

Industrial Location at a Local Level: Comments on 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 several issues with regard to the territorial levels that have been used in location analysis. We analyse the advantages and disadvantages of performing location analyses at several local levels. We use data for new manufacturing firms located at three levels: municipality, county and travel-to-work areas. We show that location determinants depend on the territorial level used in the analysis and conclude that the level at which the investigation is performed should be carefully selected.

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

(*)This research was partially funded by the CICYT: SEJ2004-05860/ECON, the CICYT: SEJ2004-07824/ECON and the *Xarxa de Referència d'R+D+I en Economia i Polítiques Públiques* (Catalan Government). I am indebted to J. Trullén and R. Boix for being so generous with their local database and again to R. Boix for kindly providing data on Catalan travel-to-work areas. I would also like to acknowledge the helpful and supportive comments of Miguel Manjón and Elisabet Viladecans. Any errors are, of course, my own.

(♣) 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 attracted growing interest from scholars in recent years. Although these analyses have been conducted with a variety of methodological techniques, data bases and theoretical approaches, all are in agreement about the importance of territorial aspects for explaining these decisions. Moreover, as the greater availability of statistical information has enabled researchers to access huge data bases on both territorial and firm characteristics, we now have the opportunity to carefully analyse how infrastructures, agglomeration economies, clusters and human capital (among other issues) affect location decisions.

Previous scientific contributions have helped to explain why firms choose some sites instead of others and we can now provide some useful policy recommendations on how territories can increase their appeal and attract new firms. Unfortunately, much useful information is still lacking with regard to the best territorial level at which to study location issues. Careful analysis of previous empirical contributions on industrial location shows that, thanks to the availability of disaggregated data bases, location decisions are now studied mainly at a local level, whereas several years ago they were normally studied at a regional level. Also, since most contributions depart from a framework of agglomeration economies, these decisions are studied at the level at which agglomeration economies are stronger, i.e. at the local level. Some articles have strongly emphasized that using local data better illustrates these location decisions.

The problem arises, however, when the interested scholar attempts to go further and discuss what local level means. This is a key question because the word “local” can take on several slightly different meanings, especially if we compare “local” units from different countries. Local level in the U.S. context, for example, is not the same as in the U.K. or Italy. It is therefore important to find agreement on what the “local level” is and how to homogenise territorial units from different countries. It is also important to carefully analyse whether the

local area is necessarily better than areas such as regions or provinces. Another discussion then arises about whether these analyses should rely on administrative units (e.g. municipalities), functional units (e.g. travel-to-work areas (TTWA)) or a combination of the two. In this paper we focus on this latter discussion.

The aim of this paper is to take a first step towards identifying the territorial level/s that is/are relevant for location decisions and determining how the characteristic of territories affect these decisions. We analyze whether 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 carefully.

We assume that it is important to take into account both local administrative units (e.g. municipalities and counties) and local functional units (TTWA). In fact, local functional units are believed to better portray current economic conditions because their boundaries are made in accordance with economic data such as commuting data. This paper contributes to the existing empirical literature on industrial location by beginning a discussion that has not yet been tackled by other scholars¹. It is an important issue because greater knowledge of such location decisions should help implement more efficient entry promoting policies.

This paper is organised as follows. The second section reviews both the literature on location and the discussion on the level of territorial units that best fits 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 comprises our conclusions and future lines of research.

2. Industrial location: a territorial approach

2.1 Review of literature on location

¹ One exception is the study by Rosenthal and Strange (2004), which approached this issue in a different but similar way.

Location issues can be approached from two sides. First there is the firm's perspective. Here the object of the analysis is how the characteristics of the firm affect its location decisions. Second there is the territory perspective. Here the core of the analysis is how the characteristics of the territories can influence the location of firms (i.e. how they can attract or discourage firms). The first analysis focuses on aspects such as the entrepreneur, firm size and the industry to which the firm belongs. The second analysis considers territorial aspects such as the availability of labour, the geographical position of the sites, population distribution and the workers' skill levels.

