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Document de treball nº - 7- 2010

DEPARTAMENT D'ECONOMIA
Facultat de Ciències Econòmiques i Empresarials

Edita:

Departament d’Economia
http://www.fcee.urv.es/departaments/economia/public_html/index.html
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Dirigir comentaris al Departament d’Economia.

Dipòsit Legal: T - 1836 - 2010

ISSN 1988 - 0812

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On the effect of the geographical scope of agglomeration economies on firm location*

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This article analyses how agglomeration economies shaped the location decisions of new manufacturing start-ups in Catalan municipalities in 2001-2005. We estimate whether the locations of new firms are spatially autocorrelated and whether this phenomenon is industry-specific. Our aim is to estimate the geographical scope of agglomeration economies on firm entries. The data set comes from a compulsory register of manufacturing establishments (REIC: Catalan Manufacturing Establishments Register).

JEL classification: R1, R3

Keywords: firm location; spatial autocorrelation

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*This research was partially funded by SEJ2007-64605/ECON, SEJ2007-65086/ECON, the "Xarxa de Referència d'R+D+I en Economia i Polítiques Públiques" and the SGR Program (2009-SGR-322) of the Catalan Government and the PGIR program N-2008PGIR/05 of the Rovira i Virgili University. We are grateful to seminar participants at the 12th EUNIP Conference (Universitat Rovira i Virgili). This article has benefited from discussions with D. Liviano, M. Manjón, F. Pablo and E. Viladecans. Any errors are, of course, our own.

I. Introduction

Location determinants of new firms have been widely analyzed[1] because firm entry has important implications for economic growth and job creation. Previous analyses have pointed out that spatial asymmetries and a firm's characteristics are two of the main drivers of firms' decisions, because their specificities (supply of inputs, production processes, labour requirements, etc.) interact with territorial characteristics and the locational preferences of new firms will depend on this interaction. Additionally, a cornerstone of Regional and Urban Economics is that while some firms and industries tend to cluster, because of agglomeration economies derived from specialization or diversity (localization and urbanization economies respectively), natural advantages, historical reasons,[2] chance or other factors, others do not follow such agglomerative patterns.

Despite recent advances in the literature on location, some issues concerning spatial econometrics and spatial statistical techniques have still not been subject to full analysis by researchers. In particular, most empirical analyses try to explain the location of firms in certain sites on the basis of the characteristics of those sites, but do not take into account what is happening in neighbouring areas. This is the goal in this article: to explicitly consider such spatial interactions among sites and to analyse whether the location of new firms is determined by the location decisions of other new firms. Since very little is known about the spatial dependence of new firms, it is important to explore whether this phenomenon is specific to certain industries. Accordingly, here we study the role and the geographical scope of agglomeration economies on the location patterns of manufacturing firms in Catalonia by carrying out a spatial exploratory analysis.

The rest of the article is organized as follows. In Section II we review previous spatial approaches to industrial location. In section III we describe our data and the spatial statistical techniques used. In section IV we present our main results and, finally, section V concludes.

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[1] See Arauzo-Carod et al. (2010) for a review of empirical contributions on industrial location determinants.

[2] See Koo and Lee (2006).

II. Industrial location: a spatial approach

Spatial interdependence in firm location may be approached through spatial autocorrelation analysis. Spatial autocorrelation exists if the values of a variable (e.g., whether a manufacturing establishment chooses a given municipality as a location) are related to the values of that variable in neighbouring locations. Some scholars have introduced such spatial proximity issues in a very rough way without explicitly introducing spatial statistics and econometric techniques into the location analysis, although the contributions by Alañón *et al.* (2007) and Autant-Bernard (2006), among others, are exceptions to this. Alañón *et al*. (2007) used BB Joint Count test statistics, Count Data estimates with spatially lagged explanatory variables and Spatial Autoregressive Probit models. Autant-Bernard (2006) used a discrete choice approach with spatially lagged knowledge spillovers. Other authors have focused on exploratory analysis based on Moran's I statistic: Barrios *et al.* (2009) for Belgian, Portuguese and Irish sub-regions, Moral (2009) for a Spanish region (Madrid) and Arauzo-Carod (2007) for the Catalan municipalities. However, these papers do not deal with the attenuation of agglomeration economies with distance.

The purpose of this article is to extend previous contributions and to demonstrate that the location decisions of new firms also depend on the characteristics of neighbouring sites and on the location decisions of other manufacturing firms. These dimensions, related to the so called geographical scope of agglomeration economies, are the main contribution of this article, since scholars usually assume implicitly that activity outside a location has no effect on activity within it. It is important to notice that benefits of agglomeration may attenuate with distance, the closer agents are physically, the greater the potential for interaction among them (Rosenthal and Strange, 2004).

III. Data and methodology

Data

Data about new manufacturing establishments (codes 14 to 36 of the NACE classification)[3] comes from REIC (Register of Catalan Manufacturing Establishments), on which all manufacturing establishments must figure before they start their activities. For the 2001-2005 period there were 4,282 entries, of which two industries (fabricated metal products, 28.9%, and machinery and equipment, 10.5%) accounted for 39.4%.

