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Josep-Maria Arauzo-Carod

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Departament d’Economia
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Universitat Rovira i Virgili
Facultat de Ciències Econòmiques i Empresarials
Avgda. de la Universitat, 1
432004 Reus
Tel. +34 977 759 811
Fax +34 977 300 661

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Industrial Location at a Local Level: Some Comments about the Territorial Level of the Analysis*

Josep-Maria Arauzo-Carod (♣): josepmaria.arauzo@urv.cat

Abstract:

This paper contributes to the existing literature on industrial location by discussing some issues regarding the territorial levels that have been used in location analysis. We analyse which could be the advantages and disadvantages of performing locational analysis at a different local levels. We use data for new manufacturing firms located at municipality, county and travel to work areas level. We show that location determinants vary according to the territorial level used in the analysis, so we conclude that the level at which we perform the investigation should be carefully selected.

Keywords: industrial location, cities, agglomeration economies, count data models

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(♣) QURE (Department of Economics, Universitat Rovira i Virgili)
Av. Universitat, 1; 43204 – Reus
Phone: + 34 977 759 800 Fax + 34 977 759 810

1. Introduction

The analysis of location decisions taken by manufacturing firms has been attracting a growing interest from scholars in recent years. Those analyses have been carried out using a diversity of methodological techniques, data bases and theoretical approaches but they share a wide agreement about the importance of territorial aspects in order to explain those decisions. Furthermore, the increased availability of statistical information has allowed researchers to access huge data bases about both territorial and firm characteristics and, consequently, those scholars have nowadays the opportunity to carefully analyse the role of infrastructures, agglomeration economies, clusters and human capital (among other issues) over location decisions.

As a consequence of previous scientific contributions, now we have a better knowledge of why firms choose some sites instead of others, so we can provide useful policy recommendations about how to increase the attractiveness of some territories and how to pull new firms. Unfortunately, there is one area with a lot of missing (and useful) information: the territorial level where to study the location issues. An accurate analysis of previous empirical contributions on industrial location will show that, thanks to the availability of disaggregated data bases, location decisions are now studied mainly at a local level, while some years ago was most usual to find those kind of analysis at a regional level. Additionally, given that most of contributions depart from an agglomeration economies framework, those decisions are studied at the level in which agglomeration economies are stronger, this is the local level. As a consequence, some articles have widely emphasized that using local data allows to better portrait those location decisions.

But the problem arises when the interested scholar tries to go further and to discuss about what local level means. This is a key question because the word “local” can fit into slightly different meanings, especially if we compare “local” units belonging to different countries. Then, talking about local level in the U.S. context is not the same that doing that in the U.K. or in Italy, for instance. So, it is important to reach an agreement about what is the "local level" and how to homogenise territorial units belonging to different countries. And it is also important to analyse carefully if local area is necessarily better than any other area like, for instance regions or provinces. Therefore, after this debate arise another discussion about if those analyses should rely on administrative units (for instance, municipalities), on functional units (for instance travel to work areas -TTWA-) or on a combination of both. Here we focus in this later discussion.

This is, specifically, the aim of this paper, to make a first step in the identification of the territorial level/s that is/are relevant for location decisions and how the characteristic of territories affect those decisions. We want to analyze if changes in the territorial level also change location determinants. If the answer is yes, as we expect, then the territorial level of the analysis should be selected cautiously.

Our assumption is that is important to take into account both local administrative units (municipalities and counties, for instance) and local functional units (TTWA). In fact, local function units have the advantage that are supposed to better portray current economic conditions, because their boundaries are made according to some kind of economic data, as commuting data is. This paper contributes to the existing empirical literature on industrial location by starting a discussion not fully developed yet by scholars[1]. This is an important issue because a better knowledge of such location decisions should help to implement more efficient entry promoting policies.

This paper is organised as follows. The second section presents the review of the location literature and the discussion about which level of territorial units fits better within this kind of analysis. The third section develops the model, the econometric estimation and the variables used. The fourth section presents our main results. Finally, the fifth section contains conclusions and future lines of research.

[1] There is an exception by Rosenthal and Strange (2004), which approached this issue in a different but somewhat close way.

2. Industrial location: a territorial approach

2.1 Review of location literature

The location issues can be approached from two different sides. On the one hand, we do have the firm's point of view. So, the object of the analysis is how the firm's characteristics act over their location decisions. On the other hand, we do have the territory point of view. Here the core of the analysis is how the characteristics of the territories can influence (this is, how they can attract or discourage) the location of firms. The former analysis focuses on aspects such the figure of the entrepreneur, the firm size and the industry to which the firm belongs, among others, while the later analysis considers territorial characteristics such the labour availability, the geographical position of the sites, the population distribution and the skill level of workers, among others.

Hayter (1997) focuses the analysis on territorial characteristics and classifies empirical location literature into three approaches: a neoclassical approach, a behavioural approach and an institutional approach. The neoclassical approach links location decisions with profit-maximisation and cost-minimising strategies. The behavioural approach is about location decisions taken under uncertainty and imperfect information. And, finally, the institutional approach takes into account the institutional environment in which those decisions are taken. According to those approaches, the first one considers variables like agglomeration economies, land prizes, wages, transportation costs and worker's skills; the second one considers non economic variables like personal circumstances of the entrepreneur and others as the firm size; and the third one considers variables like the existence and characteristics of suppliers and customers, the role of public administrations and trade unions and the relations and linkages with other firms of the area.

