 1993-2002		
	(1)	(2)	(3)
δ^1_{jt}	0.255 (0.171)	0.114 (0.092)	0.106 (0.070)
δ^2_{jt}	0.385* (0.155)	0.343** (0.070)	0.374** (0.059)
δ^3_{jt}	0.118 (0.146)	0.034 (0.058)	0.188** (0.051)
δ^4_{jt}	0.103 (0.166)	0.477** (0.069)	0.483** (0.060)
Diff munic. tax rate	0.055** (0.016)	0.017* (0.008)	0.042** (0.005)
Diff activity zone	5.350** (0.136)	5.476** (0.162)	2.345** (0.091)
Nobs	6,006	6,006	6,006
N(Z=1)	3,239	3,239	3,239
N(Z=0)	2,767	2,767	2,767
Percentage concordant	99.7	88.3	72.3

Notes: 1 star means 95%-significant and 2 stars mean 99%-significant. Standard errors are in parentheses. The "diff"s stand for the difference of the values taken by the considered variable on both sides of the boundary. For example, *[Diff activity zone]* takes its value in the set $\{-1, 0, 1\}$. 1 corresponds to the situation where there is an activity zone on the lowest tax rate side; 0 corresponds to the situation where there is no activity zone or an activity zone on both sides; -1 corresponds to the situation where there is an activity zone on the highest tax rate side.

5 Conclusion

Direct spatial Poisson regressions provide us with elasticities of plant creations to the tax rate. However, these results may be biased due to untreated endogeneity. The best way to deal with this issue seems to adopt a framework close to Regression Discontinuity Design (RDD). First, we distinguish the total local tax rate into two main components. The first is the municipality tax rate. For many reasons, the municipality tax rate cannot be considered as exogenous and, therefore, observing the elasticity of creations to this rate will lead to biased estimates. The second is the sum of department and region tax rates. The main source for potential endogeneity is the existence of an unobserved spatial determinant for attractivity that may be correlated to the observed tax rates. Assuming the continuity of such an unobserved determinant and observing the discontinuity of tax rates at the boundaries of departments and regions, we build RDD estimates of the impact of taxes on plants' location. A crucial point is to control for the municipality tax rate (which is also discontinuous). Our RDD logistic regressions confirm that local taxes do have a significant impact on the probability of a firm to create a plant in a given municipality, everything else being equal.

Giving sense to this coefficient is uneasy. One should not infer from our results that the best fiscal policy for a municipality is to "race to the bottom", that is, to infinitely cut taxes. On the contrary, local authorities must find an equilibrium between tax revenues and infrastructure. We do not argue whether this equilibrium has to be "high-tax high-infrastructure" or "low-tax low-infrastructure". What we actually measure is the extent to which, all infrastructure and agglomeration effects being equal, changing the tax rate in a given zone affects plants' creation in this zone.

In addition, our study might provide a few insights about fiscal zoning policies[11]. Typically, the cost of such a policy is not carried by the municipality, so that lower taxes would not bring about lower investment in infrastructure. Our study concludes that zoning policies may have a significant and positive effect on plants' creation. However, this effect is likely to be local: plants created in a low-tax zone would have been created nearby (but maybe not in the low-tax zone) even without a zoning policy. If one believes in our model, this type of policy mainly improves

[11]Many zoning policies have been carried out over the last years in France: "Zones Franches Urbaines" (ZFU), "Zones Urbaines Sensibles" (ZUS)... They all aim at fostering plant creations in challenged infra-municipality areas by lowering tax rates – or even exempting newly created plants from taxes.

the attractivity of the zones whose tax rates are lowered to the detriment of those whose tax rates are maintained unchanged. This analysis deserves to be developed in an explicit evaluation of these fiscal zoning policies.

References

ANDERSSON, F., AND R. FORSLID (2003): "Tax Competition and Economic Geography," *Journal of Public Economic Theory*, 5(2), 377–405.

BALDWIN, R. E., AND P. KRUGMAN (2004): "Agglomeration, Integration and Tax Harmonisation," *European Economic Review*, 48, 1–23.

BARTIK, T. J. (1985): "Business Location Decisions in the United States: Estimates of the Effects of Unionization, Taxes, and Other Characteristics of States," *Journal of Business and Economic Statistics*, 3(1), 14–22.

BECKER, R. A., A. R. WILKS, R. BROWNRIGG, AND T. P. MINKA (2005): maps*, Draw Geographical Maps*, R package version 2.0-27.

BEST, N. G., K. ICKSTADT, AND R. L. WOLPERT (2000): "Spatial Poisson Regression for Health and Exposure Data Measured at Disparate Resolutions," *Journal of The American Statistical Association*, 35(452), 1076–1088.

BEST, N. G., K. ICKSTADT, R. L. WOLPERT, AND D. J. BRIGGS (2000): "Combining Models of Health and Exposure Data: the SAVIAH study," in *Spatial Epidemiology*, ed. by P. Elliot, J. Wakefield, N. G. Best, and D. J. Briggs, pp. 393–414. Oxford Univ. Press.

BLACK, S. (1999): "Do Better Schools Matter? Parentual Valuation of Elementary Education," *Quarterly Journal of Economics*, 114(2), 577–579.

BLUNDELL, R., R. GRIFFITH, AND F. WINDMEIJER (1997): "Individual Effects and Dynamic Count Data," mimeo University College London.

CHARLOT, S., AND S. PATY (2006): "Taxable Agglomeration Rent: Evidence from a Panel Data," mimeo CESAER.

COHEN, J. P., AND C. J. M. PAUL (2005): "Agglomeration Economies and Industry Location Decisions: The Impacts of Spatial and Industrial Spillovers," *Regional Science and Urban Economics*, 35, 215–237.

CRESSIE, N. A. C. (1993): *Statistics for Spatial Data*. Wiley.