Hayter (1997) focuses the analysis on territorial characteristics and divides the literature on empirical location into three approaches: a neoclassical approach, a behavioural approach and an institutional approach. The neoclassical approach links location decisions to profit-maximising and cost-minimising strategies. The behavioural approach concerns location decisions taken under uncertainty and imperfect information. Finally, the institutional approach takes into account the institutional environment in which these decisions are taken. The first approach considers variables such as agglomeration economies, land prices, wages, transportation costs and worker's skills. The second approach considers non-economic variables such as the entrepreneur's personal circumstances and variables such as firm size. The third approach considers variables such as the existence and characteristics of suppliers and customers, the role of public administrations and trade unions, and relations and links with other firms in the area.

2.2 Discussion on the territorial units of analysis

Most recent contributions to location issues depart from the seminal paper by Carlton (1979) on location decisions in metropolitan areas. A review of these contributions shows that while papers from the 1980s and 1990s² mainly used larger areas such as U.S. states (Head et al., 1995; Friedman et al., 1992; Coughlin et al., 1991; Bartik, 1985) or metropolitan areas (Carlton, 1983 and

² There are some exceptions from the 1990s, e.g. Smith and Florida (1994), who used U.S. counties, and Woodward (1992), who used both U.S. counties and states.

1979), papers published in the 21st century have relied mainly on smaller areas³ such as 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 note that most of those contributions were based on administrative territorial units (states, provinces, counties or municipalities) rather than functional territorial units (e.g. metropolitan areas or TTWA). However, Rosenthal and Strange (2003) used a different approach, constructing rings around zip codes (1, 5, 10 and 15 miles) and analysing how new firms are attracted to the area depending on which ring is used to measure local variables such as employment.

Common explanations for this territorial disaggregation have been improvements in data availability at a local level and recent advances in areas such the New Economic Geography (NEG), which emphasize the role of local areas in the generation of agglomeration economies. Besides these explanations, however, the empirical contributions on industrial location do not really discuss the territorial level in which the analysis is performed and simply use the available data. Therefore, given that it is now easier to obtain data at a local level, and given the contributions from the NEG, scholars have gradually shifted to the municipality level. Another explanation relates to the econometric techniques used in location analysis. In the 1980s and 1990s, the most popular specification was the Conditional Logit Model (CLM). However, this model has one important drawback—the difficulty in calculating the likelihood function when there are so many alternatives (sites), which is very common at a local level. One solution may be to use a Count Data Model (CDM). These models have no computational constraints on the number of alternatives (larger data sets can be used) and have been employed by most researchers since the 1990s.

³ Exceptions from the 21st century are Cieslik (2005) and Basile (2004), who used data from provinces. Rosenthal and Strange (2001) also used areas of different sizes, such as zip codes, counties and states.

As a result of the above process, recent location studies have better portrayed the location determinants, so the policy implications arising from their findings fit the real economy better. However, we believe that this is not enough and that it is not only a matter of having or not having local data and trying to disaggregate these data at the minimum territorial level. We believe it is important to analyse which territorial level best illustrates the location phenomena.

Unfortunately, this last question has not yet been raised by scholars. A review of location contributions shows that the territorial level in which entries are analysed is not an important issue. In fact, it is not even an issue at all because it has not been discussed in any of these contributions. There are some exceptions, however. Arauzo and Manjón (2004), for example, depart from local sites (municipalities), aggregate them into counties and provinces and then test the effects of this aggregation on 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 continue in the same way but, while Arauzo and Manjón (2004) only considered administrative units (municipalities, counties and provinces), in this paper we deal with both administrative units (municipalities and counties) and functional units (travel-to-work areas).

3. The empirical analysis

3.1 The database

Our data refer to local units in Catalonia⁴. We have two types of datasets: data on firm entries and data on territorial characteristics (municipalities, counties and TTWA).

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.

The database on entries is the REIC (the Catalan Manufacturing Establishments Register)⁵, which has plant-level micro data on the creation and location of new manufacturing establishments. The REIC provides data on both new and relocated establishments but, given the specificities of these groups of establishments, we decided to use data only on strictly new ones⁶. We also selected only those establishments with codes 12 to 36 (NACE-93 classification)⁷ and left out incomplete registers. Our database therefore comprises 4,282 new manufacturing establishments located in Catalan municipalities between 2001 and 2005.