2.2 Discussion about the territorial units of analysis

Most of current contributions of location issues depart from seminal paper of Carlton (1979) about location decisions in metropolitan areas. A review of those contributions show that while papers from the eighties and nineties[2] use mainly larger areas like U.S. states (Head et al., 1995; Friedman et al., 1992; Coughlin et al., 1991; Bartik, 1985) or metropolitan areas (Carlton, 1983 and 1979), research work from the XXIth century rely principally in smaller areas[3] like counties (Arauzo and Manjón, 2004; List, 2001; List and McHome, 2000; Coughlin and Segev, 2000) or municipalities (Manjón and Arauzo, 2007; Arauzo, 2005; Arauzo and Manjón, 2004; Holl, 2004a, 2004b and 2004c; Figueiredo et al., 2002; Guimarães et al., 2000; Baudewyns et al., 2000; Baudewyns, 1999). It is important to notice that most of those contributions are based on administrative territorial units (states, provinces, counties or municipalities) instead of functional territorial units (metropolitan areas or TTWA, among others). However, Rosenthal and Strange (2003) use a different approach, since they built up rings around zipcodes (1, 5, 10 and 15 miles) and analyse how new firms are attracted to the area depending on which ring is used to measure local variables like employment.

A shared explanation for this territorial disaggregation has been the improvements on data availability at a local level, also with recent advances in areas such the New Economic Geography (NEG), that emphasize the role of local areas on the generation of agglomeration economies. But apart from those reasons, the empirical contributions on industrial location do not really discuss about the territorial level in which the analysis is performed and, simply, use the available data. Therefore, given that nowadays is easier to obtain data at a local level and given the contributions of NEG, scholars have gradually shift to the municipality level. There is an additional explanation related to the econometric techniques used in location analysis. During the eighties and nineties the Conditional Logit Model (CLM) was the most popular specification, but this model has an important drawback, which is the difficulty to calculate the

[2] Nevertheless, there are some exceptions at the nineties like Smith and Florida (1994), who use U.S. counties, and Woodward (1992), who use both U.S. counties and states.
[3] Among the exceptions at the XXIth century there are Cieślik (2005) and Basile (2004), who use data from provinces. Rosenthal and Strange (2001) also use areas of different sizes like zipcodes, counties and states.

likelihood function when there are so many alternatives (sites), which is so common at a local level. A possible solution can be the utilisation of a Count Data Model (CDM). Those models have no computational constraints about the number of alternatives (it is possible to use larger data sets) and have been used by most of researchers since the nineties.

As a consequence of the previous process, recent location studies are better portraying the location determinants and, hence, the policy implications that arise from their findings can fit better with real economy. However, our point is that this is not enough and that it is not only a matter of having or not local data and trying to disaggregate this data at the minimum territorial level. The point is to analyse which is the territorial level that portraits better location phenomena.

Unfortunately, the last question has not been raised up by scholars. A review over those location contributions will show that the territorial level in which to analyse entries is not an important issue. In fact, even it is not an issue to be considered because it is not discussed in those contributions. There are, nevertheless, some exceptions. For instance, Arauzo and Manjón (2004) depart from local sites (municipalities) and then aggregate them into counties and provinces and, then, test the effects of this aggregation over location analysis. Their results show that location factors do not act uniformly over broad geographical areas, and suggest comparing results from several territorial levels. Specifically, they conclude that "(…) Catalan firms tend to choose between counties rather than between municipalities" (Arauzo and Manjón, 2004, p. 299). Here we are following the same way, but while in Arauzo and Manjón (2004) only administrative units were considered (municipalities, counties and provinces), here we deal with both administrative (municipalities and counties) and functional units (travel to work areas).

3. The empirical analysis

3.1 The database

Our data refers to local units in Catalonia[4] and we have two types of datasets, on the one hand the data about firm entries and, on the other hand, the data about territorial characteristics (municipalities, counties and TTWA).

The database about entries is the REIC (Catalan Manufacturing Establishments Register)[5], which has plant-level micro data on the creation and location of new manufacturing establishments. The REIC provides data both about new and relocated establishments but given the specificities about those groups of establishments we decided to use data only about strictly new ones[6]. We also selected only those establishments with codes 12 to 36 (NACE-93 classification)[7] and we also drop out the incomplete registers. So we have a database of 4,282 new manufacturing establishments located into Catalan municipalities between 2001 and 2005.

[INSERT TABLE 1 ABOUT HERE]

The database about territorial characteristics comes mainly from Trullén and Boix (2004) database about Catalan municipalities, from the Catalan Statistical Institute (IDESCAT) and from Catalan Cartographical Institute[8]. Our data covers almost all the Catalan municipalities[9] and *comarques* (counties)[10]. We have also obtained the design of Catalan TTWA using commuting data from 2001[11]. The number of municipalities is 946, while the *comarques* are 41 and the TTWA