CROZET, M., T. MAYER, AND J.-L. MUCCHIELLI (2004): "How do Firms Agglomerate? A Study of FDI in France," *Regional Science and Urban Economics*, 34, 27–54.

Crépon, B., and E. Duguet (1997): "Estimating the Knowlege Production Function from Patent Numbers: GMM on Count Panel Data with Multiplicative Errors," *Journal of Applied Econometrics*, 12(3), 243–263.

Duranton, G., L. Gobillon, and H. G. Overman (2006): "Assessing the Effects of Local Taxation Using Microeconomic Data," mimeo.

Gómez-Rubio, V. (2005): *RArcInfo: Functions to Import Data from Arc/Info V7.x Binary Coverages*, R package version 0.4-6.

Guimarães, P., O. Figueirdo, and D. Woodward (2003): "A Tractable Approach to the Firm Location Decision Problem," *The Review of Economics and Statistics*, 85(1), 201–204.

Hahn, J., P. Todd, and W. Van der Klaauw (2001): "Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design," *Econometrica*, 69(1), 201–209.

Hausman, J., B. Hall, and Z. Griliches (1984): "Econometric Models for Count Data with an Application to the Patents R&D Relationship," *Econometrica*, 52(4), 909–938.

Holmes, T. J. (1998): "The Effect of State Policies on the Location of Manufacturing: Evidence from State Borders," *Journal of Political Economy*, 106(4), 667–705.

Holmes, T. J., and J. J. Stevens (2004): "Geographic Concentration and Establishment Size: Analysis in an Alternative Economic Geography Model," *Journal of Economic Geography*, 4(3), 227–250.

Houdebine, M., and J.-L. Schneider (1997): "Mesurer l'influence de la fiscalité sur la localisation des entreprises," Discussion Paper G9720, INSEE.

Madiès, T., S. Paty, and Y. Rocaboy (2004): "Horizontal and Vertical Externalities: An Overview of Theoretical and Empirical Studies," *Urban Public Economic Review*, 2, 63–93.

Papoulis, A., and A. U. Pillai (2002): *Probability, Random Variables and Stochastic Processes*. McGraw Hill.

R Development Core Team (2005): *R: A Language and Environment for Statistical Computing*, R Foundation for Statistical Computing, Vienna, Austria.

Riou, S. (2006): "Transfer and Tax Competition in a System of Hierarchical Governments," *Regional Science and Urban Economics*, 36, 249–269.

Schneider, J.-L. (1997): “La Taxe Professionnelle : Eléments de Cadrage Economique,” Discussion paper, INSEE.

Silverman, B. W. (1986): *Density Estimation for Statistics and Data Analysis*. Chapman and Hall.

Wooldridge, J. M. (2002): *Econometric Analysis of Cross Section and Panel Data*. MIT Press.

A Formalization on attractivity

The notion of attractivity can be formalized as follows. New plants' location decision is based on an intensity function $p(\mathbf{x}, t)$ where $\mathbf{x}$ is a point of the geographical space and t denotes time. This function is assumed to be Lebesgue-measurable such that $p \in \mathcal{L}^2(\mathbb{R}^2 \times \mathbb{R})$ ($\mathcal{L}^2(\mathbb{R}^2 \times \mathbb{R})$ being the space of square integrable functions of $\mathbb{R}^2 \times \mathbb{R}$) and $\int_{\mathbf{x} \in A} \int_{t \in I} p(\mathbf{x}, t) d\mathbf{x} dt$ is the probability that a firm that aims at establishing a new plant during the time interval I decides to chose to locate in area A. We assume that: $p(\mathbf{x}, t) = p_0(\mathbf{x}) + g(\mathbf{x}, t)$ where $p_0 \in \mathcal{L}^2(\mathbb{R}^2)$, $g \in \mathcal{L}^2(\mathbb{R}^2 \times \mathbb{R})$ and:

$$\begin{cases} \int g(\mathbf{x}, t) e^{-i\omega t} dt = 0 & \forall |\omega| < \omega_0 \ \forall \mathbf{x} \\ \iint g(\mathbf{x}, t) e^{-i\mathbf{\Omega x}} d\mathbf{x} = 0 & \forall |\Omega| < \Omega_0 \ \forall t \end{cases}$$

where $i^2 = -1$. In other words, the space-time variability associated to function g vanishes for both time and spatial wavelengths independently. There exist both time (h) and space (H) filters such that:

$$\begin{cases} \int p(\mathbf{x}, t-u) h(u) du &= p_0(\mathbf{x}) \\ \iint p(\mathbf{x} - \mathbf{s}, t) H(\mathbf{s}) d\mathbf{s} &= p_0(\mathbf{x}) \end{cases}$$

p_0 is the "absolute attractivity" of point $\mathbf{x}$. The existence of p_0 is equivalent to assume that the process of new plant creation is time-stationary and, except from a deterministic mean, also spatially stationary. According to Cressie (1993, Eq. 3.1.2.), $p_0(\mathbf{x})$ is the large scale variation of absolute attractivity and $g(\mathbf{x}, t)$ is the sum of the small scale variation, the micro-scale variation and the measurement error of absolute attractivity. $p_0(\mathbf{x})$ might be understood either as a spatial or a temporal average of the location process of new establishments. It is, therefore, possible to imagine a spatial average of the process that would correspond to the spatial long wavelengths of the location process. With respect to these long spatial wavelengths, the short ones would correspond to the local attractivity over which local authorities can have some control.