[INSERT TABLE 1 ABOUT HERE]

Our database of territorial characteristics comes mainly from the database of Trullén and Boix (2004) on Catalan municipalities, the Catalan Statistical Institute (IDESCAT) and the Catalan Cartographical Institute.⁸ Our data cover almost all the Catalan municipalities⁹ and *comarques* (counties).¹⁰ We also obtained the design of Catalan TTWA using commuting data from 2001.¹¹ The number of municipalities is 946, the number of *comarques* is 41 and the number of TTWA is 74. Note that both *comarques* and TTWA are made up of municipalities.

The territorial variables (for municipalities, *comarques* and TTWA) are divided into the following groups:

⁵ At <http://www10.gencat.net/reic/> you can find a sample of the establishments included in this database.

⁶ See Manjón and Arauzo (2006) for a detailed analysis of the interrelations between 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 We have left out 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) due to lack of data.

¹⁰ *Comarques* are territorial units formed by adjacent municipalities. There are 41 *comarques* in Catalonia. The average area of the Catalan *comarques* is 781 km².

¹¹ This dataset was kindly provided by R. Boix, who followed the methodology used by the Italian Statistical Institute (1997). The delimitation of the TTWA is based on an algorithm consisting of five stages. The algorithm starts at the municipal administrative unit and uses data on 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 of its characteristics and an application for the Spanish case.

- 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 provincial 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 provincial 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 number of years in education of individuals over 25 years of age (EDU)

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

$$\begin{aligned}
N_{ij} = & \mathbf{b}_1 RES_{ij} + \mathbf{b}_2 RES - VAR_{ij} + \mathbf{b}_3 JOB_{ij} + \mathbf{b}_4 URB_{ij} + \mathbf{b}_5 DISURB_{ij} + \mathbf{b}_6 DENS_{ij} + \\
& + \mathbf{b}_7 COAST_{ij} + \mathbf{b}_8 DIS - 100_{ij} + \mathbf{b}_9 DIS - CAT_{ij} + \mathbf{b}_{10} DIS - PRO_{ij} + \mathbf{b}_{11} EDU_{ij} + \\
& + \mathbf{b}_{12-28} LE - i_{ij} + \mathbf{b}_{29} ROAD - CAP_{ij} + \mathbf{b}_{30} ROAD - AIR_{ij} + \mathbf{b}_{31} ROAD - HAR_{ij} + \\
& + \mathbf{b}_{32} JOB - IND_{ij} + \mathbf{b}_{33} JOB - SER_{ij} + \mathbf{b}_{34} SMALL_{ij} + \mathbf{e}_{ij}
\end{aligned}$$

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

¹² See Table A.2 (Appendix) for a description of the economic sectors used to calculate the Location Economies.

¹³ Also for the Catalan case we have demonstrated (Alañón and Arauzo, 2006) the positive effect of road accessibility on the location decision of firms.

3.2. Count data models

Most recent research work on location decisions has been based on Count Data Models (CDM), especially when the territorial factors that affect the location decisions of new firms is analysed. These CDM include the Poisson Model (PM), the Negative Binomial Model (NBM), the Zero Inflated Poisson Model (ZIPM) and the Zero Inflated Negative Binomial Model (ZINBM).

Poisson models are perhaps the most popular specification of CDM. These are particularly useful when a highly disaggregated territorial level, such as the local level, is used. This is because the number of spatial units is large, so the size of the units is small (e.g. the number of municipalities in a country) and a large number of these areas is not going to receive any new establishments. In the literature this situation is known as the “zero problem”. One of the main advantages of the PM is that it can deal with the “zero problem”. Specifically, the PM shows how many times a site (e.g. a municipality or county, etc.) is chosen by an entering establishment. Therefore, municipalities where no new establishments are located provide relevant information¹⁴ because the 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:

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

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

$$\text{Pr ob}(Y = y_i) = \frac{e^{-I_i} I_i^{y_i}}{y_i!} \quad y_i = 0, 1, 2, \dots \quad (2)$$

in which the most common representation of I_i is:

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

$$\ln I_i = \mathbf{b}x_i \quad (3)$$

where \mathbf{b} is the parameter vector to be estimated and x_i is a vector of site characteristics that act as location determinants.