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[4] Catalonia is an autonomous region of Spain with about 7 million inhabitants (15% of the Spanish population) and an area of 31,895 km2. It contributes 19% of Spanish GDP. The capital of Catalonia is the city of Barcelona.
[5] At http://www10.gencat.net/reic/ is showed a sample of the establishments included in this database.
[6] See Manjón and Arauzo (2006) for a detailed analysis of interrelations betweens locations and relocations.
[7] See the appendices for a list of the manufacturing industries.
[8] See Table A.1 (Appendix) for a description of the explanatory variables.
[9] Due to lack of data for five new municipalities (Gimenells i el Pla de la Font, Riu de Cerdanya, Sant Julià de Cerdanyola, Badia del Vallès and La Palma de Cervelló) we have drop out them.
[10] *Comarques* are territorial units formed by adjacent municipalities. There are 41 *comarques* in Catalonia. The average area of Catalan *comarques* is 781 km^2.
[11] This dataset was kindly provided by R. Boix who followed methodology used by the Italian Statistical Institute (1997). The delimitation of the TTWA is carried out from an algorithm that consists of five stages. The algorithm starts at the municipal administrative unit and uses data of resident working population, total working population and commuting data from the place where people live to the place where they work. See Boix and Galletto (2006) for a detailed explanation about its characteristics and for an application for the Spanish case.

are 74. It is important to notice that both *comarques* and TTWA are made of municipalities.

The variables about territorial characteristics (referred to municipalities, *comarques* and TTWA) are classified into the following groups:

- Agglomeration economies: Urbanisation Economies (URB), Disurbanisation economies (DISURB), Population density (DENS), Location Economies (LE-*i*)[12]
- Market size: Residential population (RES), Jobs (JOB)
- Transport infrastructure: Average travel time by road to the 4 province capitals (ROAD-CAP)[13], Average travel time by road to the closest airport (ROAD-AIR), Average time by road to the closest merchandise harbour (ROAD-HAR)
- Geographical position: Shore-line areas (COAST), Distance to the nearest city with at least 100,000 inhabitants (DIS-100), Distance to the capital of Catalonia (Barcelona) (DIS-CAT), Distance to the closest province capital (DIS-PRO)
- Industrial mix: Percentage of manufacturing jobs (JOB-IND), Percentage of service jobs (JOB-SER), Percentage of small firms (SMALL)
- Other: Residential population change (RES-VAR), Average education years of individuals older than 25 (EDU)

We estimate the number of new manufacturing establishments opened in a municipality as a function of the local specific characteristics:

$$\begin{aligned} N_{ij} = {} & \beta_1 RES_{ij} + \beta_2 RES-VAR_{ij} + \beta_3 JOB_{ij} + \beta_4 URB_{ij} + \beta_5 DISURB_{ij} + \beta_6 DENS_{ij} + \\ & + \beta_7 COAST_{ij} + \beta_8 DIS-100_{ij} + \beta_9 DIS-CAT_{ij} + \beta_{10} DIS-PRO_{ij} + \beta_{11} EDU_{ij} + \\ & + \beta_{12-28} LE-i_{ij} + \beta_{29} ROAD-CAP_{ij} + \beta_{30} ROAD-AIR_{ij} + \beta_{31} ROAD-HAR_{ij} + \\ & + \beta_{32} JOB-IND_{ij} + \beta_{33} JOB-SER_{ij} + \beta_{34} SMALL_{ij} + \varepsilon_{ij} \end{aligned}$$

[12] See Table A.2 (Appendix) for a description of the economic sectors used for the Location Economies calculations.

[13] We have demonstrated also for the Catalan case (Alañón and Arauzo, 2006) the positive effect of the road accessibility over location decision of firms.

where N_{ij} is the number of new plants located in an area j inside each one of the territorial i categories, ε_{ij} is an error term, and the other variables are the previously explained variables.

3.2. Count data models

Most of recent research work about location decisions is based on Count Data Models (CDM), especially among the approaches based on the analysis of territorial factors that affect location decisions of new firms. Those CDM include the Poisson Model (PM), Negative Binomial Model (NBM), Zero Inflated Poisson Model (ZIPM) and Zero Inflated Negative Binomial Model (ZINBM).

Poisson models are perhaps the most popular specification of CDM and are particularly useful when scholars use a highly disaggregated territorial level, as the local level is. The reason has to do with the fact that the number of spatial units is large and, consequently, the size of those units is small (e.g., the number of municipalities of a country) there are a high number of these areas that are not going to receive any new establishment. In this literature this situation is known as the "zero problem". One of the main advantages of PM is that those models can deal with the "zero problem". Concretely, PM shows how many times a site (e.g., municipality, county, etc.) is chosen by an entering establishment. Therefore, municipalities where no new establishments are located provide relevant information[14] since values of the independent variables in these sites can help to explain why they have not been chosen by any new establishment.

In this paper, we assume that the probability that a site (municipality, county or TTWA) will attract a new manufacturing firm depends on the specific characteristics of the site:

$$\Pr ob(y_i) = f(x_i) \tag{1}$$

[14] See Cameron and Trivedi (1998) for detailed information about how zero observations contribute to the likelihood function.

where y_i shows the number of new manufacturing firms located in site *i* and x_i shows site characteristics that act as a location determinant. Each y_i is a random variable with Poisson distribution and with λ_i parameter (related to regressors x_i):

$$\Pr ob(Y = y_i) = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!} \qquad y_i = 0, 1, 2, ... \qquad (2)$$

in which the most common representation of λ_i is:

$$Ln\lambda_i = \beta x_i \qquad (3)$$

where β is the parameter vector to be estimated and x_i is a vector of site characteristics that act as a location determinants.