B Selected industries

The activity sectors selected in our study are the following. Manufacture of food products and beverages - Manufacture of tobacco products - Preparation and spinning of textile fibres - Manufacture of wearing apparel; dressing and dyeing of fur - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials - Manufacture of pulp, paper and paper products - Publishing, printing and reproduction of recorded media - Manufacture of coke, refined petroleum products and nuclear fuel - Manufacture of chemicals and chemical products - Manufacture of rubber and plastic products - Manufacture of other non-metallic mineral products - Manufacture of basic metals - Manufacture of fabricated metal products, except machinery and equipment - Manufacture of machinery and equipment n.e.c. - Manufacture of office machinery and computers - Manufacture of electrical machinery and apparatus n.e.c. - Manufacture of radio, television and communication equipment and apparatus - Manufacture of medical, precision and optical instruments, watches and clocks - Manufacture of motor vehicles, trailers and semi-trailers - Manufacture of other transport equipment - Manufacture of furniture; manufacturing n.e.c. - Recycling - Electricity, gas, steam and hot water supply - Collection, purification and distribution of water - Construction - Wholesale trade and commission trade, except of motor vehicles and motorcycles - Land transport; transport via pipelines - Water transport - Air transport - Supporting and auxiliary transport activities; activities of travel agencies - Post and telecommunications - Computer and related activities - Research and development - Other business activities - Sewage and refuse disposal, sanitation and similar activities.

C Probabilistic framework

The model presented here owes to Best, Ickstadt, and Wolpert (2000) and Best, Ickstadt, Wolpert, and Briggs (2000). First, we justify the connection between binomial and Poisson distributions. Second, we derive the natural framework for a Poisson regression on covariates which represent both establishments and municipalities' characteristics.

C.1 From binomial to Poisson distributions

We keep the notations introduced in sections 2 and 3.1. Let μ_m be the total number of type m establishments setting up in the spatial set $\mathfrak{F}$ and $N_m(A_k)$ the number of the latter establishments setting up in area A_k, where $k \in \{1, \ldots, K\}$. $N_m(A_k)$ follows a binomial distribution of parameter $p_{k,m} = \int_{A_k} \varphi_m(\mathbf{u})d\mathbf{u}$ and, for $n \in \mathbb{N}^+$,

$$\mathrm{P}\{N_m(A_k) = n\} = C_{\mu_m}^n p_{k,m}^n (1 - p_{k,m})^{\mu_m - n}$$

We assume that the set of the K areas A_k is a partition of $\mathfrak{F}$ and that the size of each area is small. More precisely, we assume that we are in the conditions requested to apply the Poisson theorem (Papoulis and Pillai, 2002):

$$\text{when } \mu_m \to \infty,\ p_{k,m} \to 0 \text{ such as } \mu_m p_{k,m} \to \Lambda_{k,m} \text{ then:}$$
$$C_{\mu_m}^n p_{k,m}^n (1 - p_{k,m})^{\mu_m - n} \to e^{-\Lambda_{k,m}} \frac{(\Lambda_{k,m})^n}{n!}$$

It follows that $N_m(A_k)$ converges in distribution to $Poisson\,(\Lambda_{k,m})$ where $\Lambda_{k,m} \sim \mu_m \int_{A_k} \varphi_m(\mathbf{s}) d\mathbf{s}$ when $\mu_m \to \infty$ and $p_{k,m} \to 0$. We set:

$$\mu_m \varphi_m(\mathbf{s}) = \lambda_m(\mathbf{s})$$

C.2 Deriving the likelihood of the Poisson model

We assume that, for a given area A_k, the probability distribution of creations is of Poisson type whose intensity $\lambda_m(\mathbf{s})$ depends on the considered spot $\mathbf{s}$ in space and on the plant type. Thus, the average number of creations in area A_k verifies:

$$\Lambda_m(A_k) = \int_{A_k} \lambda_m(\mathbf{s}) d\mathbf{s}$$

It follows that:

$$P\{N_m(A_k) = n\} = \frac{\left(\int_{A_k} \lambda_m(\mathbf{s}) d\mathbf{s}\right)^n}{n!} \exp\left[-\int_{A_k} \lambda_m(\mathbf{s}) d\mathbf{s}\right]$$

We assume that the intensity of the Poisson distribution is written:

$$\forall \mathbf{s} \in \mathfrak{F}\ ,\ \ \lambda_m(\mathbf{s}) = \lambda_m^0(\mathbf{s}). \exp\left[x_m(\mathbf{s}).\beta\right] \tag{4}$$

where β is an unknown vector of parameters to be estimated through maximum likelihood and $x_m(\mathbf{s})$ is a set of covariates depending on the spot $\mathbf{s}$ and on the type m of the considered plant. λ_m^0 is an *a priori* Poisson intensity. Vector β characterizes the relationship between the spatial intensity and the covariates x_m.

To be consistent with section 3.1, λ_m^0 is assumed to be constant over any area A_k, as well as the covariates x_m. Thus, λ_m is constant over A_k. This allows us to lighten the notations: $x_m(\mathbf{s}|\mathbf{s} \in A_k) = x_{k,m}$, $\lambda_m^0(\mathbf{s}|\mathbf{s} \in A_k) = \lambda_{k,m}^0$, $S_k = \int_{A_k} d\mathbf{s}$, $\Lambda_{k,m}^0 = \int_{A_k} \lambda_m^0(\mathbf{s}) d\mathbf{s} = \lambda_{k,m}^0 S_k$, $\Lambda_{k,m} = \Lambda_m(A_k)$, and $N_{k,m}$ is the actual number of type m plants established in area k. Expression (4) can then be written:

$$\Lambda_{k,m} = \Lambda_{k,m}^0. \exp\left[x_{k,m}.\beta\right] \tag{5}$$

We, then, obtain:

$$P\{N_{k,m} = n\} = \frac{\left(\Lambda^0_{k,m}.\exp\left[x_{k,m}.\beta\right]\right)^n}{n!}\exp\left(-\Lambda^0_{k,m}.\exp\left[x_{k,m}.\beta\right]\right)$$

The contribution of the area k to the likelihood is similar to the one obtained by Best, Ickstadt, Wolpert, and Briggs (2000).