However, PM make two important assumptions. The first is that the mean and the variance should be equal, but this is usually violated when dealing with industrial location decisions because of the concentration of entries in some areas (which causes the variance to be greater than the mean and is known as the “overdispersion problem”). Overdispersion is explained in terms of unobserved heterogeneity in the mean function. 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:

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

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

The second assumption concerns the “zero problem”. Poisson models can deal with situations in which there are a large number of observations whose value is zero, but some problems arise when this number is excessive. This second problem can also be solved 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 that there is also an important “zero problem” for the specification of the municipalities¹⁵. These results suggest that other CDM apart

¹⁵ As expected, the higher the territorial disaggregation, the higher the “zero problem”. The explanation is based on the number of potential sites faced by the entrants. At the TTWA level, there are 72 alternatives, at the *comarques* level there are 41 and at the municipality level there are 941. It is therefore easier to have sites with 0 entries when the number of those sites is high (and its size is small).

from PM should be used, but which model to select depends on the characteristics of the data set.

When deciding which CDM best fits our data, we must bear in mind that these models also involve different probability models. For example, the NBM assumes between-subject heterogeneity but also that the process is the same for both zero and non-zero counts, while the ZIPM and NBM have different probability models for these counts. Moreover, the ZIPM does not allow for between-subject heterogeneity, whereas the NBM does.

Although we can guess that the PM is not the best option (according to the characteristics of the data set), let us present the location determinants for this basic model.

[INSERT TABLE 3 ABOUT HERE]

Since we suspected that the Poisson distribution was not correct, we performed a test of the Poisson goodness-of-fit¹⁶. We obtained a large chi-square value, which confirms that the PM is not a good choice. When there is overdispersion, a NBM approach is usually more suitable. We then performed another test to decide between the PM and the NBM. The likelihood ratio test of $\alpha=0$ is a test of the overdispersion of the α parameter¹⁷. Our results show that α is (mainly) significantly different from zero, which reinforces our first assumption that the PM was not the best choice¹⁸. Therefore, we carry out this later estimation.^[KPC1]

[INSERT TABLE 4 ABOUT HERE]

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

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

¹⁸ In any case, there are several doubts about the *comarques* estimation, a result which is similar to the previous one obtained by the Poisson goodness-of-fit test. These doubts can be explained by the fact that the number of zeros both at the *comarques* level (2.44%) and at the TTWA level (8.11%) is lower than at the municipalities level (51.33%).

Though the NBM best fits our data, there are alternatives. As we explained earlier, the NBM assumes between-subject heterogeneity whereas the ZIPM assumes different probability models for the zero and non-zero counts, i.e. for the sites that received at least one firm (non-zero counts) and the sites that received no firms during the period analysed (zero counts). The main problem is to distinguish between these two situations.

Specifically, the problems of overdispersion can be solved using a NBM, ZIPM or ZINBM¹⁹ but the situation gets more complicated if there is also a zero inflation problem. In this case, the unobserved heterogeneity that causes overdispersion may also cause zero inflation problems (Cameron and Trivedi, 1998).

Previously we estimated a NBM that allows for between-subject heterogeneity. Let us try a technique such as ZIPM²⁰ that does not allow for between subject heterogeneity but has different probability models for the zero and non-zero counts. The Vuong (1989) test for comparing ZIPM and PM favours ZIPM in the case of municipalities and is not significant for *comarques* or TTWA.

[INSERT TABLE 5 ABOUT HERE]

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 the data are not overdispersed, it will be acceptable to use ZIPM. However, if they are overdispersed, we should try a ZINBM. Since there is an important zero inflation for the municipality data, this situation probably requires a separate process for zero and non-zero counts²¹, so we will perform the ZINBM only for the municipality data.