Data is grouped at a local (municipality) level for Catalonia (Spain). According to population data from 2001, the 946 Catalan municipalities had an average size and surface of 6,724 inhabitants and 33.7km^2, respectively.

Methodology

We have estimated a measure of spatial autocorrelation for new manufacturing establishments for the 2001-2005 period (Moran's I statistic). It is defined as follows (Anselin, 1988):

$$I = N / S_0 \sum_i \sum_j w_{ij} (x_i - \mu)(x_j - \mu) / \sum_i (x_i - \mu)^2 \qquad (1)$$

where N is the number of observations; w_{ij} is the i-jth element of a spatial weights matrix (W), which is set to 1 if municipalities i and j are considered to be neighbours and to 0 otherwise; x_i and x_j are the number of new establishments of a given manufacturing activity which have been set up in municipalities i and j respectively; and S_0 is a scaling constant, so that $\sum_i \sum_j w_{ij}$. A positive and significant z-value for this statistic indicates positive autocorrelation; that is, new manufacturing start-ups tend to locate close to one other.

We have calculated spatial statistics using six distance-based neighbourhood criteria.[4] These criteria set w_{ij} to 1: that is, municipality i and municipality j are considered to be neighbours if the distance between them is from: 0-15 kilometres (1storder); 15-25

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[3] See table A.1 in the Appendix

[4] Arauzo-Carod (2007) uses 10, 20 and 30 km distance-based criteria for Catalan counties while Viladecans (2004) uses 20 km for the largest Spanish municipalities. Previous distances match with the size of local Catalan labour markets which are about 30 km.

kilometres (2nd order); 25-35 kilometres (3rd order); 35-45 kilometres (4th order); 45-55 kilometres (5th order); and 55-65 kilometres (6th order).

IV. Results

The results of Moran's I test are shown in Table 1 and can be summarized as follows. Firstly, except for office machinery (only significant for the 4th order) and for coke and related products, there is positive spatial autocorrelation in the location of new establishments at a local level. This spatial dependence may be caused by agglomeration economies derived from specialization, since it shows that similar firms tend to locate together.

[INSERT FIGURE 1 ABOUT HERE]

Secondly, spatial autocorrelation in firm entry diminishes when distance increases. These results are consistent with Rosenthal and Strange (2001) and Alañón *et al.* (2007) which show that agglomeration economies attenuate with distance. The decreasing spatial patterns are shown in Fig. 1(a), 1(b), 1(c) and 1(d), in which the statistical significance of Moran's I for each distance band and industry is represented

[INSERT TABLE 1 ABOUT HERE]

And, thirdly, spatial autocorrelation has some industry-specific components. In particular, the 20 manufacturing industries for which spatial autocorrelation is significant and shows a decreasing pattern can be classified into 3 categories according to their significance thresholds. Moran's I is significant at least at 35 kilometres for 6 industries (14, 18, 19, 22, 32 and 33), at 45 km for five industries (21, 24, 26, 27 and 35) and at 55 km for nine industries (15, 17, 20, 25, 28, 29, 31, 34 and 36). For the last distance band considered (55-65 km) none of the industries present significant positive spatial autocorrelations.

The first category contains some high and medium technology industries (22, 32 and 33) but also some low and medium technology industries (18 and 19). Finally, the second and third categories contain industries with different technological requirements.

Our results show that not all types of firms share the same need to be located close to similar firms. For some industries it is fundamental if they are to perform better, while for others interaction with firms of the same industry (if there are any) does not depend on physical proximity.

V. Conclusions

This article contributes to the extant empirical literature that shows that location decisions are influenced by the location decisions of other firms in neighbouring territories, and sheds light on the geographical scope of agglomeration economies. Nevertheless, these results may be sensitive to industrial aggregation, so further research with a more disaggregated industrial dataset is needed.

Several policy implications arise from our main findings. Firstly, since entrant firms tend to agglomerate, entry promoting policies should be concentrated in specific areas. Secondly, previous entry patterns mainly apply to selected industries (25, 28, 29 and 32, among others), so entry promoting efforts should focus on these industries. Decisions on transport infrastructures should consider the differences between the geographical scope of agglomeration economies and the attributed size of local labour markets. Therefore, policies regarding entry of new firms must have both a spatial and an industry dimension if their effectiveness is to increase.