$$\mathcal{L}_{k,m} = N_{k,m}\left[\log(\Lambda^0_{k,m}) + x_{k,m}.\beta\right] - \log(N_{k,m}!) - \Lambda^0_{k,m}.\exp\left[x_{k,m}.\beta\right]$$

Thus,

$$\mathcal{L}_{k,m} = Cte + N_{k,m}.x_{k,m}.\beta - \Lambda^0_{k,m}.\exp\left[x_{k,m}.\beta\right] \tag{6}$$

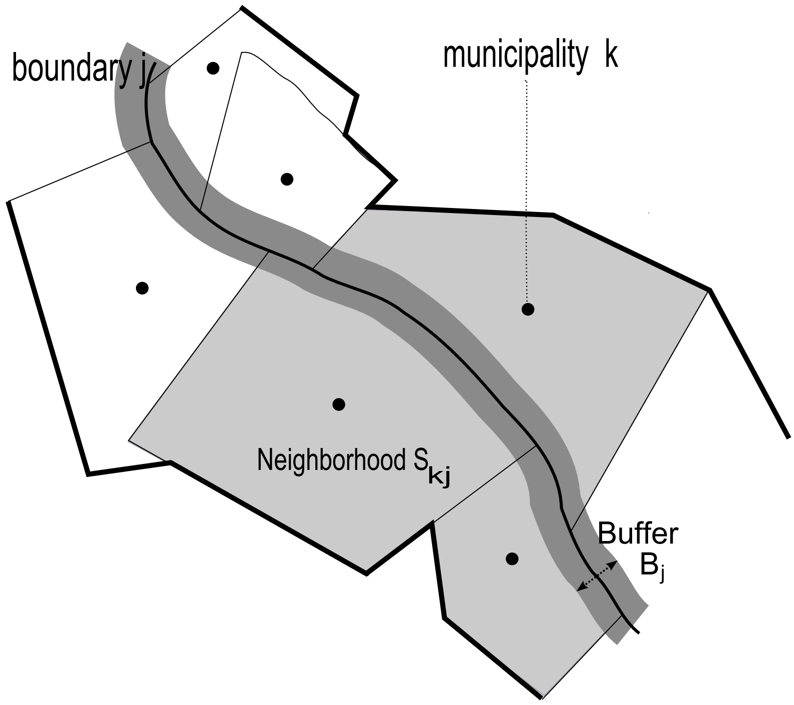
If we assume that the number of establishment creations of type m in area k is independent from the number of creations in a neighboring area (*i.e.* spatial independence) or the number of creations of type $m' \neq m$ (*i.e.* plant type independence), then the likelihood is simply the sum of the $\mathcal{L}_{k,m}$ (from equation (6)) for $k \in \{1\ldots,K\}$ and $m \in \{1,\ldots,M\}$. The assumption of independence, and notably the spatial independence, may seem strong at first glance, since agglomeration effects play a huge role in the establishment creation process. This makes crucial our assuming an exogenous $\Lambda^0_{k,m}$: after purging out from this deterministic spatial attractivity pattern, it is more acceptable to assume independence of creations across municipalities. Attempts to relax the assumption of spatial exogeneity for $\Lambda^0_{k,m}$ are appealing as they result in estimating this spatial trend as well. However, they end up discarding the independence hypothesis and the easy-to-do maximum likelihood estimation and adopting simulation approaches (notably, those based on Monte Carlo Markov Chains).

D More about Regression Discontinuity (RD) Design

A department boundary separates two departments and is practically identified from the couple of departments involved. We index the set of boundaries on $\mathbb{N}$. Let us first consider the boundary j. We define an infinitely thin buffer of land B_j around boundary j. Municipalities of interest are those intersecting this buffer B_j: we restrict our attention to those contiguous with department boundaries (see figure D).

Let us now consider a municipality k — whose territory is denoted hereafter $\mathcal{M}_k$ — intersected by the buffer B_j. A municipality is said to belong to municipality k's neighborhood, denoted S_{kj}, if this municipality is k itself, or if it fulfills the three following conditions (see figure D):

FIGURE 7: **Regression discontinuity framework**: an infinitely thin buffer B_j is defined around a boundary j that separates two departments; this buffer intersects some municipalities on both sides of the boundary; considering municipality k, a neighborhood S_{kj} of municipality k is defined as the set containing municipality k and all municipalities i) intersecting B_j, ii) located on the other side of the boundary and iii) contiguous to municipality k (case presented here); dots are municipality centroids.



(i) to intersect buffer B_j;

(ii) to be located on the other side of the boundary (with respect to municipality k);

(iii) to be close to municipality k (in a sense to be precised).

There are various possible choices for condition (iii). One possibility is to take all the municipalities defined by (i) and (ii). Another possible choice consists in selecting only the closest municipality to k verifying (i) and (ii). Another one is to select the municipalities that are contiguous with municipality k, just like in figure (D).

We now consider a plant i located in municipality k. We assume that plant i's location decision was taken according to an objective function $Y_{ij}(\mathbf{s})$ defined over the geographical space and maximized at the actual location $\mathbf{s}_i$ spot for plant i. Thus:

$$\forall \mathbf{s} \in S_{kj} \ , \ Y_{ij}(\mathbf{s}_i) > Y_{ij}(\mathbf{s})$$

Finally, we assume the following form for the objective function:

$$\forall \mathbf{s} \in S_{kj} \ , \ Y_{ij}(\mathbf{s}) = \tilde{\mu} + \gamma \tau_{ij}(\mathbf{s}) + \tilde{\eta}_{ij}(\mathbf{s}) \tag{7}$$

where τ is the sum of regional and departmental tax rates, $\tilde{\mu}$ is a constant and $\tilde{\eta}_{ij}$ is an unobserved variable that is continuous with respect to the geographical space (*i.e.* $\lim_{\|\mathbf{t}-\mathbf{s}\|\to 0} \tilde{\eta}_{ij}(\mathbf{t})$ exists and equals $\tilde{\eta}_{ij}(\mathbf{s})$). No additional hypothesis is made at this stage on the unobserved variable $\tilde{\eta}_{ij}$ except from spatial continuity. $\tilde{\eta}_{ij}$ thus summarizes all the continuous variables that play a role in the value taken by Y_{ij} (spatial or individual).

