XIII Encuentro de Economía Aplicada
Sevilla, 10-12 June 2010

Location of knowledge intensive firms and cluster creation

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Abstract:

The aim of this paper is to evaluate the location decisions of knowledge intense firms inside a renewed urban district in the city of Barcelona. After some decades of an intense decrease of the economic activity, and especially the industrial one, in the year 2000 the city council of Barcelona has implemented a plan which considers de renovation of the urban and the economic structure of this district. Part of the development plan tries to improve the presence of the knowledge based firms in the area creating a cluster of these advanced activities. The objective of the paper is to evaluate the success of this local policy and to test if cluster amenities are relevant to attract knowledge-based activities. First we do a differences-in-differences analysis to compare the increase on the number of firms located in the cluster with the increase of the firms of the rest of the city and the metropolitan area in order to evaluate the cluster implementation. And second, with the objective to test if the cluster amenities are determinant for the location of these type of firms, we perform a multivariate regression analysis explaining intra-city firm location at the ZIP code level over the 2001-06 period. Data about new firms came from a business-census and contains detailed information about location determinants of those firms as well as their firm characteristics.

Keywords: firm location, cluster, knowledge firms, local public policies
JEL CODES: R12

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*This paper is also part of a research project financially supported by grants SEJ2007-64605/ECON and SEJ2007-65086/ECON, the "Xarxa de Referència d'R+D+I en Economia i Polítiques Públiques" and the "Xarxa de Referència d'R+D+I en Economia Aplicada" of the Catalan Government and the PGIR program N-2008PGIR/05 of the Rovira i Virgili University. Usual caveats apply.

1. Introduction

Since the second half of the 1980s, both the local and international competitive scenarios have changed. The globalization process, with the increased levels of international competition and the appearance of new emerging sectors, is considerably modifying the industrial specialization and the competitive capacity of many cities. On the one hand, the crisis of traditional industrial sectors, which started in the middle of the seventies, still continues, as they are exposed to competition from less developed countries with much lower production costs. On the other hand, the new emerging sectors, linked to new technologies and the knowledge economy (advanced industries and services), with a growing demand, the use of more sophisticated technologies and highly skilled labour, also increase their relative weight. These changes have reshaped the productive structure of cities, although they have not all been impacted along the same patterns. Some medium cities, with a high degree of industrial specialization in more traditional fields, are experiencing a considerable decrease in the number of jobs they offer while the expansion of more advanced activities usually takes place in economically larger cities, with distinct productive traits. This globalization process has a clear impact on urban environments. The impact of globalization on the urban setting may bring about a series of changes, however. For one, cities dominated by the manufacturing world or traditional services may be forced to renew their economic foundation. The most advanced manufacturing sectors and high value-added services will tend to concentrate in the centre of the cities, whereas it is envisaged that the greater labour-intensive activities will be moved towards the outskirts. Thus, the cities concluding their restructuring process will be specialized in activities with a greater added value and will be surrounded by areas where complementary and lower value-added activities will take place (Duranton and Puga, 2000).

In recent years, in front of this new scenario of increasing competition and economic restructuration, local and regional public policies are being redesigned to help their economic agents to have a better adaptation. There are different options of local policies but most of them focus on the restructuring of their productive structure reinforcing the most advanced activities and the ones related to innovation and knowledge in front of the traditional ones more affected by the economic regeneration (Malecki, 2007). Local and regional strategies to promote technology-based economic development can be designed in different ways. In this line, there has been a renewed interest in cluster creation as one of the options of local

development policies (Cooke, 2002). More specifically, innovative clusters creation seem to be a good opportunity to improve the knowledge-based economy allowing the local knowledge spillovers and, as a consequence, to increase the productivity and the competitiveness of cities. However, as Suire and Vicente (2009) pointed out, some of the Sillicon-Valley type clusters that were examples of success in the nineties have declined (French Sillicon Sentier or Sillicon Alley), while others have became more stables (the proper Sillon Valley or the French Telecom Valley). Recently, some papers point considerable doubts on the guaranteed success of the clusters promotion policies. More specifically, their empirical evidence show that the effect of these clusters on the urban growth could be much more modest that the ones previously though. Therefore, those works queried the efficiency of investing big amounts of public resources to promote those agglomerations (Appold, 2005, Martin and Sunley, 2003, Martin *et al* 2008 or Duranton, 2009).

The city of Barcelona, a city with about one and a half million of inhabitants and a metropolitan area around three million of inhabitants, has also been affected by all this structural changes[1]. After a decades of growth of industrial activity, mostly located in one of the districts of the city, in the seventies these activity started to decrease and, at the same time, the urban area started an intense loose of attractiveness. Around the year 2000 the City Council of Barcelona has designed a development plan (22@)[2] which considers de renovation of the urban and the economic structure of the district affected by the deindustrialization and the urban decrease. The 22@ project was created with the objective to transform the ancient industrial area of the city in a new urban space where the knowledge economy has a key role. Concretely, in line with the cities and regions mentioned before, the local development policy tries to develop a cluster of high-tech and knowledge activities in order to improve competitiveness of whole city and to generate an area specialized in such activities[3]. Additionally, the project implied also a reurbanisation process in which land is provided for of high-tech firms, university activities and social housing.

[1] See Parellada and Viladecans (2008) for a wide analysis of the transformation and adaptation of different cities to the globalisation processes. The city of Barcelona is one of the analysed cases.
[2] The project (and the area) is called 22@ because 22 refers to the city code of the ancient Poblenou district and @ refers to the technology orientation activities aimed to this area.
[3] This project has received about 180 M € from local administration.