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

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

²¹ If we consider the municipalities that received no entries, there are clearly some important constraints related, among other factors, to the availability of labour and the size of the municipality. Specifically, these municipalities have an average population of 657 inhabitants

[INSERT TABLE 6 ABOUT HERE]

Table 6 shows the results of a Vuong (1989) test to discriminate between the ZINBM and the NBM. This statistic has a standard normal distribution with large positive values if the ZINBM is favoured and large negative values if the NBM is favoured. If the value is close to zero (in absolute values), neither the ZINBM nor the NBM is favoured. The large positive value (5.81) suggests that the ZINBM rather than the NBM should be used.

Having compared the advantages and disadvantages of several econometric models and taken into account the characteristics of the data on municipalities, *comarques* and TTWA, it is 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. The model that fits best with municipalities appears to be the ZINBM and the model that fits best with *comarques* and TTWA appears to be the NBM.

4. Results

As we explained in the introduction, the main aims of this paper are to discuss the territorial units at which location analysis should be conducted and to compare the differences obtained using different territorial units. Of course, we must first identify at which geographical level territorial characteristics affect firm location decisions, i.e. should we focus at local administrative levels such as municipalities or *comarques* or at local functional levels such as TTWA?

The econometric estimations show the expected results, i.e. 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

(6,720 for all municipalities) and only an average of 282 workers are located there (2,984 for all municipalities).

countries. With regard to market size, the most populated areas (mainly municipalities, followed by TTWA) showed a negative impact on firm location. This result fits with a deconcentration process, though much empirical evidence suggests the opposite effect (Holl, 2004a and 2004c). The number of jobs had the opposite effect since workforce concentration had a positive effect on entrants, mainly at the municipality level. These results suggest that there are different specialisation processes: some areas are specialised in residential activities and are less attractive to firms, while others specialise in economic activities and are more attractive to firms.

Agglomeration economies also showed expected results, i.e. a positive effect of urbanisation economies and a negative effect of disurbanisation economies. The positive effect is explained by benefits from the agglomeration of economic activities (Guimarães et al., 2004; Figueiredo et al., 2002; List, 2001; Guimarães et al., 2000; Hansen, 1987) and the negative effect reflects the negative consequences of an excessive concentration of economic activities (Henderson, 1997). The population density variable shows a clearly negative effect. This is better understood if, as some scholars suggest (Figueiredo et al., 2002; Guimarães et al., 2000), population density is a proxy for land costs. Finally, location economies showed a wide range of effects that depended on the differences between the sectors analysed²².

The results for transport infrastructure are not very clear. On the one hand, they show (a little) evidence of the need to locate near major harbours and airports. On the other hand, there is some evidence for a negative effect of proximity to the capital of Catalonia (Barcelona). This result may fit with previous evidence of a deconcentration from the main urban areas.

Another important issue is the geographical location of the territorial units. Specifically, shoreline amenities help to attract firms but distance from the most important cities does not. This result is common in the literature on location (Polèse and Shearmur, 2004; Guimarães et al., 2000).

²² We do not present results from Location Economies but these are available upon request.

The industrial mix variables show that a local specialisation in manufacturing activities has a positive effect on entrants (only for municipalities and *comarques*), while a local specialisation in service activities has a positive effect on entrants at the municipality level. A high percentage of small firms also increases the attractiveness of *comarques* and TTWA.

The effect of a change in the residential population in previous years depends on the territorial area. The effect is clearly positive for TTWA, ambiguous (both positive and negative) for municipalities, and not significant for *comarques*. Finally, the education attachment [KPC2] of individuals has a negative effect on entrants at a municipality level. This means that, though commuting rates in Catalonia are low, the labour markets in which firms look for their employees are not necessarily local. An alternative explanation may be that manufacturing tends to specialize in low-technology activities.