In the general case, $\mathbb{E}(\tau_{ij}\tilde{\eta}_{ij}) \neq 0$, then the OLS estimate of γ is not consistent. The Regression Discontinuity (RD) principle is based upon conditioning the regression with respect to a geographical neighborhood of a discontinuity point of τ_{ij}. By hypothesis:

$$\begin{cases} Y_{ij}\left(\mathbf{s}|\mathbf{s} \in \mathcal{M}_k\right) &= \tilde{\mu} + \gamma \tau_k + \tilde{\eta}_{ij}(\mathbf{s}) \\ Y_{ij}\left(\mathbf{s}|\mathbf{s} \in S_{kj} \setminus \mathcal{M}_k\right) &= \tilde{\mu} + \gamma \tau'(\mathbf{s}) + \tilde{\eta}_{ij}(\mathbf{s}) \end{cases}$$

where $\setminus$ denotes the set difference, τ_k is the sum of regional and departmental tax rates in municipality k and $\tau'(\mathbf{s})$ is the regional and departmental tax rate applied in the municipality to which $\mathbf{s}$ belongs to (and which is not municipality k, as we assumed). We, then, build a binary variable $T_{ij}(\mathbf{s})$ such that:

$$\begin{cases} T_{ij}(\mathbf{s}) &= 1 \text{ if } \tau_k \leqslant \bar{\tau}' \\ T_{ij}(\mathbf{s}) &= 0 \text{ if } \tau_k > \bar{\tau}' \end{cases}$$

where $\bar{\tau}'$ is the mean of $\tau'(\mathbf{s})$ over the whole set S_{kj}. In other words, if plant i is located in $\mathbf{s}_k$ in municipality k, then $T_{ij}(\mathbf{s}_k) = 1$ if the regional and departmental tax rate in municipality k is lower than the one applied in $S_{kj} \setminus \mathcal{M}_k$. $T_{ij}(\mathbf{s}_k) = 0$ when the regional and departmental tax rate in municipality k is higher than in $S_{kj} \setminus \mathcal{M}_k$.

Replacing τ_{ij} with T_{ij}, and redefining $\tilde{\mu}$ and $\tilde{\eta}_{ij}$ accordingly, we obtain a modified version of equation (7):

$$\forall \mathbf{s} \in S_{kj} \ , \ Y_{ij}(\mathbf{s}) = \mu + \alpha T_{ij}(\mathbf{s}) + \eta_{ij}(\mathbf{s}) \tag{8}$$

We focus our attention on parameter α. In each neighborhood S_{kj}, we assume that η_{ij} and T_{ij} are independent[12]. This does not mean that η_{ij} and T_{ij} are independent in general; it is enough that these two variables are independent conditionally to the fact that they are both observed in the same spatial neighborhood S_{kj}. Thus, the regression of a set of observations made on a set of neighborhoods $\mathfrak{S} = \bigcup_{j\in\{1,\ldots,N\},k\in\{1,\ldots,M\}} S_{kj}$ leads to an estimate of $\begin{pmatrix}\mu & \alpha\end{pmatrix}'$ whose limit in probability verifies:

$$\text{plim}\,\widehat{\begin{pmatrix}\mu \\ \alpha\end{pmatrix}} = \begin{pmatrix}\mu \\ \alpha\end{pmatrix} + \left\{\mathbb{E}\left[\left.\begin{pmatrix}1 & T_{ij}(\mathbf{s}) \\ T_{ij}(\mathbf{s}) & T_{ij}^2(\mathbf{s})\end{pmatrix}\right| \mathbf{s} \in \mathfrak{S}\right]\right\}^{-1} \begin{pmatrix}\mathbb{E}(\eta_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S}) \\ \mathbb{E}(T_{ij}(\mathbf{s})\eta_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S})\end{pmatrix}$$

By the rule of iterated expectations:

$$\mathbb{E}(T_{ij}(\mathbf{s})\eta_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S}) = \mathbb{E}\left\{\mathbb{E}\left[T_{ij}(\mathbf{s})\eta_{ij}(\mathbf{s})|\mathbf{s} \in S_{kj}\right]|S_{kj} \subset \mathfrak{S}\right\} = \mathbb{E}(T_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S})\mathbb{E}(\eta_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S}) \tag{9}$$

Developing the inverse matrix[13] we have:

$$\text{plim } \hat{\alpha} = \alpha + \frac{1}{\text{var}(T_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S})}\left[-\mathbb{E}(T_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S}).\mathbb{E}(\eta_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S}) + \mathbb{E}(T_{ij}(\mathbf{s})\eta_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S})\right]$$

and finally, using (9):

$$\text{plim}\hat{\alpha} = \alpha.$$

[12]Another way to say it is to assume, following Hahn, Todd, and Van der Klaauw (2001), that $\mathbb{E}(\eta_{ij}(\mathbf{s})|\mathbf{s} \in S_{kj})$ is continuous with respect to $\mathbf{s}$. Practically, this means that S_{kj} is sufficiently small to consider that $\eta_{ij}(\mathbf{s}|\mathbf{s} \in S_{kj})$ does not depend on $\mathbf{s}$. This last point does not hold for T_{ij} which jumps from 0 to 1 somewhere in the neighborhood. Then, by continuity, we have $\mathbb{E}(\eta_{ij}(\mathbf{s})T_{ij}(\mathbf{s})|\mathbf{s} \in S_{kj}) = \mathbb{E}(\eta_{ij}(\mathbf{s})|\mathbf{s} \in S_{kj})\mathbb{E}(T_{ij}(\mathbf{s})|\mathbf{s} \in S_{kj})$. This last result is similar to conditional independence of η_{ij} and T_{ij} with respect to S_{kj}.