However, PM make two important assumptions. The first one is that the mean and the variance should be equal, but this is usually violated when we deal with industrial location decisions, because of the concentration of entries in some areas (this causes the variance to be greater than the mean, which is known as the "overdispersion problem"). The existence of overdispersion is explained in terms of unobserved heterogeneity in the mean function. Nevertheless, this problem is easily solved by using a NBM, which allows the variance to exceed the mean.

The probability distribution of the negative binomial model is:

$$\Pr \text{ob}(Y = y_i|u) = \frac{\exp((-\lambda_i \exp(u_i))\lambda_i^{y_i}}{y_i!} \qquad (4)$$

where $\exp(u)$ has a gamma distribution with mean 1 and variance *α*.

The second assumption is about the "zero problem". Poisson models can deal with situations in which there are a high number of observations with value zero, but some problems arise when this number is excessive. This second problem can also be solved by using a NBM.

[INSERT TABLE 2 ABOUT HERE]

The descriptive statistics about entrants (Table 2) show that there is an "overdispersion problem" for all the territorial units (municipalities, *comarques* and TTWA) and there is also an important "zero problem" for the specification of the municipalities[15]. Those results suggest using other CDM apart from PM, but the selection of one of those models rely on the characteristics of the data set.

The decision among which one of the CDM fits better with our data must take into account that they imply also different probability models. For instance, NBM assume between-subject heterogeneity but presume the same process for zero and non-zero counts, while ZIPM and NBM have different probability models for the zero and non-zero counts. ZIPM, furthermore, does not allow for between-subject heterogeneity, while NBM does.

Even if we guess that the PM is not the best option (according to the characteristics of the data set), let's present the location determinants for this basic model.

[INSERT TABLE 3 ABOUT HERE]

Given that we suspected that Poisson distribution is not correct, we have performed a test of the Poisson goodness-of-fit[16]. We have obtained a large value for chi-square that confirms that the PM is not a good choice. When there is overdispersion usually a NBM approach is more appropriate. Nevertheless, we also perform another test for deciding between a PM and NBM. The likelihood ratio test of alpha=0 is a test of the overdispersion of the alpha parameter[17]. Our results show that alpha is (mainly) significantly different from

[15] As is expected, higher the territorial disaggregation higher the "zero problem". The explanation is on the number of potential sites faced by the entrants. At a TTWA level the alternatives are 74, at a *comarques* level the alternatives are 41 and at a municipality level the alternatives are 941. So it is easier to have sites with 0 entries when the number of those sites is high (and its size is small).

[16] When a goodness-of-fit test is conducted, the range of the data is divided into a number of intervals. Then, the number of points that is into each interval is compared to the expected number of points for that interval according to the hypothesized distribution of the data (here the hypothesis is to have a Poisson distribution).

[17] If alpha=0, the Negative Binomial distribution is equivalent to a Poisson distribution and there is no overdispersion (alpha determines the degree of dispersion).

zero and, therefore, reinforces our first assumption that PM was not the best choice[18]. So, we carry out this later estimation.

[INSERT TABLE 4 ABOUT HERE]

Even if NBM fit better with our data, there are also other alternatives. As we have explained before, NBM model between-subject heterogeneity while ZIPM assume different probability models for the zero and non zero counts, that is for the sites that have received at least one firm during the analysed period (non zero counts) and the sites that have no received any firms during the period (zero counts). The main problem is to distinguish between both situations.

Specifically, overdispersion problems can be solved by using a NBM, ZIPM or ZINBM[19], but the situation gets more complicated if there is also a zero inflation problem. In this case the unobserved heterogeneity that cause overdispersion could also cause zero inflation problems (Cameron and Trivedi, 1998).

Previously we have estimated a NBM that allows for between-subject heterogeneity. Let's try a technique like ZIPM[20] that does not allow for between subject-heterogeneity but has different probability models for the zero and nonzero counts. The Vuong (1989) test for comparing between ZIPM and PM favours ZIPM in case of municipalities and is not significant for *comarques* and TTWA.

[INSERT TABLE 5 ABOUT HERE]

Additionally, a ZINBM could be a good choice if we suspect that there is a separate process for zero and non zero counts and for between-subject heterogeneity. If there is no overdispersion of the data, using ZIPM will be OK,

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[18] In any case, there are some doubts for the *comarques* estimation, a result which is similar to the previous one obtained by the Poisson goodness-of-fit test. Those doubts could be explained by the lower number of zeros both at the *comarques* level (2.44%) and at the TTWA level (8.11%), compared to the higher percentages at the municipalities' level (51.33%).

[19] From our knowledge, only Kim et al. (2006) have used ZINBM for location analysis.

[20] ZIPM has been used for location analysis, among other scholars, by List (2001) and Gabe (2003), both at a county level.

but if the data is overdispersed, we should try a ZINBM. Given that there is an important zero inflation for the municipality data, we can guess that this situation implies a separate process for zero and non zero counts[21], so we will perform the ZINBM only for municipality data.

[INSERT TABLE 6 ABOUT HERE]

At Table 6 we show the results of a Vuong (1989) test that discriminates ZINBM vs. NBM. This statistic has a standard normal distribution with large positive values favouring the ZINBM and with large negative values favouring the NBM. If the value is close to zero (in absolute values) does not favour neither ZINBM nor NBM. The large positive value (5.81) suggests using ZINBM instead of NBM.