The econometric estimations we presented earlier show that municipalities have the highest significance rates (in terms of number of significant variables), followed by *comarques* and TTWA. This reinforces our initial assumption regarding the importance of using highly disaggregated local data for location analysis. Also interesting is the fact that, apart from some specific variables for location economies and the change in residential population, there are no sign changes for the significant variables in our estimations. Therefore, the effect either exists or does not exist and is usually in the same direction

While our results are not conclusive, it appears that a firm's location decisions are mainly concerned with local administrative units (municipalities and *comarques*), while functional units (TTWA) are of less importance. In any case, we would like to add several comments in order to specify these results.

TTWA are designed using commuting data. These areas can be defined as local (somewhere) closed labour markets inside which most people in the area live and work. Based on this definition, TTWA represent real economic areas with a lot of linkages between individuals and firms. Unfortunately, however, the

geography of commuting is modified by the geography of public infrastructures, which impose restrictions on people's willingness (and ability) to commute. This is especially true for the territory we are analysing here (Catalonia). In Catalonia the transport infrastructures and public transportation systems have enormous problems (especially the railways), so commuting distances are shorter than in other similar areas. As a result, TTWA identified using commuting data may provide an inaccurate portrait of real economic areas. We may therefore argue that TTWA are not real economic or administrative units: these areas do not exist legally because there is no official classification for them.

Another possible shortcoming of TTWA concerns the methods used to design them²³. Since there are differences between the existing methods, the areas obtained are not exactly the same. Moreover, since commuting data modify the size, number and shape of TTWA, these are unstable territorial units because individual commuting patterns change regularly. This may be a positive situation because changes in TTWA take into account spatial variations in economic activity.

We can make the same criticisms when *comarques* are used as the territorial unit. The current design of these areas stems from the 1980s (with some subsequent minor changes) but they were originally designed in the Middle Ages, when a *comarca* was a type of market area. Naturally, these Middle Age markets no longer exist.

Our estimations suggest that the municipality level may best explain the location decision of firms, though the *comarques* and the TTWA must also be taken into consideration. Evidence from the comparison of several territorial levels is still inconclusive, which indicates that more work must be done in this direction.

Other factors that have not been analysed here but need to be introduced into the analysis (which is extremely difficult given the scarcity and heterogeneity of available data) also influence location decisions. One of these involves political

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

competences and town hall budgets (town halls are responsible for running municipalities), which are much higher than those of the *Consells Comarcals* (the political institution at this level). Of course, no comparison with institutions responsible for the TTWA exist because this level does not officially exist (there is no public institution with competences and budgets). This is important because institutional factors are key to a firm's decisions. Although obviously not the main factors in location issues, they help to better illustrate the differences across territorial levels.

5. Conclusions

In this paper we have discussed the territorial level/s at which location phenomena should be analysed. Departing from existing empirical location literature, we have shown that, as there is no real examination of the selection of the territorial level, scholars use the available data without considering what is the most suitable territorial level. This paper contributes to the existing literature on industrial location by highlighting the role of the territorial level at which the analysis is conducted. This research continues previous work by Arauzo and Manjón (2004) and adds functional territorial units (TTWA) to the administrative units analysed in that study. Our results show that the characteristics of municipalities seem to best explain the location decisions of manufacturing firms, followed by *comarques* (counties) and TTWA.

We have also discussed which econometric method best fits data on the location of manufacturing firms, where overdispersion and "zero problems" are common. Using count data models (as is usual in the literature on industrial location), we found that, rather than the more standard Poisson Models, Negative Binomial Models (NBM) should be used for *comarques* and TTWA and Zero Inflated Negative Binomial Models (ZINBM) should be used for municipalities.

Much research needs to be conducted in this field but here we have begun to answer an important question in the literature on location. Future research should focus on international comparisons 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 |
| <i>Comarques</i> | 41 | 154,252 | 104.4 |
| TTWA | 74 | 85,464 | 57.9 |

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

Table 2
Descriptive statistics about entrants

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

Source: author

Table 3
Location determinants (Poisson Model: PM)^{a, b}

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

^a Note: The dependent variable is the number 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: author

Table 4
Location determinants (Negative Binomial Model: NBM)^{a, b}

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

Table 5
Location determinants (Zero Inflated Poisson Model: ZIPM)^{a, b}

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

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) |
| Inalpha | | -0,42095*** (0,10154) |
| alpha | | 0,65643 (0,06665) |
| Vuong test of ZINBM vs. NBM | | |
| z | | 5.82*** |
| N | | 938 |
| LR χ^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: author

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 | Deurbanisation 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 provincial 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: author

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).