Before the economic crisis of the seventies the area has been a very dynamic industrial and logistic area specialized basically in traditional manufacturing activities like textile, food and wine or metal activities. After the seventies industrial crisis, those activities experimented an important decrease. As a consequence of this deindustrialization process, lots of buildings of the companies in crisis were abandoned and this urban area of Barcelona was neglected by the authorities and the economic agents. It was in the eighties when with the urbanization process that preceded the Olympic Games in 1992 in the city of Barcelona, a renewed attention was attracted by the area. So, during those years new infrastructures were built, the seacoast was recuperated and a new and modern residential district was developed. Later, by mid of the year 2000, with the called 22@ Barcelona development plan, the city council of Barcelona wants to recuperate the area as the economic motor of the city. Opposed to what characterized the industrial structure of the area in the past, the new development 22@ plan tries to improve the most advanced economic activities. That is to say, the project of the city council was to create a cluster of activities related to the new technologies of information and communication, and also to improve the presence of those activities related to the research, the design and the multimedia. The common characteristic of these activities and the main difference with the activities located in the area in the XIX and XX centuries is their high technological contents and their intensive use of human capital and knowledge. For that reason, to achieve the objectives of the initiative 22@ Barcelona an urban transformation of the area is also needed. This transformation will give to the firms located in the area a new business and residential district with all the physical and technological infrastructures needed for the firms dedicated to those advanced activities.

The objective of the paper is to evaluate the success of this local development policy and to better understand the location patterns of knowledge based firms that are trying to be attracted by the new cluster. First, in order to evaluate the success of the new local knowledge base cluster we do a differences-in-differences analysis to compare the increase in the number of advanced firms located in the cluster with the number of advanced firms located in the rest of the city and the metropolitan area. And secondly, in order to test if cluster amenities are relevant to attract knowledge-based activities we perform a multivariate regression analysis explaining intra-city firm location over the 2001-07 period. Data about new firms came from a 22@ business-census (2007) and contains detailed information about location determinants of those firms as well as firm characteristics. Additionally, we use data on firms located in the

cluster in order to check three different questions: (i) which are the location amenities (including a host of attributes related to neighbourhood knowledge-spillovers) of the 22@ district as stated by different types of firms; (ii) whether the firms that place more value on these attributes are those that are disproportionately located in the 22@ district; and (iii) whether these firms tend to be more engaged in knowledge-transfer activities.

The paper is organized as follows: in the second section we review empirical literature about cluster creation and the location patterns of high-tech and knowledge firms. In the third section we present the empirical part of the paper: first a descriptive analysis of the data; second a differences-in-differences analysis to test for the success of the cluster creation policy; and third we estimate an orderet logit model to test for the effect of cluster amenities on location decision of firms. Finally, fifth section concludes.

2. Cluster creation and the location of knowledge and high technology firms

Cluster creation is a common strategy for local and regional governments to implement development policies. The general admitted idea for the policy makers is that clusters bring economic advantages, as the increase of productivity and competitiveness of firms, in the area in which they are developed. This supposition has justified the investment of big amounts of public resources of the local and regional administrations to support the creation and development of clusters. The work of Michael Porter (1990, 2000) was a key influence to understand the interest of policy makers in this strategy. He defined a cluster as a: "geographic concentration of interconnected companies, specialized suppliers, service providers, and associated institutions in a particular field that are present in a nation or region. (…) Clusters arise because they increase the productivity with which companies can compete. The development and upgrading of clusters is an important agenda for governments, companies, and other institutions. Cluster development initiatives are an important new direction in economic policy, building on earlier efforts in macroeconomic stabilization, privatization, market opening, and reducing the costs of doing business*"* (*The Competitive advantages of nations,* 1990). As Martin *et al* (2008) pointed out, the idea of a cluster is close to what other papers in the literature call agglomeration economies. An agglomeration of economic activities implies the emergence of positive externalities which can make more

productive the firms located in these agglomerations. The sources and the scope of the agglomeration economies have been broadly analyzed in the literature. Alfred Marshall (1890) was the first author trying to concrete them in three types. Briefly, he distinguished between: 1) Labour market pooling; 2) Input externalities and 3) Knowledge spillovers. Other approaches distinguish the source of agglomeration economies enhancing the effects of geographic specialization in specific activities (localization economies) or the growth promotion effects of agglomeration economies that arise from the size of an area and its diverse economic environment (urbanization economies). In fact, cluster effects could be captured through the to localization effects' estimation. There is a large literature trying to test those effects. For example, Rosenthal and Strange (2004) did a survey on empirical analysis of agglomeration and Duranton (2009) review the papers that have analyzed the effects of geographical concentration on productivity, wages and employment gains. Dumais *et al* (2002), Rigby and Essletzbichler (2002) and more recently Ellison *et al* (2010) test the existence of marshallian external economies. Most of the empirical evidence seems to confirm the advantages for firms of being located in agglomerated areas. However, as Duranton (2009) remarks, most of the empirical approaches do not take into account the causality problems and so the results have to be carefully interpreted. In any case, the quantitative effects of concentration in efficiency gains are not impressive at all.

But it is important to note that all the empirical analysis refer to concentration of economic activities that occur naturally. That is to say, without the intervention of any local or regional public policy. There is a very few literature about the effects of a public supported clusters on the firms' performance. Because the cluster are artificially created by local or regional authorities, it is difficult to avoid case studies without the possibility of making suitable comparisons (see as examples of this type of approaches the works of Garnsey and Hefferman, 2005 or Glomerman *et al*, 2005). One exception is the paper of Martin *et al* (2008) that empirically analyzes a public policy promoting industrial clusters in France in the late nineties applying a differences-in-differences approach. The authors conclude that the cluster policy had modest and transitory effects on employment of firms involved and had been very costly for the public administration. In line with these results, other approaches have been also critical on the *panacea* that creating a cluster could be (Appold, 2005, Martin and Sunley, 2003, Martin *et al* 2008 or Duranton, 2009).