After discussing all of pros and contras of several econometric models and taking into account the characteristics of the data about municipalities, *comarques* and TTWA, it seems clear that we should use different models for municipalities (here there is overdispersion and zero inflation), on the one hand, and for *comarques* and TTWA (here there is overdispersion but no zero inflation), on the other hand. So, the model that seems that fits better with municipalities appears to be ZINBM, while data from *comarques* and TTWA seems to be better analysed using NBM.

4. Results

As we have explained at the introductory section, the main aim of this paper is to discuss the territorial units at which location analysis must be done and also to compare differences obtained by using different territorial units. Of course, previous to this assumption is to identify at which geographical extent territorial

[21] If we have a look over the municipalities that received no entries, it is clear that there are some important constraints related, among other factors, with labour availability and municipality size. Specifically, those municipalities have an average population of 657 inhabitants (6,720 all the municipalities) and only an average of 282 workers located there (2,984 all the municipalities).

characteristics affect firm location decisions. This is, ¿should we focus at local administrative levels, like municipalities or *comarques*, or perhaps is better to focus at local functional levels like TTWA?

The econometric estimations show the expected results in line with previous empirical evidence both from the same territorial area (Manjón and Arauzo, 2007; Arauzo, 2005; Arauzo and Manjón, 2004) and from other countries. About the market size variables, most populated areas (mainly municipalities, followed by TTWA) show a negative impact on firm location. This result fits with a deconcentration process, but there is plenty of empirical evidence that suggest the contrary effect (Holl, 2004a and 2004c). The effect of the number of jobs was the opposite, since the workforce concentration acts positively over entrants, mainly at a municipality level. Those results could be showing different specialisation processes: some areas are specialised on residential activities and are less attractive for firms, while other specialise on economic activities and are more attractive for firms.

Agglomeration economies also present the expected results: a positive effect of urbanisation economies, and a negative effect of disurbanisation economies. The former effect is explained by the benefits of the agglomeration of economic activities (Guimarães et al., 2004; Figueiredo et al., 2002; List, 2001; Guimarães et al., 2000; Hansen, 1987), while the later effect shows the negative consequences of an excessive concentration of economic activities (Henderson, 1997). Population density variable shows a clearly negative effect. This result could be better understood if population density is a proxy for land costs, as some scholars suggest (Figueiredo et al., 2002; Guimarães et al., 2000). Finally, location economies show a wide range of effects, according to the differences of each one of the sectors analysed[22].

Transport infrastructure variables are not very clear. On the one hand, they show a (small) evidence of the need for being located near major harbours and airports but, on the other hand, there is some evidence of a negative effect of

[22] We do not present results from Location Economies but those are available upon request.

the proximity to the Catalonia's capital (Barcelona). It could be logical to fit this later result wit the previous evidence of deconcentration from major urban areas.

Geographical position of territorial units is also an important issue. Specifically, shore-line amenities help to attract firms while the distance to most important cities bring lower attractiveness, as is usual in the location literature (Polèse and Shearmur, 2004; Guimarães et al., 2000)

Industrial mix variables show that a local specialisation in manufacturing activities acts positively over entrants (only for municipalities and *comarques*), while a local specialisation in service activities attracts more firms at a municipality level. At the same time, a higher rate of small firms also increases attractiveness of *comarques* and TTWA.

About the other variables, the residential population change in previous years has a different effect according to territorial area: clearly positive for TTWA, ambiguous (positive and negative) for municipalities, and no significant for *comarques*. And, finally, education attachment of individuals acts negatively over entrants at a municipality level. This latter result means that (even of commuting rates are low in Catalonia) the labour markets in which firms look for their employees are not necessary local. An alternative explanation could rely into manufacturing specialisation into low-technology activities.

The several econometric estimations presented before show that municipality level shows the higher significance rates (in terms of number of significant variables), followed by *comarques* and TTWA. Those results reinforce our initial assumption about the importance of using highly disaggregated local data for locational analysis. Another interesting issue is the fact that (except from some specific variables about location economies and from the residential population change) there are no sign changes for the significant variables in our estimations. So, the effect exists or does not exist, but (almost) ever in the same sense.

While our results are not conclusive, it would seem that firm's location decisions are concerned mainly by local administrative units (municipalities and *comarques*), while functional units (TTWA) are of less importance. Anyway, we would like to make some comments that can specify these results.

Our main concern is about TTWA. As is well known, those areas are designed using commuting data, and can be defined as local labour (somewhere) closed markets inside which (most of) people of the area use to live and to work. According to this definition, we should agree that those TTWA are representing real economic areas with a lot of linkages among individuals and firms. But, unfortunately, the geography of commuting is modified by the geography of public infrastructures, which impose some restrictions over people's willingness (and capacity) to commute. This is especially true for the territory (Catalonia) that we are analysing here. Specifically, in Catalonia there are huge problems about transport infrastructures and public transportation systems (mainly about railway) and, consequently, commuting distances are shorter than in other similar areas. So, the TTWA identified by using commuting data could be showing an inaccurate portrait of real economic areas. Therefore, perhaps it should be possible to argue that TTWA are not full real economic units, neither administrative units are (in fact, those areas do not exist legally since there is not an official classification of TTWA).

There could be an additional shortcoming about TTWA that deals with the methodology used for the design of the areas[23]. There are some differences among the existent methodologies and, consequently, those differences imply that the areas obtained are not exactly the same. Additionally, commuting data modifies the size, number and shape of TTWA, so, those are not stable territorial units as individual commuting patters use to change regularly. Nevertheless, later situation could be positive, given that TTWA changes take into account spatial variations of economic activity.