[13]$\left\{\mathbb{E}\left[\left.\begin{pmatrix}1 & T_{ij}(\mathbf{s}) \\ T_{ij}(\mathbf{s}) & T_{ij}^2(\mathbf{s})\end{pmatrix}\right| \mathbf{s} \in \mathfrak{S}\right]\right\}^{-1} = \frac{1}{\text{var}(T_{ij}(\mathbf{s})|\mathbf{s}\in\mathfrak{S})}\mathbb{E}\left[\left.\begin{pmatrix}T_{ij}^2(\mathbf{s}) & -T_{ij}(\mathbf{s}) \\ -T_{ij}(\mathbf{s}) & 1\end{pmatrix}\right| \mathbf{s} \in \mathfrak{S}\right]$

A similar reasoning provides:

$$\text{plim } \hat{\mu} = \alpha + \mathbb{E}(\eta_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S})$$

Finally, where does the continuity assumption of $\mathbb{E}(\eta_{ij}(\mathbf{s})|\mathbf{s} \in \mathfrak{S})$ with respect to space and the discontinuity assumption of T_{ij} play a role? On the one hand, the discontinuity assumption on T_{ij} is the reason for which the matrix $\left[\mathbb{E}\left(\begin{matrix} 1 & T_{ij}(\mathbf{s}) \\ T_{ij}(\mathbf{s}) & T_{ij}^2(\mathbf{s}) \end{matrix}\right)\middle| \mathbf{s} \in \mathfrak{S}\right]$ is invertible. Since T_{ij} is an index variable correlated to space, if there was no discontinuity, then $\mathbb{E}(T_{ij}(\mathbf{s}))$ would be equal either to 0 or to 1. In both cases, the matrix would be singular. Precisely, the identification of α relies on the invertibility of the previous matrix. On the other hand, the continuity of η_{ij} is the reason for which it can be treated locally as a constant and the very local correlation between T_{ij} and η_{ij} vanishes, even if these two variables are correlated through space when they are considered from a general point of view (i.e. unconditionally to space).

This leads us to another point we want to raise about RD: since a part of the overall tax rate (which is a sum of regional, departmental and municipal components) is decided by the municipality, an individual effect associated to the chosen municipality k remains in the tax rate applied to the plant. Unfortunately, this individual effect is also discontinuous at the department boundary, since all the municipalities are contained in only one department. Thus, the municipality part of the tax cannot be put in the residual since the continuity assumption of the residual would fail. Our strategy is to control for the municipality tax rate. Including directly this tax rate as an additional variable in the RD regression makes it possible to identify the α coefficient and all the previous results remain valid. (8) is, then, modified into the following model:

$$\forall \mathbf{s} \in S_{kj},\ Y_{ij}(\mathbf{s}) = \mu + \alpha T_{ij}(\mathbf{s}) + \upsilon \sum_{\ell=1}^{q} z_\ell.\mathbf{1}(\mathbf{s} \in \mathcal{M}_\ell) + \eta_{ij}(\mathbf{s}) \qquad (10)$$

where the set of municipalities contained in $\mathfrak{S}$ is indexed over $\{1, \ldots, q\}$, z_ℓ stands for municipality ℓ's tax rate and υ is the unknown coefficient of the municipality tax rate in the objective function. Imagine that the local effect is not controlled for. Then the error term is $\eta'_{ij}(\mathbf{s}) = \upsilon \sum_{\ell=1}^{q} z_\ell.\mathbf{1}(\mathbf{s} \in \mathcal{M}_\ell) + \eta_{ij}(\mathbf{s})$. Since we cannot assume anymore that $T_{ij}(\mathbf{s})$ and $\eta'_{ij}(\mathbf{s})$ are independent conditionally to S_{kj}, $\hat{\alpha}$ is likely to be biased.

Note that we do not introduce a boundary-specific fixed-effect as Black (1999) does for the following reason: it might be useful to add a fixed-effect if T_{ij} was not the only discontinuous variable at the boundary j and if this additional variable was correlated with T_{ij} and took different values on average on each boundary. In the present case, we assume that such a situation does not occur. As it is likely that introducing a boundary fixed-effect in regressions would dramatically reduce the amount of information used to identify α, we decided no to do so.

Finally, Y_{ij} is an unobserved latent variable. What we actually observe are the municipalities where plants settle. An efficient model is to consider as the dependent variable a binary variable $Z_{ij}(\mathbf{s})$ corresponding to the decision of the individual firm i to be located on the left hand-side or on the right hand-side of boundary j, one side being the lowest tax rate side, while the other is the highest one. This is what is implemented in subsection 4.2.

E Spatial regressions with municipality equipment inventory

In 1998, a systematic inventory of the various equipment available in each of the 36,600 French municipalities was undertaken. Some of these variables have been used to characterize the "absolute attractivity" in the spatial regression. Tables E and E below focus on the inventory variables used in the regression corresponding to column (5) of table 4.1. A municipality has the possibility to delegate the fixation of the corporate municipality tax to some local gathering of municipalities. This is called "Intercommunalité" in French. The index of the level of intercommunality adopted in this paper corresponds to the ratio of the municipality revenues that come from a decision taken at the intercommunality structure level over the total revenue of the considered municipality. Table E shows the results obtained with a Poisson modeling of the municipality count of plant setting-up. Table E shows the results obtained with a Negative binomial regression. One can note the good consistency of the two regression results, even if the sign of the municipality tax rate is negative in the negative-binomial regression, while it is positive in the Poisson regression. This suggests a certain amount of uncertainty in the determination of the corresponding parameter. We consider this as another evidence of the weakness of the Poisson/Negative binomial spatial regression in the estimation of this parameter.