Regarding more specifically on location decisions patterns of knowledge firms, empirical contributions about have emphasized specificities of such firms in terms of the areas where to be located. Firstly, location decisions of high-tech firms are clearly shaped by the spatial distribution of knowledge infrastructures (Audretsch *et al*., 2005; Carrincazeaux *et al*., 2001; Bade and Nerlinger, 2000) like universities, public and private R&D centers or technical colleges. Nevertheless, there seem to be some particularities depending on public and private R&D institutions (Licht and Nerlinger, 1998) since the former have a positive influence over firm location decisions while the influence of the later is not clear. Secondly, interactions between firms and public organizations are needed in order to develop a cluster of high-tech firms as well with the existence of highly diversified scientific capabilities. Those interactions are related not only for guarantee efficiency of those firms but also for attracting them to a specialized cluster, as Autant-Bernard et al (2006, p. 184) point out for the biotech system in France: "*Rather than the quantitative potential of public- and private-sector research in the region, it is the diversity of available scientific competencies and the capacity to develop public/private interactions that favour the establishment of biotech start-ups in the region*".

Nowadays, knowledge processes get benefit from the activities of other firms, public research centers and universities from all over the world (no matter where they are located) but, nevertheless, face-to-face interactions still are of great importance for firms and individuals (McCann and Simonen, 2005; Grabher and Stark, 1997). A very well known example of theses interactions is identified by the *milieu innovateur* (Aydalot, 1986), which represents the territorial area in which there are some interactions among firms and individuals that allow to learn from each other and from those interactions and also by sharing access to common resources. As some scholars have shown (Audretsch and Feldman, 1996; Lundvall, 1993 and Storper, 1992) innovative capacity is shaped by firm access to knowledge sources, so knowledge intensive firms will tend to locate close to those areas in order to benefit from such knowledge spillovers. Obviously, this spatial proximity will depend on the knowledge characteristics (Breschi, 2000). If knowledge is (mainly) tacit, firms will tend to be spatially concentrated but if knowledge is (mainly) codified, there is no need for such concentration since it is possible to access this knowledge by non spatial ways (publications, licenses and so on). We assume that firms located in 22@ cluster need to catch up this tacit knowledge in order to increase their innovation rate and, consequently, their productivity.

3. Empirical analysis

3.1 Descriptive analysis

The data of the census performed in May 2007 indicates that there are about 2,000 firms located in the Barcelona 22@ district. Nearly half of these firms were located in the area after the year 2000. In terms of employment, there are about 42,100 employees in the district and a 60% of them belong to firms created in the area after 2000. Additionally, the industrial mix of 22@ district is rapidly changing from a traditional manufactured-basis to a service-oriented one. This transformation is of great importance since in the past, as it has been explained, the area has been more manufactured oriented than the whole city of Barcelona. Concretely, while manufactures weighted 62.5% in the sixties, after 2000 they were only 25% in the district. On the other hand, the service activities have increased a lot their presence in the area. So, in the sixties they represent only the 22% of the whole economic activity and after 2000 they represent nearly the 67%. It is known that the transformation of the productive structure is a stylized fact that affects most of the big cities after the crisis of the seventies. In fact, manufacturing firms are relocating their productive activity from the centre of the cities to the suburbs with the objective to avoid higher costs in the city centre. But the transformation of the productive structure seems to be more intense in the 22@ district than in the rest of the city of Barcelona. The data from the city indicated that in the last decade the percentage of service activities has increased one point while the same percentage has increased 8 points in the 22@ district.

[INSERT TABLE 1 UPON HERE]

If we carry out a detailed analysis of the new activities located in the 22@ district, it is shown that there has been a continuous increase of the presence of firms more related to the innovation and knowledge, the called @ activities. More than half of the firms located in the area in the latest years belong to those sectors. It seems that new firms located in 22@ district are more knowledge oriented than previous ones located in the same area (but before 22@ was designed and implemented), since technological patterns (in terms of skilled workers, industry, R&D activities, etc.) are increasing over time. So, we expect former incumbents firms to have lower technological intensity than new ones, even if we take into account that incumbents firms can shift to higher technological intensity. Data about R&D activities

clearly show that firms located inside 22@ district are increasing such activities. Concretely, while only 13.4% of firms located there during the eighties did R&D activities, during the nineties the percentage raised to 26.6% of firms and from 2000 the 43.2% of firms located there are engaged in R&D activities. Finally, about the human capital, it seems clear that firms located in the 22@ district after 2000 have a different profile than the incumbent ones. In concrete terms, more than 52% firms located in the area in the eighties have less than 10% of employees with a high degree and only a 4.8% of those firms had a 75% of their employment with a high degree. While firms created in the area after 2000 had only a 28% of their employment without a high degree and an 18.5% of firms in which 75% of the employment have a high degree.

3.2 The effects of cluster creation on the increase of knowledge based firms

After this brief description of the economic structure of the 22@ district, the first empirical part of the paper tries to solve its first objective: To evaluate the success of the cluster creation in the 22@ district of the city of Barcelona. In fact, one of the aims of the local policy was to increase the number of firms located in this area belonging to knowledge based activities. To analyze whether the local policy creating a cluster was successful in this respect we quantify the impact of the cluster policy on the increase in the number of firms belonging to these advanced activities[4].

Econometric approach: data and methodology

To test if the cluster creation policy in the Barcelona 22@ district has led to a change in the industrial structure of the treated local area (Barcelona's district number 22, Poblenou), in favor of advanced industries, we estimate the following 'difference-in-differences' regression (see Card and Krueger (1994) and Bertrand *et al* (2004), for applications of the DD approach):

$$\%@\,firms_{it} = \alpha\, d22@_i \times d(year_t \geq 2000)_t + \lambda_t + \mu_i + \gamma_i t_t + \varepsilon_{it} \qquad (1)$$

[4] The considered @ activities are, in the manufacturing sector: *Edition and graphic arts, Office machines and computers, Electronic material, equipment of radio and TV* and *Medical equipments;* and in the service sector: *Telecommunications, Financial sector, Research and development, Other business activities, Education and cultural activities*.

Where $\%@\,firms_{it}$ is the share of firms belonging to @ industries in the overall number of firms in the local area *i* and year *t*. The @industries are the selected knowledge and technological industries belonging both to the manufacturing and to the services activities. This variable allows us to test for the productive structure specialization. The dummy $d22@_i$ identifies the treated local area (Barcelona's district number 22, Poblenou) and $d(year_t \geq 2000)_t$ is a dummy equal to one for years following the implementation of the project in 2000. To perform the analysis we use data on the number of firms by local area for the period 1996-2005, which means that there are four years in the pre-treatment period (1996-1999) and six post-treatment years. We also include in the equation a set of fixed year effects, λ_t, local area fixed effects, μ_i, and local area specific time trends, $\gamma_i t_t$.