[23] See, among others, Coombes et al. (1986), Ball (1980) and Smart (1974), for instance.

Similarly, we can raise the same criticisms for the use of *comarques* as a territorial unit. The current design of those areas comes from the eighties (with some minor changes made later) but the original design is from Middle Ages, when *comarques* were supposed to be some kind of market areas. But, as is logical, those markets from the Middle Ages do not exist nowadays.

Our estimations have shown that it seems that municipality level could explain better location decision of firms. It is also true, of course, that *comarques* and TTWA must be taken into consideration too. So, the evidence about the comparison of the several territorial levels is (yet) not conclusive, which indicates that more work must to be done into this direction.

Additionally to previous comments, there are other issues influencing location decisions that have not been analysed here and that need to be introduced into the analysis (which is extremely difficult given the scarcity and heterogeneity of available data). One of them, for instance, relates to political competences and budgets of city councils (responsible for the management of municipalities), which are largely higher compared wit those of *Consells Comarcals* (the political institution at this level). And, of course, there is no comparison with institutions responsible of TTWA because, since this level does not exist officially (there is not a public institution with competences and budgets). This latter fact is of some importance because institutional factors are a key issue for firm's decisions. Nevertheless this importance, it is obvious that those are not the main factors about location issues, but they help to better portrait the differences across territorial levels.

5. Conclusions

This paper has discussed which is/are the territorial level/s in which location phenomenon should be analysed. Departing from existing empirical location literature, we have shown that there is not a real examination about the selection of the territorial level and, therefore, scholars use the available data without considering which is the more suitable territorial level. At this point, this paper contributes to the existing literature on industrial location by highlighting the role of territorial level at which analysis is undertaken. This research continues previous work by Arauzo and Manjón (2004) and adds functional territorial units (TTWA) to the administrative units analysed there. Our results show that municipality level characteristics seems to explain better location decisions of manufacturing firms, followed by *comarques* (counties) and TTWA level.

We have also discussed which econometric methodology fits better with the data about location of manufacturing firms, where overdispersion and "zero problems" are common features. Having used count data models (as is usual in industrial location literature) we have found that, depending of the territorial level, Negative Binomial Models - NBM (*comarques* and TTWA) and Zero Inflated Negative Binomial Models - ZINBM (municipalities) should be preferred in front of more standard Poisson Models.

There is already a lot of research to be done in this field, but here we have started to answer an important question in location literature. Future research should focus on international comparisons in order to check the robustness of our results.

Tables

Table 1
Description of territorial units

Areas	Number	Population 2001 (average)	Firm Location 2001-2005 (average)
Municipalities*	941	6,721	4.5
Comarques	41	154,252	104.4
TTWA	74	85,464	57.9

*Here we are considering only 941 of the 946 Catalan municipalities.
Source: own elaboration.

Table 2
Descriptive statistics about entrants

Areas	Mean	Standard deviation	Min.	Max.	% of zeros
Municipalities	4.545	16.440	0	280	51.33
Comarques	104.439	176.952	0	850	2.44
TTWA	57.864	167.731	0	1,252	8.11

Source: own elaboration.

Table 3
Location determinants (Poisson Model: PM)[a, b]

	Coefficients		
	Municipalities	***Comarques***	**TTWA**
RES	-0.00016***	0.00002	-0.00002***
	(0.00001)	(0.00004)	(0.00001)
RES-VAR	0.04416	1.07736	1.84640***
	(0.06278)	(0.96847)	(0.35475)
JOB	0.00037***	-0.00003	0.00005***
	(0.00002)	(0.00008)	(0.00002)
URB	0.00018***	0.00106**	0.00000
	(0.00003)	(0.00051)	(0.00001)
DISURB	-0.00000*	-0.00000***	-0.00000***
	(0.00000)	(0.00000)	(0.00000)
DENS	-0.00009***	-0.00154***	-0.00000
	(0.00001)	(0.00021)	(0.00000)
COAST	0.644266***	0.03173	0.09944
	(0.05349)	(0.48339)	(0.11476)
DIS-100	-0.00003***	-0.00004**	-0.00001***
	(0.00000)	(0.00002)	(0.00001)
DIS-CAT	-0.00001***	-0.00001	-0.00001***
	(0.00000)	(0.00001)	(0.00000)
DIS-PRO	0.00000	0.00002	-0.00001
	(0.00000)	(0.00002)	(0.00001)
EDU	-0.14088***	0.17035	-0.04135
	(0.02747)	(0.30180)	(0.13385)
ROAD-CAP	0.01974***	0.01749	0.01418*
	(0.00347)	(0.01580)	(0.00778)
ROAD-AIR	-0.00092	-0.03004**	0.01408*
	(0.00259)	(0.01524)	(0.00737)
ROAD-HAR	-0.00092	0.01813	-0.00998
	(0.00306)	(0.01313)	(0.00795)
JOB-IND	2.53260***	21.11338***	-0.87370
	(0.29254)	(4.56543)	(2.03340)
JOB-SER	0.28208**	2.38274	-2.76234
	(0.12527)	(7.49817)	(2.58866)
SMALL	-0.65242	111.98510***	0.05215***
	(0.62546)	(25.65857)	(0.00893)
CONST.	2.51725***	-115.12150***	3.94423**
	(0.67856)	(25.81506)	(2.0564)
N	938	41	74
Pseudo R^2	0.7107	0.9701	0.9612
LR X^2 (33)	11652.63*	7794.40*	12554.76*
Log likelihood	-2471.9048	-120.2497	-253.49536
Goodness-of-fit X^2	3265.517	25.04627	198.4751
Prob > X^2 (903)	0.0000		
Prob > X^2 (6)		0.0007	
Prob > X^2 (39)			0.0000

[a] Note: Dependent variable is the count of new plants.
[b] Note: Results of Location Economies are available upon request.
(***) Significance at 1%, (**) significance at 5% and (*) significance at 10%. Standard errors between brackets.
Source: own elaboration.