Table 5: Poisson regression of the municipality count of plant setting-up

Parameter	Estimate	Std	Pr > ChiSq
Intercept	-5.3725	0.0485	<.0001
Department & Region tax rate	-0.0655	0.0033	<.0001
Municipality tax rate	0.0037	0.0013	0.0041
Department & Region SFC	0.5412	0.0219	<.0001
Municipality SFC	0.0595	0.0013	<.0001
Intercommunality index	0.2447	0.0136	<.0001
distance to closest highway (km)	-0.0126	0.0004	<.0001
dummy postoffice	0.3079	0.0301	<.0001
dummy activity zone	1.3441	0.0302	<.0001
dummy public transportation by bus	0.1251	0.0144	<.0001
dummy city public transportation	0.9643	0.0167	<.0001
dummy school restaurant	0.2567	0.0348	<.0001
dummy nursery school	0.5210	0.0290	<.0001
dummy school evening services	0.3316	0.0228	<.0001
dummy gathering of primary schools (*regroupement pédagogique*)	-0.0101	0.0161	0.5289
dummy secondary school (*collège*)	0.1284	0.0223	<.0001
dummy upper secondary school (*lycée*)	0.5555	0.0204	<.0001
dummy technical upper secondary school (*lycée technique*)	0.2896	0.0196	<.0001
dummy hospital	0.3538	0.0183	<.0001
dummy athletics equipment	0.4113	0.0185	<.0001
dummy gymnasium	0.4814	0.0277	<.0001
dummy indoor swimming pool	0.5882	0.0180	<.0001
dummy public library	0.0833	0.0258	0.0012
dummy 1993	-0.1388	0.0252	<.0001
dummy 1994	-0.1732	0.0255	<.0001
dummy 1995	-0.2170	0.0258	<.0001
dummy 1996	-0.1266	0.0252	<.0001
dummy 1997	-0.1294	0.0253	<.0001
dummy 1998	-0.1145	0.0252	<.0001
dummy 1999	-0.0015	0.0245	0.9517
dummy 2000	0.1005	0.0239	<.0001
dummy 2001	0.0808	0.0240	0.0008
dummy 2002	0.0000	0.0000	.

Table 6: Negative binomial regression of the municipality count of plant setting-up

Parameter	Estimate	Std	Pr > ChiSq
Intercept	-5.1966	0.0627	<.0001
Department & Region tax rate	-0.0530	0.0049	<.0001
Municipality tax rate	-0.0085	0.0020	<.0001
Department & Region SFC	0.4337	0.0352	<.0001
Municipality SFC	0.0936	0.0048	<.0001
Intercommunality index	0.2107	0.0211	<.0001
distance to closest highway (km)	-0.0153	0.0006	<.0001
dummy postoffice	0.3022	0.0321	<.0001
dummy activity zone	1.3073	0.0317	<.0001
dummy public transportation by bus	0.1349	0.0202	<.0001
dummy city public transportation	0.9180	0.0219	<.0001
dummy school restaurant	0.2946	0.0376	<.0001
dummy nursery school	0.5409	0.0304	<.0001
dummy school evening services	0.2799	0.0272	<.0001
dummy gathering of primary schools (*regroupement pédagogique*)	-0.1525	0.0266	<.0001
dummy secondary school (*collège*)	0.1878	0.0272	<.0001
dummy upper secondary school (*lycée*)	0.5794	0.0331	<.0001
dummy technical upper secondary school (*lycée technique*)	0.2757	0.0316	<.0001
dummy hospital	0.3423	0.0294	<.0001
dummy athletics equipment	0.3654	0.0249	<.0001
dummy gymnasium	0.4944	0.0300	<.0001
dummy indoor swimming pool	0.5601	0.0269	<.0001
dummy public library	0.1150	0.0288	<.0001
dummy 1993	-0.1191	0.0383	0.0019
dummy 1994	-0.1993	0.0385	<.0001
dummy 1995	-0.2183	0.0387	<.0001
dummy 1996	-0.1416	0.0382	0.0002
dummy 1997	-0.1332	0.0382	0.0005
dummy 1998	-0.1366	0.0381	0.0003
dummy 1999	-0.0302	0.0374	0.4200
dummy 2000	0.0412	0.0369	0.2643
dummy 2001	0.0558	0.0370	0.1316
dummy 2002	0.0000	0.0000	.
Dispersion	1.4132	0.0288	

F Sensitivity analysis

All along the estimation phase, we have to make decisions about which hypotheses to retain and which to discard. In this annex, we analyze the robustness of our results by relaxing several assumptions. We consider regression (3) in table 4.2 as the benchmark regression.

F.1 Plant size

The bigger the firm, the bigger the effects, table F.1 says. However, some effects are still observed on medium plants (from 10 to 50 employees).

TABLE 7: RD logistic regression depending on the size of firms

Covariates	Estimates - Panel 1993-2002		
Nb. of employees	$. \geqslant 50$	$10 < . < 50$	Benchmark
δ^1_{jt}	0.029 (0.166)	0.130 (0.078)	0.106 (0.070)
δ^2_{jt}	0.645** (0.134)	0.305** (0.066)	0.374** (0.059)
δ^3_{jt}	0.362** (0.113)	0.148 (0.057)	0.188** (0.051)
δ^4_{jt}	0.575** (0.130)	0.442** (0.067)	0.483** (0.060)
Diff munic. tax rate	0.012 (0.012)	0.049* (0.006)	0.042** (0.005)
Diff activity zone	2.505** (0.211)	2.316** (0.102)	2.345** (0.091)
Nobs	1,245	4,761	6,006
N(Z=1)	710	2,529	3,239
N(Z=0)	535	2,232	2,767
Percentage concordant	71.5	72.7	72.3

Notes: 1 star means 95%-significant and 2 stars mean 99%-significant. Standard errors are in parentheses. The "diff"s stand for the difference of the values taken by the considered variable on both sides of the boundary.