We will also explore the possibility that the effects of the project are not instantaneous, by estimating separate effect for each year. It could happen, for example, that the project needs time to take-off; this could happen if firms are expectant regarding the success of the project (i.e., they wait until other firms come in) or if complex infrastructure projects are to be undertaken before firms are able to settle in the local area. Due that the local policy is implemented in a area that has to be restructured, one part of the project implies important investments in changing the urban structure of the area. And obviously, this needs more time than if the cluster project was developed in an area without pre-existent urban and industrial structure. In this case the estimated DD regression will be:

$$\%@\,firms_{it} = \sum_t \alpha_t\, d22@_i \times d(year_t = t)_t + \lambda_t + \mu_i + \gamma_i t_t + \varepsilon_{it} \qquad (2)$$

Where $d(year_t = t)_t$ are dummies which identify each of the post-treatment years, α_t being the year-specific treatment effects. We will show also the results allowing this parameter to change for the pre-treatment years, in order to see if the year 2000 can be really considered as the starting point for the project.

The sample of local areas includes those treated by the 22@ cluster project and a control group which includes all the local areas in the metropolitan area of Barcelona. We introduce the 35 municipalities of the metropolitan area and the rest of the districts of the city. The validity of the 'difference-in-differences' approach rests on the assumption that the paths of $\%@\,firms_{it}$ would not be systematically different for the 22@ local area and the rest of the metropolitan area in the absence on the local policy intervention. As can be seen from Figure 1, the 22@ and full Metro Area trends of $\%@\,firms_{it}$ are virtually parallel. This suggests that, prior to the treatment, the economies of the urban area and that of the 22@ where restructuring its industrial composition (from traditional sectors to @ ones) is a similar way. This means that the Metro Area as a whole could be could be a priori a good control group for the 22@ local area. An alternative control group would be formed by those local areas which

are close enough to the 22@ to share some specific location traits with it. Figure 1 also depicts the trend for this potential control group, which includes all the local areas located in a close neighborhood (i.e., those belonging to the St. Martí municipal district). Note that the trend of $\%@\,firms_{it}$ in the neighborhood local areas is much more stepper, although it is difficult to know the magnitude of the bias caused by the difference in these two slopes. This different path might be due to the fact that some of these neighboring areas where object of various huge infrastructure projects both prior and after the Olympic Games and that their economy probable took off once the economic downturn at the beginning of the 1990 decade passed off. In any case, there is another problem with this group, derived from the (possible) spatial spillovers of the 22@ project. If this was the case, the control group would be contaminated by the treatment and the estimated treatment effect would be downward biased. For these two reasons, we prefer not to use the neighbors (which we will label W22@) as a control and use it instead as an additional treatment in order to look for the possibility of spillovers. In this case, the DD regression will look like:

$$\%@\,firms_{it} = \left[\alpha\, d22@_i + \beta\, dW22@_i\right] \times d(year_t \geq 2000)_t + \lambda_t + \mu_i + \gamma_i t_t + \varepsilon_{it} \quad (3)$$

These spillovers could be either positive or negative. Positive spillovers could appear if the 22@ district also confers benefits to firms located close to the project but not in the core. Negative spillovers could appear if some firms that would otherwise located in the neighborhood decide to mode instead to the 22th district because of the benefits conferred by the project. Of course, the validity of the spillover result rests also on the difference between the slopes of the treatment group (now W22@) and the control group (the full Metro Area). In any case, to further assess the validity of the control groups, we will estimate these equations with and without the local area-specific time trends. If both the treatment and control groups evolve similarly, the inclusion of these trends should not change much the estimated treatment effect. We will also provide result further dividing the neighbor-hood area into North and South, the North being less affected by the above mentioned infrastructure projects than South.

Results

The effect of the 22@ cluster creation project on the share of @ firms in Barcelona's 22th district (Poblenou), using as control group all the local areas in the Metropolitan Area, are displayed in Table 1. Columns (1), (3) and (5) show the results without area-specific time trends, while columns (2), (4) and (6) show what happens when these trends are included. The inclusion of the trends does not alter the size and significance of the estimated treatment effects, corroborating our impression that the control group used is appropriate. The effect of the 22@ project is positive and statistically significant in all the cases. The results in columns (1) and (2) suggest that the project has raised the share of *@firms* in the Barcelona 22th

district by a 1%, that is from 13% to 14%. This 1% is approximately half the distance in the share of *@firms* between the 22th districts and the average of the Metropolitan Area.

[INSERT TABLE 2 UPON HERE]

In any case, note that this effect is really modest in size, since some of the local areas in the Barcelona's Metropolitan Area have much higher shares of this kind of .firms. The results obtained when breaking the post-treatment years in two sub-periods show that the impact in the second sub-period is not bigger than in the first one (see columns (3) and (4)). When looking at the results by post-treatment year (columns (5) and (6)), one finds that the impact of the project is higher during the first years, but seems to decrease a little the following years. However, these results should be interpreted with some caution, given the lack of precision of the estimates. In any case, what seems true is that the project had some impact at the beginning but stagnated afterwards, something also suggested by the visual inspection of Figure 2, which plots the predicted @firm shares in the treatment and control groups for the period 1996-2005. This could be due to the fact that, once the first impulse of the project occurred, the location of additional firms has to wait until the planned infrastructures were built up. After the completion of the major rebuilding project some of these impediments disappears. Unfortunately, the lack of comparable data for recent years does not allow us to follow these developments; however, data on a recent.