Table 4
Location determinants (Negative Binomial Model: NBM)[a, b]

	Coefficients		
	Municipalities	***Comarques***	**TTWA**
RES	-0.00018***	0.00003	-0.00001
	(0.00006)	(0.00004)	(0.00002)
RES-VAR	0.42865***	0.99511	1.60783**
	(0.17638)	(1.02742)	(0.73068)
JOB	0.00043***	-0.00005	0.00003
	(0.00011)	(0.00008)	(0.00004)
URB	0.00045***	0.00113**	0.00001
	(0.00011)	(0.00053)	(0.00002)
DISURB	-0.00000**	-0.00000**	-0.00000
	(0.00000)	(0.00000)	(0.00000)
DENS	-0.00014***	-0.00162***	0.00000
	(0.00003)	(0.00021)	(0.00000)
COAST	0.93493***	0.27418	0.14606
	(0.19105)	(0.65626)	(0.27798)
DIS-100	-0.00001*	-0.00004**	-0.00001
	(0.00001)	(0.00002)	(0.00001)
DIS-CAT	-0.00001***	-0.00001	-0.00002***
	(0.00000)	(0.00001)	(0.00001)
DIS-PRO	0.00000	0.00002	-0.00001
	(0.00001)	(0.00002)	(0.00001)
EDU	-0.09235	0.07690	-0.11016
	(0.06533)	(0.40443)	(0.18702)
ROAD-CAP	-0.00086	0.01436	0.01953
	(0.00835)	(0.02080)	(0.01373)
ROAD-AIR	0.00588	-0.03208**	0.01490
	(0.00681)	(0.01556)	(0.01286)
ROAD-HAR	0.00108	0.01788	-0.01270
	(0.00828)	(0.01319)	(0.01377)
JOB-IND	2.64367***	19.65435***	0.57759
	(0.76231)	(4.52053)	(3.49029)
JOB-SER	-0.37869	2.69328	-0.34345
	(0.29123)	(8.04557)	(3.97113)
SMALL	2.27402	118.84970***	0.05518***
	(2.08545)	(31.46159)	(0.01803)
CONST.	-0.72721	-120.65420***	2.59598
	(2.14345)	(30.50986)	(3.38832)
N	938	41	74
Pseudo R^2	0.1966	0.4631	0.3037
LR X^2 (33)	776.95	207.56	207.26
Log likelihood	-1587.1545	-120.31309	-237.59227
/lnalpha	0.09588	-19.37027	-2.26243
	(0.08604)	(327.7616)	(0.32020)
alpha	1.10062	0.00000	0.10410
	(0.09470)	(0.00000)	(0.03333)
Likelihood ratio test of alpha=0	chibar2(01) = 1569.50 Prob>=chibar2=0.000	chibar2(01) = 0.00 Prob>=chibar2=0.498	chibar2(01) = 31.81 Prob>=chibar2=0.000

[a] Note: Dependent variable is the count of new plants.
[b] Note: Results of Location Economies are available upon request.
(***) Significance at 1%, (**) significance at 5% and (*) significance at 10%. Standard errors between brackets.
Source: own elaboration.

Table 5
Location determinants (Zero Inflated Poisson Model: ZIPM)[a, b]

	Coefficients		
	Municipalities	***Comarques***	**TTWA**
RES	-0.00014***	0.00002	-0.00003***
	(0.00001)	(0.00004)	(0.00001)
RES-VAR	-0.08539	1.07748	1.64746***
	(0.07008)	(0.96848)	(0.37122)
JOB	0.00033***	-0.00003	0.00006***
	(0.00002)	(0.00008)	(0.00002)
URB	0.00034***	0.00106**	0.00001
	(0.00004)	(0.00051)	(0.00001)
DISURB	-0.00000***	-0.00000***	-0.00000***
	(0.00000)	(0.00000)	(0.00000)
DENS	-0.00009***	-0.00154***	-0.00000
	(0.00001)	(0.00021)	(0.00000)
COAST	0.46226***	-0.03175	0.11221
	(0.05402)	(0.48339)	(0.11490)
DIS-100	-0.00003***	-0.00004**	-0.00002***
	(0.00000)	(0.00002)	(0.00001)
DIS-CAT	-0.00001***	-0.00001	-0.00001***
	(0.00000)	(0.00001)	(0.00000)
DIS-PRO	0.00000	0.00002	-0.00001
	(0.00000)	(0.00002)	(0.00001)
EDU	-0.15030***	0.17035	-0.13199
	(0.03056)	(0.30180)	(0.14133)
ROAD-CAP	0.02438***	0.01749	0.01331*
	(0.00354)	(0.01580)	(0.00775)
ROAD-AIR	-0.00040	-0.03003**	0.01124
	(0.00262)	(0.01524)	(0.00724)
ROAD-HAR	-0.00439	0.01813	-0.00620
	(0.00302)	(0.01313)	(0.00794)
JOB-IND	1.58336***	21.11346***	-3.69946
	(0.33274)	(4.56546)	(2.33647)
JOB-SER	0.69688***	2.38200	-4.41444
	(0.15832)	(7.49825)	(2.90557)
SMALL	-1.11806	111.98310***	0.04908***
	(1.10817)	(25.65871)	(0.00913)
CONST.	3.10583***	-115.11920***	6.64176***
	(1.14074)	(25.8152)	(2.27213)
Inflate RES	-0.00169***	-0.00029	-0.00016
	(0.00020)	(0.18581)	(0.00012)
CONST.	1.55417***	-12.88202	-0.92677
	(0.17796)	(1583.48000)	(1.06456)
Vuong test of ZINBM vs. PM			
z	7.65***	0.05	1.05
N	938	41	74
LR X^2 (34)	7166.16	7587.83	11871.30
Log likelihood	-1986.723	-120.2497	-248.867
Nonzero obs.	458	40	68
Zero obs.	480	1	6