References

- Alañón, Á. and Arauzo, J.M. (2006): "Infraestructures de Transport i Localització Industrial. Evidència Empírica per a Catalunya", *Nota d'Economia* **83-84**: 69-87.
- Arauzo, J.M. (2005): "Determinants of Industrial Location. An Application for Catalan Municipalities", *Papers in Regional Science* **84 (1)**: 105-120.
- Arauzo, J.M. and Manjón, M. (2004): "Firm Size and Geographical Aggregation: An Empirical Appraisal in Industrial Location", *Small Business Economics* **22**: 299-312.
- Arauzo, J.M. and Viladecans, E. (2006): "Industrial Location at the Intra-metropolitan Level: A Negative Binomial Approach", *Estudios de Economía Española núm. 224 FEDEA*.
- Ball, R.M. (1980): "The use and definition of Travel-to-Work Areas in Great Britain: some problems", *Regional Studies* **14**: 125-139.
- Bartik, T.J. (1985): "Business Location Decisions in the U.S.: Estimates of the Effects of Unionization, Taxes, and Other Characteristics of States", *Journal of Business and Economic Statistics* **3**: 14-22.
- Basile, R. (2004): "Acquisition versus greenfield investment: the location of foreign manufacturers in Italy", *Regional Science and Urban Economics* **34**: 3-25.
- Baudewyns, D. (1999): "La localisation intra-urbaine des firmes: une estimation logit multinomiale", *Revue d'Économie Régionale et Urbaine* **5**: 915-930.
- Baudewyns, D.; Sekkat, K. and M. Ben-Ayad (2000): "Infrastructure publique et localisation des entreprises à Bruxelles et en Wallonie", in M. Beine and F. Docquier (eds.), *Convergence des régions: cas des régions belges*, De Boeck (p. 280-303): Brussels.
- Boix, R. and Galletto, V. (2006): "Sistemas Locales de Trabajo y Distritos Industriales Marshallianos en España", *Economía Industrial* **359**: 165-184.
- Cameron, A.C. and Trivedi, P.K (1998): *Regression analysis of count data*, Cambridge University Press.
- Carlton, D. (1983): "The location and employment choices of new firms: An econometric model with discrete and continuous endogenous variables", *Review of Economics and Statistics* **65**: 440-449.
- Carlton, D. (1979): "Why new firms locate where they do: An econometric model". In: Wheaton, W. (ed.), *Interregional Movements and Regional Growth*, The Urban Institute, Washington.
- Cieslik, A. (2005): "Location of foreign firms and national border effects: the case of Poland", *Tijdschrift voor Economische en Sociale Geografie* **96(3)**: 287-297.
- Coombes, M.G.; Green, A.E. and Openshaw, S. (1986): "An efficient algorithm to generate official statistical reporting areas: the case of the 1984 Travel-to-Work Areas revision in Britain", *Journal of the Operational Research Society* **37**: 943-953.
- Coughlin, C.C. and Segev, E. (2000): "Location determinants of new foreign-owned manufacturing plants", *Journal of Regional Science* **40**: 323-351.
- Coughlin, C.C.; Terza, J.V. and Arromdee, V. (1991): "State characteristics and the location of foreign direct investment within the United States", *The Review of Economics and Statistics* **73**: 675-683.