Table 2 explores the possibility that some of the benefits of the 22@ project have spilled over its boundaries. The results in column (1) suggest that the effect in the neighborhood is positive and even stronger than in the core of the 22@ district (the rise in the share of @firms is 3% and 1% in these two places, respectively). However, these spillovers disappear once we allow for local area specific trends in column (2). At the bottom of the table we show with a t-test that we can not reject the equality in the 22@ and the full Metro Area trends, but that we are able to reject the equality between the trend of the 22@ neighbors and that of the Metro Area. This means that our control group is not a good control for the 22@ neighbors. We are not able to say thus if there are spillover effects or not. To fix this problem, we divide the 22@ neighbors according its geographical situation: those located South include the local areas mostly affected by the rebuilding efforts that occurred around the Olympic . This group is the one that shows a stepper trend in the share of *@firms*. Columns (5) and (6) show the results obtaining when splitting the neighbors that way. Results in Column (5) are quite odd, suggesting that spillovers are negative for North neighbors and positive for the South ones. However, after controlling for area trends, both spillovers seem to be negative, although only those on the North neighbors are statistically significant at a 90% level. And the t-tests on the

equality of trends suggest that the trends between these two neighbor groups are different than the ones followed by the 22th district and the full Metro Area. So, also the North neighbors' path is more stepper than the 22th district one. However, in this case, the difference between trends is not so great, and the negative spillovers found when not including there are trends remain afterwards. Although we have to admit this result is not really robust, its implications are quite interesting. It seems that part of the positive effect of the 22@ project on the 22th district comes at the expense of a negative effect on the neighborhood.

[INSERT TABLE 3 UPON HERE]

3.3 Location patterns of knowledge technological based firms

After have seen that the results of the cluster creation policy are modest in terms of the number of new firms created, the second step of the empirical analysis consists in explaining which factors are relevant to attract this type of knowledge-based activities. After seeing that the quantitative effects of the cluster policy are not quantitatively impressive, our hypothesis in this second empirical part is that the location amenities arising through the cluster creation could be determinant for the attraction of new firms and so, the effects of the cluster could not be negligible.

Econometric approach: data and methodology

To test for this possibility, we perform a multivariate regression analysis explaining intra-city firm location at the ZIP code level over the 2001-07 period. We use data about new firms that came from a survey of firms located in 22@ district since 2001 until May 2007. The survey contains detailed information about location determinants of those firms as well as firm characteristics. Additionally, we use data on firms located in the district in order to check three different questions: (*i*) which are the location amenities (including a host of attributes related to neighborhood knowledge-spillovers) of the 22@ district as stated by different types of firms; (*ii*) whether the firms that place more value on these attributes are those that are disproportionately located in the 22@ district; and (*iii*) whether these firms tend to be more engaged in knowledge-transfer activities. The total amount of the survey contains 289 firms.

One of the questions of the survey was about the location determinants. Concretely, firms were asked to rank several location factors according to their importance in their location decision process in the Barcelona 22@ district on a scale of 1 to 5 (with '1' representing that the location factor was "not at all important" and '5' representing that the location factor was "very important").

Among those factors we have chosen some aspects that could gather some location amenities related to a cluster. First, we test for the importance of "location economies" as a determinant for firm location. Following the referenced literature about agglomeration economies, it seems that an specialized environment –provided by a cluster- can be seen as a good location for a firm. Second we try to introduce some variables that could be a good proxy of he marshallian externalities: 1) The input externalities are introduced with two location factors consumers proximity and suppliers proximity, 2) The labour pooling (measured by the location factor availability of skilled labour) and 3) the knowledge spillovers measured by the existence of an innovative environment.

Given the nature and characteristics of the data, the most appropriate model seems to be an ordered logit model.[5] The dependent variable is the rank given by firms to previously described location factors and the independent variables are some characteristics of those firms that are hypothesized to explain the importance given to those location factors: i) be a knowledge-based firm (@ firm); ii) be a knowledge-based firm that located in the 22@ district after the year 2000 (the moment in which the local policy to promote the cluster started); iii) the firm size; iv) be a multinational firm and v) the age of the firm. These characteristics have been selected according to empirical findings in empirical industrial location literature regarding how firm characteristics affect their location decisions (see Arauzo *et al.* 2010 for a review). Concretely, they cover aspects like technological level, size, (whether the firms is a family business) or internationalization.

In order to better understand the characteristics of the data set and the econometric methodology, it is important to notice that individuals were only required to rank how each

[5] We have also carried out a probit estimation but our results remained, mainly, unaltered. In this probit estimation we grouped ranks given by respondents assuming that those ranking 4 or 5 considered that the location factor was important for their decision while those ranking 1, 2 or 3 considered that the location factors was not important.

one of location factors provided in the interview contributed to their location decisions, but nothing was asked to compare among those location determinants and no additional explanations of them was provided (so, it is possible that interviewed individuals could catch a different meaning of the location factor)[6].

Measuring influence of those location factors over real location decisions allows using an ordered logit model. This type of discrete choice models is a specific case of multinomial logit model in which dependent variable is allowed to have more than two possible outcomes. Concretely, the five measures of location importance of location factors are ordered scales where 1 < 2 < 3 < 4 < 5. In any case, it is important to notice that distances between adjacent ranks (e.g., between 2 and 3) are unknown.

Following Greene (1999), there is a latent variable model:

$$y^* = \beta' + \varepsilon$$

where y^* is the unobserved dependent variable, x is a vector of explanatory variables, β is an unknown parameter vector and ε is the error term (with a standard logistic distribution). Given that y^* is unobserved, it is possible to observe:

$$\begin{aligned} y &= 0 \quad if \quad y^* \le 0 \\ y &= 1 \quad if \quad 0 < y^* \le \mu_1 \\ y &= 2 \quad if \quad \mu_1 < y^* \le \mu_2 \\ &\vdots \qquad\qquad \vdots \\ y &= J \quad if \quad \mu_{J-1} \le y^* \end{aligned}$$

where y is the frequency of attendance, μ is the vector of unknown parameter estimated with the β vector and J is the number of categories. The ordered logit model allows to estimate parameter vectors for β and μ. It is important to notice that the estimated μ shows dividing lines between Y = 0 and 1 (μ_0), Y = 1 and 2 (μ_1), Y = 2 and 3 (μ_2) and so on.