[a] Note: Dependent variable is the count of new plants.
[b] Note: Results of Location Economies are available upon request.
(***) Significance at 1%, (**) significance at 5% and (*) significance at 10%. Standard errors between brackets.
Source: own elaboration.

Table 6
Location determinants (Zero Inflated Negative Binomial Model: ZINBM)[a, b]

		Coefficients
		Municipalities
RES		-0,00016***
		(0,00005)
RES-VAR		0,07521
		(0,15730)
JOB		0,00037***
		(0,00012)
URB		0,00047***
		(0,00010)
DISURB		-0,00000***
		(0,00000)
DENS		-0,00012***
		(0,00003)
COAST		0,46004***
		(0,15965)
DIS-100		-0,00001
		(0,00001)
DIS-CAT		-0,00001***
		(0,00000)
DIS-PRO		-0,00001
		(0,00001)
EDU		-0,04470
		(0,06553)
ROAD-CAP		0,00229
		(0,00758)
ROAD-AIR		0,00811
		(0,00635)
ROAD-HAR		-0,00603
		(0,00756)
JOB-IND		1,57420**
		(0,74668)
JOB-SER		0,12265
		(0,34775)
SMALL		1,46703
		(2,38722)
CONST.		0,24119
		(2,44010)
Inflate	RES	-0,00364***
		(0,00080)
	CONST.	1,99853***
		(0,34180)
lnalpha		-0,42095***
		(0,10154)
alpha		0,65643
		(0,06665)
Vuong test of ZINBM vs. NBM		
z		5.82***
N		938
LR X^2 (34)		596.84
Log likelihood		-1509.136
Nonzero obs.		458
Zero obs.		480

[a] Note: Dependent variable is the count of new plants.
[b] Note: Results of Location Economies are available upon request.
(***) Significance at 1%, (**) significance at 5% and (*) significance at 10%. Standard errors between brackets..
Source: own elaboration.

Appendix

Table A.1
Explanatory variables: definition and sources

Variable	Definition	Source
RES	Residential population (2001)	Trullén and Boix (2004)
RES-VAR	Residential population change between 1991 and 2001	Trullén and Boix (2004)
JOB	Jobs (2001)	IDESCAT
URB	Urbanisation Economies: jobs per km^2 of urbanised land (2001)	Trullén and Boix (2004), IDESCAT and own calculations
DISURB	Disurbanisation economies: URB^2 (2001)	Own calculations
DENS	Population density: residential population per km^2 of urbanised land (2001)	Trullén and Boix (2004) and own calculations
COAST	Shore-line areas	IDESCAT
DIS-100	Distance (km) to the nearest city with at least 100,000 inhabitants	Catalan Cartographical Institute
DIS-CAT	Distance (km) to the capital of Catalonia (Barcelona)	Catalan Cartographical Institute
DIS-PRO	Distance (km) to the closest province capital	Catalan Cartographical Institute
EDU	Average education years of individuals older than 25 (2001)	Trullén and Boix (2004)
LE-"i"	Location Economies: jobs in sector "i" (i = 1, …, 17) per km^2 of urbanised land) (2001)	Trullén and Boix (2004) and own calculations
ROAD-CAP	Average travel time by road to the 4 province capitals (2001)	Trullén and Boix (2004)
ROAD-AIR	Average travel time by road to the closest airport (2001)	Trullén and Boix (2004)
ROAD-HAR	Average time by road to the closest merchandise harbour (2001)	Trullén and Boix (2004)
JOB-IND	Percentage of manufacturing jobs (2001)	IDESCAT
JOB-SER	Percentage of service jobs (2001)	IDESCAT
SMALL	Percentage of small firms (less than 50 workers) (2001)	Trullén and Boix (2004)

Source: own elaboration.

Table A.2
NACE-93 classification (used for Location Economies calculations)

Code	Industry
1	Agriculture
2	Fishing
3	Mining and quarrying
4	Manufacturing industries
5	Electricity, gas and water supply
6	Construction
7	Wholesale and retail trade
8	Hotels and restaurants
9	Transport and telecommunications
10	Financial intermediation
11	Real estate, renting and business activities
12	Public administration and defence; compulsory social security
13	Education
14	Health and social work
15	Other service activities
16	Private households with employed persons
17	Extra-territorial organisations

Source: Trullén and Boix (2004).

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