- Figueiredo, O.; Guimarães, P. and Woodward, D. (2002): "Home-field advantage: location decisions of Portuguese entrepreneurs", *Journal of Urban Economics* **52**: 341-361.
- Friedman, J.; Gerlowski, D.A. and Silberman, J. (1992): "What attracts foreign multinational corporations? Evidence from branch plant location in the United States", *Journal of Regional Science* **32**: 403-418.
- Gabe, T. (2003): "Local industry agglomeration and new business activity" *Growth and Change* **34 (1)**: 17-39.
- Guimarães, P.; Figueiredo, O. and Woodward, D. (2000): "Agglomeration and the Location of Foreign Direct Investment in Portugal", *Journal of Urban Economics* **47**: 115-135.
- Guimarães, P.; Figueiredo, O. and Woodward, D. (2004): "Industrial Location Modeling: Extending the Random Utility Framework", *Journal of Regional Science* **44 (1)**: 1-20.
- Hayter, R. (1997): *The dynamics of industrial location. The factory, the firm and the production system*, New York: Wiley.
- Head, K; Ries, J. and Swenson, D. (1995): "Agglomeration benefits and location choice: Evidence from Japanese manufacturing investments in the United States", *Journal of International Economics* **38 (3/4)**: 223-247.
- Henderson, V. (1997): "Medium size cities", *Regional Science and Urban Economics* **27**: 583-612.
- Holl, A. (2004a): "Start-ups and Relocations: Manufacturing Plant Location in Portugal", *Papers in Regional Science* **83 (4)**: 649-668.
- Holl, A. (2004b): "Transport Infrastructure, Agglomeration Economies, and Firm Birth. Empirical Evidence from Portugal", *Journal of Regional Science* **44 (4)**: 693-712.
- Holl, A. (2004c): "Manufacturing Location and Impacts of Road Transport Infrastructure: Empirical Evidence from Spain", *Regional Science and Urban Economics* **34 (3)**: 341-363.
- ISTAT (1997): *I sistemi locali del lavoro 1991*, Istituto Poligrafico e Zecca dello Stato, Roma.
- Kim, H.; Waddell, P.; Shankar, V.N. and Ulfarsson, G.F. (2006): "Exploring the Applicability of a Zero-Inflated Count Model to Predict Micro-scale Employment Location Patterns in the Puget Sound Region", *UrbanSim Papers*, mimeo.
- List, J.A. (2001): "US county-level determinants of inbound FDI: evidence from a two-step modified count data model", *International Journal of Industrial Organization* **19**: 953-973.
- List, J.A. and McHone, W.W. (2000): "Measuring the effects of air quality regulations on "dirty" firm births: Evidence from the neo and mature-regulatory periods", *Papers in Regional Science* **79**: 177-190.
- Manjón, M. and Arauzo, J.M. (2007): "La Localización de Nuevos Establecimientos Industriales: Estudios Previos y Evidencia para los Municipios Catalanes", *Ekonomiaz*, forthcoming.
- Manjón, M. and Arauzo, J.M. (2006): "Locations and Relocations: Modelling, Determinants, and Interrelations", mimeo.
- Polèse, M. and Shearmur, R. (2004): "Is distance really dead? Comparing industrial location Patterns over time in Canada", *International Regional Science Review* **27 (4)**: 431-457.

- Rosenthal, S.S. and Strange, W.C. (2004): "Evidence on the Nature and Sources of Agglomeration Economics", in J.V. Henderson and J.F. Thisse (eds.) *Handbook of Regional and Urban Economics*, Vol 4, North-Holland: Amsterdam.
- Rosenthal, S.S. and Strange, W.C. (2003): "Geography, industrial organization and agglomeration", *Review of Economics and Statistics* **85**: 377-393.
- Rosenthal, S.S. and Strange, W.C. (2001): "The Determinants of Agglomeration", *Journal of Urban Economics* **50**: 191-229.
- Smart, M.W. (1974): "Labour Market Areas: Uses and Definition", *Progress in Planning* **2 (4)**: 238-253.
- Smith, D.F. and Florida, R. (1994): "Agglomeration and Industrial Location: An Econometric Analysis of Japanese-Affiliated Manufacturing Establishments in Automotive-Related Industries", *Journal of Urban Economics* **36 (1)**: 23-41.
- Trullén, J. and Boix, R. (2004): *Indicadors 2005*, Diputació de Barcelona i Universitat Autònoma de Barcelona.
- Woodward, D. (1992): "Locational determinants of Japanese manufacturing start-ups in the United States", *Southern Economic Journal* **58**: 690-708.