Here we will analyze how firms' perception about the importance of several location factors is shaped by firms' characteristics. Concretely as we have explained before, we will analyze the following location determinants: a) Location externalities (Colum 1); b)Proximity to consumers (Column 2); c) Proximity to suppliers (Column 3); d) Availability of skilled labour (Column 4) and 5) Innovative environment (Column 5).

[6] See Bertrand and Mullainathan (2001) and Senik (2005) for a detailed analysis of methodological problems linked with using subjective variables.

Results

Table 4 shows the maximum likelihood estimation results for the ordered logit model according to four location amenities related to a cluster existence and five firm characteristics, which explain why firms rate better or worse these location amenities.

[INSERT TABLE 4 UPON HERE]

With reference to the location economies factor, that tries to capture the interest of the new firms of being located in a specialized environment and that better emphasizes the idea of a cluster, it is positive and significant for the knowledge-based firms (@Firms). This result seems to prove that knowledge-based firms prefer to concentrate in areas with some level of specialization on these activities. And so, creating a knowledge-based cluster which concentrates firms belonging to the same industry is perceived as an attractive factor for the new firms belonging to these activities. For the @Firms that arrived to the district after the year 2000, there is the same perception of this location factor due that the coefficient is not significantly different.

The existence of location economies is also an important location factor for the more mature firms; the variable *Age* is positive and significant. However, the effect is smaller than the one obtained by the @firms. This result could indicate that the location economies could have a positive effect on the survival of firms. That is to say, being located in an area with strong location economies makes firms more efficient. Garnsey and Heffernan (2005) find that survival rates for the Cambridge technology-based firms are consistently higher than the regional or national averages. Additionally, Staber (2001), show that location in clusters of firms in the same industry increased business failure rates, but location in diversified clusters of firms operating in complementary industries reduced failure rates. In the same line, the work Globerman *et al* (2005) applied to the information technology firms in Canada find evidence that firms located in the Toronto CMA, and more specifically those located in a relatively small area within the Toronto experience faster growth. Their conclusion is that the impact of clustering on growth and survival performance is highly localized.

Finally, it is interesting to notice that multinational firms perceive as a negative location amenity the existence of location economies. In fact, the estimated coefficient is negative,

significant and its value is higher than the others. This result could indicate that the multinationals make the location decisions facing on a bigger geographical environment than the 22@ district which could be the whole city or the metropolitan area (a more diversified environment).

Regarding to the location factors related to the marshallian economies effects, first, the supplier proximity is not a significant location factor whatever it is the characteristics of the firm. This result could mean that the geographical area taken into account by firms on this respect could be bigger than the district and so the providers could be located in the rest of the city or even in the metropolitan area. Second, the labor pooling as an attractive location factor is not significant for the knowledge-based firms and it is significant only for the most aged firms. This later result could be surprising since the positive effect that educational level of the workforce have over entries of new firms has been largely demonstrated (Coughlin *et al*., 1991; Woodward, 1992; Smith and Florida, 1994, Coughlin and Segev, 2000). But is has to be said that normally these contributions refers to a larger geographical areas like states or counties of the US. In the case of the spatial area used in this analysis (a district inside a city) it seems logical to assume that firms look for skilled labor not only inside the district but (at least) in the whole city, so availability of labor at 22@ is not a key determinant since firms can easily access skilled labor inside the whole city of Barcelona (and even its metropolitan area). Finally, the third marshallian external economy –the existence of knowledge spillovers- seems to be an attractive location factor only for the multinational firms.

4. Conclusions

In this paper we have evaluated a local development policy applied inside a renewed urban district in the city of Barcelona (the 22th district). After some decades of an intense decrease of the economic activity, and especially the industrial one, in the year 2000 the local government has implemented a plan which considers de renovation of the urban and the economic structure of this district. Part of the plan consists in creating a cluster of knowledge-based activities. The descriptive analysis of the firm structure of the district shows that the profile of the recent created firms, afer the year 2000, is different from the incumbent ones: *i*) most of them belong to the service sector (two thirds of them) and this is an evidence of the productive transformation from manufacturing firms to tertiary firms; *ii*) there has been a continuous increase of the presence of firms more related to the innovation and knowledge,

the called @ activities (more than half of the firms located in the area in the latest years belong to those sectors); *iii*) there are more multinational firms; *iv*) the human capital of the new created firms is higher than the incumbents one; *v*) the firms of recent creation carry out more R&D activities. This evidence could be an evidence that the 22@ project seemed to have some insights of success according to its capacity to attract new firms more related to knowledge economy. But, it is important to note that perhaps these results can be generalized to the rest of the city or even the metropolitan area. The idea could be that there is a structural change towards this type of activities wherever we look. So, it could be admitted that there is nothing special in the 22@ district because the structural change affects all the metropolitan area economy. To test for that hypothesis, the first objective of the paper has been to evaluate the success of this local policy. The results of the differences-in-differences analysis to test the incidence of the cluster creation on the share of knowledge-based firms in the 22th district -using as control group all the local areas in the metropolitan area- is positive and statistically significant in all the cases. In any case, the effect is really modest in size. These results are in line with the ones obtained by Martin *et al* (2008) which analyzed the cluster development policy in France. Additionally, it seems that the effect was bigger at the beginning but stagnated afterwards. When we take into account whether some of the benefits on the cluster creation had spilled over the boundaries of the district, the evidence seems to indicate that the positive effect of the 22@ cluster creation could come at the expense of a negative effect on the neighborhood.

After seeing that the results of the cluster policy seemed really modest, the second objective of the paper has been to test if the cluster amenities are determinant for the location of the knowledge-based. With data about new firms creation we have estimated the attractiveness of some location factors related to the existence of a cluster –the location economies and the marshallian external economies- for different firms characteristics. The results indicate that the location economies are a significant location factor for the knowledge-based firms. On the opposite, the three types of the marshallian externalities (input externalities, labor pooling and knowledge spillovers) seem not to be determinant for the location of firms inside the district.