F.2 Activity sectors

As showed in table F.2, the effects remain stable and significant once the tax difference has passed a certain threshold. In some sectors (especially construction (F), wholesale trade (G) and transport and communication (I), for the third category of tax difference, related to variable

δ^3_{jt}), significance is not achieved, probably because of smaller sample sizes. One can remark that the effects can be quite strong, especially for transport and communications (I) and computer, R&D and business activities (K), which are more capital-intensive sectors.

TABLE 8: RD logistic regression depending on sectors

Covariates	Estimates - Panel 1993-2002					
	Benchmark	D	F	G	I	K
δ^1_{jt}	0.106 (0.070)	0.149 (0.133)	0.422* (0.205)	0.055 (0.193)	0.309 (0.223)	−0.033 (0.123)
δ^2_{jt}	0.374** (0.059)	0.270** (0.113)	0.263 (0.162)	0.379** (0.154)	0.832** (0.168)	0.571** (0.110)
δ^3_{jt}	0.188** (0.051)	0.210** (0.110)	0.271 (0.143)	0.233 (0.126)	0.138 (0.165)	0.255** (0.087)
δ^4_{jt}	0.483** (0.060)	0.393** (0.125)	0.568** (0.179)	0.461** (0.168)	0.447** (0.168)	0.476** (0.098)
Diff munic. tax rate	0.042** (0.005)	0.046** (0.010)	0.072** (0.015)	0.050** (0.014)	0.016 (0.017)	0.033** (0.009)
Diff activity zone	2.345** (0.091)	2.28** (0.163)	2.196** (0.238)	2.405** (0.259)	1.880** (0.212)	3.005** (0.222)
Nobs	6,006	1,486	750	865	680	2,059
N(Z=1)	3,239	764	406	456	403	1,111
N(Z=0)	2,767	722	344	409	277	948
Percentage concordant	72.3	75.5	74.6	71.2	72.5	71.1

Notes: 1 star means 95%-significant and 2 stars mean 99%-significant. Standard errors are in parentheses. The "diff"s stand for the difference of the values taken by the considered variable on both sides of the boundary. Sectors are: manufacture (D); construction (F); wholesale trade (G); transport and communication (I); computer, R&D and business activities (K).

F.3 Without the Parisian region (Île-de-France)

It is often said that the Paris area drives most of plant creations in France. It is partly true, as only 3,178 creations out of a total of 6,006 in our data are located outside the Île-de-France region. However, our results (table F.3) remain quite stable even after excluding the area around Paris (whatever the "Petite Couronne" — the three departments contiguous to Paris – or the entire Île-de-France region).

TABLE 9: RD logistic regression depending on location

Covariates	Estimates - Panel 1993-2002		
	Benchmark	Without "Petite Couronne"	Without Île-de-France
δ^1_{jt}	0.106 (0.070)	0.170* (0.076)	0.170* (0.077)
δ^2_{jt}	0.374** (0.059)	0.423** (0.082)	0.329** (0.086)
δ^3_{jt}	0.188** (0.051)	0.450** (0.080)	0.412** (0.092)
δ^4_{jt}	0.483** (0.060)	0.041 (0.082)	−0.086 (0.090)
Diff munic. tax rate	0.042** (0.005)	0.055** (0.0064)	0.067** (0.007)
Diff activity zone	2.345** (0.091)	2.308** (0.094)	2.368** (0.103)
Nobs	6,006	3,628	3,178
N(Z=1)	3,239	1,973	1,705
N(Z=0)	2,767	1,655	1,473
Percentage concordant	72.3	80.8	82.0

Notes: 1 star means 95%-significant and 2 stars mean 99%-significant. Standard errors are in parentheses. The "diff"s stand for the difference of the values taken by the considered variable on both sides of the boundary.

F.4 Other specifications for RD estimations

Adding other covariates or time dummies does not notably alter the results (table F.4). It might be meaningful to control for facilities available to inhabitants and from which are excluded people living on the other side of the department boundary. One can think about facilities organized around schools or children care.

Table 10: RD logistic regression depending on covariates

Covariates	Estimates - Panel 1993-2002			
	Benchmark	(1)	(2)	(3)
δ^1_{jt}	0.106 (0.070)	0.152* (0.071)	0.097 (0.071)	0.218** (0.081)
δ^2_{jt}	0.374** (0.059)	0.232** (0.060)	0.384** (0.059)	0.312** (0.065)
δ^3_{jt}	0.188** (0.051)	0.094 (0.052)	0.175** (0.051)	0.176** (0.056)
δ^4_{jt}	0.483** (0.060)	0.413** (0.061)	0.476** (0.060)	0.396** (0.064)
Diff munic. tax rate	0.042** (0.005)	0.048** (0.005)	0.042** (0.005)	−0.029** (0.006)
Diff activity zone	2.345** (0.091)	2.491** (0.099)	2.345** (0.092)	1.426** (0.100)
Diff munic. SFC	-	0.042** (0.005)	-	-
Diff dep. SFC	-	0.618** (0.063)	-	-
Diff Infrastructure	-	-	-	Yes
Time dummies	-	-	Yes	-
Nobs	6,006	6,006	6,006	6,005
N(Z=1)	3,239	3,239	3,239	3,238
N(Z=0)	2,767	2,767	2,767	2,767
Percentage concordant	72.3	76.5	72.9	81.3

Notes: 1 star means 95%-significant and 2 stars mean 99%-significant. Standard errors are in parentheses. The "diff"s stand for the difference of the values taken by the considered variable on both sides of the boundary.