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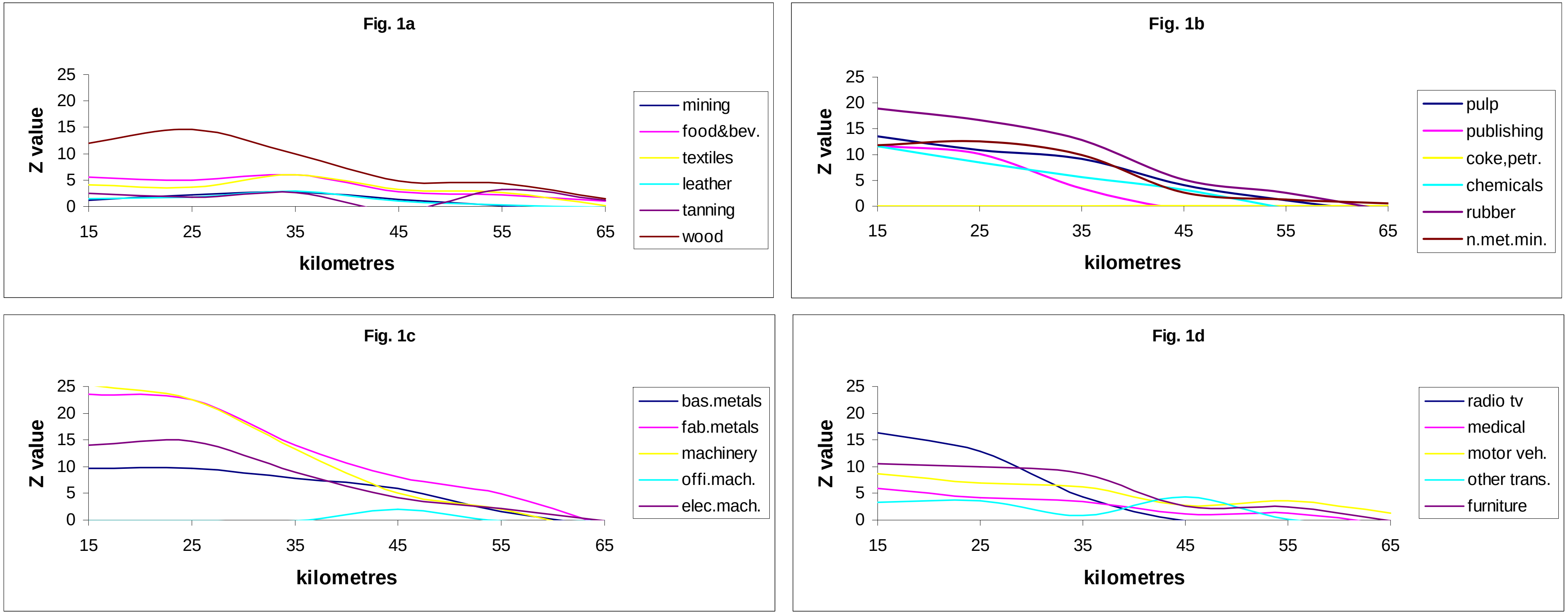
Table 1: Moran's I test for manufacturing entries

Code	0-15 km	15-25 km	25-35 km	35-45 km	45-55 km	55-65 km
14	0.011	0.018**	0.019*	0.008	0.000	-0.010
15	0.059*	0.043*	0.043*	0.017*	0.013**	0.005
17	0.044*	0.031*	0.043*	0.020*	0.015*	0.000
18	0.015	0.014***	0.020*	0.005	0.001	-0.002
19	0.025**	0.014***	0.018*	-0.007	0.019*	0.006
20	0.127*	0.129*	0.073*	0.031*	0.026*	0.008
21	0.144*	0.096*	0.067*	0.026*	0.006	-0.008
22	0.125*	0.089*	0.024*	-0.005	-0.004	-0.008
23	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
24	0.124*	0.074*	0.040*	0.020*	-0.004	-0.024*
25	0.202*	0.147*	0.094*	0.033*	0.015*	-0.006
26	0.126*	0.111*	0.072*	0.016*	0.007	0.002
27	0.104*	0.085*	0.057*	0.038*	0.009	-0.008
28	0.252*	0.199*	0.103*	0.052*	0.029*	-0.007
29	0.272*	0.199*	0.097*	0.032*	0.011*	-0.017
30	-0.002	-0.002	-0.002	0.012**	-0.002	-0.002
31	0.150*	0.130*	0.065*	0.027*	0.013**	-0.002
32	0.175*	0.114*	0.031*	-0.002	-0.003	-0.007
33	0.062*	0.037*	0.024*	0.006	0.007	-0.006
34	0.091*	0.061*	0.045*	0.017*	0.022*	0.007
35	0.035*	0.031*	0.005	0.027*	0.000	-0.003
36	0.113*	0.088*	0.063*	0.016**	0.014**	-0.002

*Indicates significant at 99% **Indicates significant at 95%
***Indicates significant at 90%

Figures 1a, 1b, 1c and 1d: Moran's I statistical significance



Z value>1.65 and <1.99 indicates significant at 90%; Z value>1.99 and <2.56 indicates significant at 95%; Z value>2.56 indicates significant at 99%

Appendix

Table A.1
NACE-93 classification (manufactures)

Code	Industry
14	Mining of non-ferrous metal ores
15	Food products and beverages
17	Textiles
18	Leather clothes
19	Tanning and dressing of leather
20	Wood and cork products
21	Pulp, paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Coke, refined petroleum products and nuclear fuel
24	Chemicals and chemical products
25	Rubber and plastic products
26	Other non-metallic mineral products
27	Basic metals
28	Fabricated metal products, except machinery and equipment
29	Machinery and equipment
30	Office machinery and computers
31	Electrical machinery and apparatus
32	Radio, television and communication equipment
33	Medical, precision and optical instruments, watches and clocks
34	Motor vehicles, trailers and semi-trailers
35	Other transport equipment
36	Furniture