To understand the modest evidence obtained in both analyses it has to be taken into account several aspects of the empirical approach. First, the analyzed period could be short enough to better gather the effects of a cluster creation in a district. In fact, we only have five years (for

the first analysis) and seven years (for the second) after the local project started. Due that the project was complicated perhaps we need a longer period to better evaluate the effect of the cluster creation. Second, we are analyzing the attractive location for new firms of a very small area (the 22th district) located inside a big city and its metropolitan area. That means that it could be difficult to separate the attractiveness of the district of the one of the city or the rest of the metropolitan area when a firm decides to locate inside the district. The geographical area of reference could be bigger than the one we have considered. And finally, as Duranton (2009) pointed out, when we try to measure the cluster creation effect we have to be very careful attending to the industrial aggregation we use. In our case, we use the @firms considering all the activities related to the knowledge activity (as the local plan described). But, it is important to say that inside this aggregation there are different industries that could react different to a cluster strategy.

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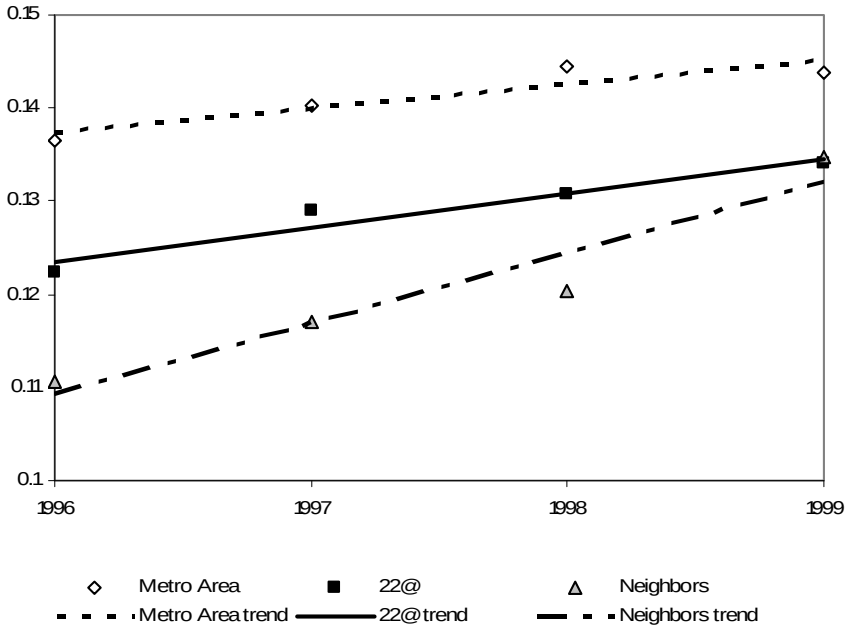
Table 1:
Descriptive statistics about firms located at Barcelona 22@ district

	1947-1994	1995-2007	TOTAL
Number of new firms	102	201	303
Mean size (workers)	19.3	41.2	33.9
HC intensity (% of high degree jobs)	26.3%	50.9%	46.2%
New firms belonging to R&D industries [b]	11,8%	23.4%	19.5%
Mean surface (m^2) of the plant	553	916	792
R&D Expenditures in 2006 (€)	131,727	306,400	259,536

Notes: (1) The date groups (1995-2000 and 2001-2007) are referred to the year in which the firm was located at 22@ (no matter their age), but the firm characteristics are from 2006
(2) Belonging to @Activities

Figure 1: *Pre-treatment trends in %@firms in treated* (22@) *and* (*potential*) *control groups* (*Metro Area and* 22@ *Neighbors*)



Notes: (1) 22@ = Barcelona's 22th district (Poblenou); Neighbors = 22@ neighbors (local areas belonging to the St. Martí district); Metro Area = all local areas belonging to Barcelona's Metropolitan Area.

Figure 2: *Predicted % @firms in the treated* (22@) *and control groups* (*Metro Area*)

Notes: (1) *% @firms* predicted on the basis of (6) of Table 2.

Table 2:
The effect of the 22@ *project on the share* of *@ firms* (%@*firms*$_{it}$)
in Barcelona's 22th *district* (*Poblenou*). *Control group: full Metro Area*

	(1)	(2)	(3)	(4)	(5)	(6)
$d22@_i \times d(year_t \geq 2000)_t$	0.011 (3.580)***	0.010 (3.041)***	0.010 (3.201)***	0.009 (2.891)***	0.016 (2.765)***	0.015 (2.552)**
$d22@_i \times d(year_t \geq 2002)_t$	--.--	--.--	-0.000 (-0.054)	-0.001 (-0.071)	--.--	--.--
$d22@_i \times d(year_t = 2000)_t$	--.--	--.--	--.--	--.--	0.010 (2.381)**	0.010 (2.411)**
$d22@_i \times d(year_t = 2001)_t$	--.--	--.--	--.--	--.--	0.014 (2.119)**	0.013 (2.331
$d22@_i \times d(year_t = 2002)_t$	--.--	--.--	--.--	--.--	0.007 (1.461)	0.008 (1.560)
$d22@_i \times d(year_t = 2003)_t$	--.--	--.--	--.--	--.--	0.007 (1.761)*	0.006 (1.889)*
$d22@_i \times d(year_t \geq 2004)_t$	--.--	--.--	--.--	--.--	0.009 (2.171)**	0.008 (2.091)**
$d22@_i \times d(year_t \geq 2005)_t$	--.--	--.--	--.--	--.--	0.017 (2.591)**	0.014 (2.341)**
Adjusted – R^2	0.952	0.986	0.958	0.986	0.960	0.988
F(*zero slopes*)	235.05 [0.000]	947.07 [0.000]	234.11 [0.000]	907.81 [0.000]	230.10 [0.000]	905.33 [0.000]
$F(\mu_i = \mu, \forall i)$	182.10 [0.000]	184.22 [0.000]	182.32 [0.000]	183.89 [0.000]	188.02 [0.000]	191.19 [0.000]
$F(\lambda_t = \lambda, \forall t)$	52.991 [0.000]	49.201 [0.000]	50.910 [0.000]	51.443 [0.000]	47.992 [0.000]	49.002 [0.000]
$F(\gamma_i t_t = 0, \forall i)$	--.--	710.33 [0.000]	--.--	690.44 [0.000])	--.--	685.44 [0.000]
$t(t_t \times d22@ = t_t)$	--.--	(0.545)	--.--	(0.511)	--.--	(0.445)
Area fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Local area trends	NO	YES	NO	YES	NO	YES
Number of obs.	820	820	820	820	820	820

Notes: (1) $d22@_i$ = 1 for Barcelona's 22th district (Poblenou) and 0 for the other local areas belonging to Barcelona's Metropolitan Area; $d(year_t \geq 2000)_t$= 1 for the years following the implementation of the 22@ project. (2) Numbers in parenthesis are t-statistics; ***, ** & * = statistically significant at the 99%, 95% and 90%; Numbers in brackets are p-values. (3) Standard errors are clustered at the Group x Year level; there are three Groups making a total of 30 clusters; one of the groups is the treated one and the other two contain the control areas (the city of Barcelona and the other local areas belonging to the Metropolitan Area of Barcelona). (4) F(*zero slopes*) = F-statistic for the joint-significance of all the variables; $F(\mu_i = \mu, \forall i)$ = F-statistic for the joint-significance of the local area fixed-effects; $F(\lambda_t = \lambda, \forall t)$= F-statistic for the joint-significance of the year fixed-effects; $F(\gamma_i t_t = 0, \forall i)$)= F-statistic for the joint-significance of the local area specific time trends; $t(t_t \times d22@ = t_t)$ = t-statistic for the equality of 22@ trend and the trend in the control group.

Table 3:
Spillover effects of the 22@ *project on the share of @ firms* (%@*firms*$_{it}$) *in a neighborhood of Barcelona's* 22th *district* (*d*W22@: *St. Andreu*): *Control group: full Metro Area*

	(1)	(2)	(3)	(4)	(5)	(6)
$d22@_i \times d(year_t \geq 2000)_t$	0.011 (5.390)***	0.010 (1.969)**	0.010 (2.887)***	0.008 (2.389)**	0.010 (5.132)**	0.010 (1.991)**
$d22@_i \times d(year_t \geq 2002)_t$	--.--	--.--	-0.000 (-0.071)	-0.003 (-0.045)	--.--	--.--
$dW22@_i \times d(year_t \geq 2000)_t$	0.032 (10.421)***	-0.022 (-0.323)	0.021 (5.690)***	-0.002 (-0.411)	--.--	--.--
$dW22@_i \times d(year_t \geq 2002)_t$	--.--	--.--	0.021 (5.690)***	-0.001 (-0.300)	--.--	--.--
$dW^N22@_i \times d(year_t \geq 2000)_t$	--.--	--.--	--.--	--.--	-0.018 (-4.981)***	-0.007 (-1.788)*
$dW^S22@_i \times d(year_t \geq 2000)_t$	--.--	--.--	--.--	--.--	0.043 (12.290)***	-0.004 (-0.744)
Adjusted – R^2	0.957	0.986	0.958	0.986	0.951	0.987
F(*zero slopes*)	226.96 [0.000]	938.28 [0.000]	234.44 [0.000]	908.85 [0.000]	227.22 [0.000]	901.12 [0.000]
$F(\mu i = \mu, \forall i)$	184.55 [0.000]	183.38 [0.000]	181.03 [0.000]	188.71 [0.000]	180.34 [0.000]	181.23 [0.000]
$F(\lambda_t = \mu, \forall t)$	58.091 [0.000]	56.291 [0.000]	54.311 [0.000]	50.023 [0.000]	48.91 [0.000]	45.56 [0.000]
$F(\gamma i t_t = \gamma t_t, \forall i)$	--.--	698.01 [0.000]	--.--	677.60 [0.000]	--.--	666.30 [0.000]
$t(t_t \times d22@ = t_t)$	--.--	(0.488)	--.--	(0.471)	--.--	--.--
$t(t_t \times dW22@ = t_t)$	--.--	(3.441)***	--.--	(3.211)***	--.--	--.--
$t(t_t \times dW^N22@ = t_t)$	--.--	--.--	--.--	--.--	--.--	(1.745)*
$t(t_t \times dW^S22@ = t_t)$	--.--	--.--	--.--	--.--	--.--	(4.551)***
Area fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Local area trends	NO	YES	NO	YES	NO	YES
Number of obs.	820	820	820	820	820	820

Notes: (1) See Table 1. (2) $dW22@_i$ = 22@ neighbors (local areas belonging to the St. Andreu district); $dW^N22@_i$ = 22@ North neighbors; $dW^S22@_i$ = 22@ North neighbors.

Table 4:
The effect of cluster location amenities on the location of firms at the Barcelona 22@ district

		Input externalities	*Labour pooling*	*Knowledge spillovers*
	Location economies	*Suppliers' proximity*	*Skilled labour*	*Innovative environment*
@Firm	0.711*	-0.024	-0.100	-0.206
	(0.395)	(0.422)	(0.450)	(0.411)
@Firm after 2000	-0.538	-0.008	0.262	0.790
	(0.503)	(0.531)	(0.550)	(0.513)
Firm size	0.001	-0.002	-0.000	0.001
	(0.001)	(0.002)	(0.001)	(0.001)
Multinational	-0.834*	-0.481	-0.339	0.752*
	(0.451)	(0.454)	(0.442)	(0.414)
Age	0.009*	0.005	0.010**	0.000
	(0.005)	(0.004)	(0.005)	(0.005)
Number of observations	289	289	289	289
Log likelihood	-390.279	-384.212	-348.250	-433.991
LR chi2(5)	9.82	4.64	5.01	8.52
Pseudo R2	0.012	0.001	0.007	0.001