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When are localization and urbanization economies important?

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When are localization and urbanization economies important? Evidence from the location of new firms^(*)

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ABSTRACT: The objective of this paper is to analyze the influence of industry characteristics on the localization and urbanization agglomeration patterns of new firm location. To this end, we analyze the location decisions of new manufacturing firms in Spain. First, for a 3-digit level, we identify for each industry which type of agglomeration economies –localization or urbanization- explain new firm's location. And second, using the coefficients obtained in these estimations for both agglomeration economies, we analyse which industry characteristics are the sources that explain differences in the strength of these economies. We focus on industry characteristics related to the three microfoundations of agglomeration that have been most prominent in the theoretical literature: labor market pooling, input sharing and knowledge spillovers. Our results point out that for industries with high influence of localization economies on their location patterns what matters is the labour market pooling mechanism. For the industries with higher effect of urbanization economies on their location patterns, knowledge spillovers and output sharing are the sources of agglomeration. The dependence of natural resources affects negatively the incidence of urbanization agglomeration economies on firm location.

Keywords: agglomeration economies, manufacturing industries, localization, urbanization,

JEL codes: L25, L60, R12, R30

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1. INTRODUCTION

The literature on agglomeration economies shows that firms enjoy positive externalities from concentration of economic activities. Many papers have shown the existence and the scope of these economies (see Rosenthal and Strange (2003) for a review of this literature). A common classification distinguishes between localization and urbanization agglomeration economies. Localization economies are those benefits for a firm derived from the presence of firms belonging to the same industry in an area. Urbanization economies are those benefits obtained by a firm arising from the size of an area and the diversity of its economy.

There is a long tradition of papers analysing the incidence of both types of agglomeration economies on firm performance. A first approach analyse the incidence of both economies on firms' productivity. Carlino (1979) is the first article that distinguished between localization and urbanization economies. He found that both types of agglomeration economies influence positively, and in a few cases negatively (agglomeration diseconomies), firm productivity; the effects were different depending on the industry. Later on the papers of Sveikaukas *et al* (1996) or Ciccone (2002) improved the empirical approach and obtained similar results. More recently, other studies confirm this evidence. Some good examples are the ones of Graham (2009), Broesma and Oosterhaven (2009), Graham et al (2010) or Fu and Hong (2010)¹. In the most recent papers there is an important methodological concern about the correction of reverse causality problem as an issue that has to be solved. Complementary to this first research line, other studies focused on the relation between location and employment growth and the existence of both types of agglomeration economies (localization and urbanization). The results of the seminal works of Glaeser et al (1992) and Henderson et al (1995) conclude that there is a clear influence of both economies on employment location and its growth. More recently, other papers confirm this evidence. La Fountain (2005), Combes (2000), Viladecans (2004) or Figueiredo et al (2009), for the French, Spanish and Portuguese cases, respectively, are good examples².

An alternative empirical strategy more related to our exercise consists in quantifying the effect of localization and urbanization agglomeration economies on the location of new

¹ Melo et al (2009) do a detailed meta-analysis of the estimates of agglomeration economies on productivity.

² See Rosenthal and Strange (2004) and Beaudry and Schiffanerova (2009) for an extensive review of the empirical research on the economics of agglomeration.

firms. In such approach the firm chooses the location where they get the maximum benefits. Rosenthal and Strange (2003), Guimarães et al (2004) and Buenstorf and Klepper (2010) are studies for the U.S case. Combes (2000) and Van Soest et al (2006) analyze the French and the Dutch cases, respectively. Finally, Arauzo-Carod and Manjón (2004), Arauzo-Carod (2005) and Jofre-Monseny (2009) are analysis for the Spanish case³. In general, the results confirm the influence of localization and urbanization economies on new firm location. Compared to other approaches, analyzing new firms location has an additional advantage; The use of the count of new firms as the dependent variable helps to partially address the identification problem. From the viewpoint of an entrepreneur, location attributes are fixed at the time of the start-up and this eliminates the possibility of a simultaneity bias (Rosenthal and Strange, 2003).

Despite all this literature confirming the influence of location and urbanization economies on productivity and location of firms, as recently Puga (2010) pointed out, more empirical work is needed to understand more precisely the sources through which these agglomeration economies work. There is an emerging but limited literature that empirically analyzes the sources of agglomeration economies. Related to our approach, the main reference is the paper of Rosenthal and Strange (2001) which identifies the characteristics of an industry that determine its degree of geographical concentration, using proxies of the three agglomeration mechanisms described by Marshall (labor market pooling, input sharing and knowledge spillovers). They find that labor market pooling is the most important agglomeration mechanism at work and that knowledge spillovers also seem to contribute to industry agglomeration, but only at the local level. Other related references are Dumais et al (1997)⁴ in which the authors seek to explain industry employment growth or Ellison et al (2010) that re-define the dependent variable, making it the tendency of two industries to co-locate. Finally, Glaeser and Kerr (2009) and Jofre-Monseny et al (2011) study the location of manufacturing start-ups across cities and industries.

However, the evidence is not conclusive about which industry characteristics better explains the location or concentration of industries. Following this literature, it seems

³ Arauzo-Carod et al (2010) review the analytical framework, the methods and the results of this literature.

⁴ Dumais et al (1997) contains different analyses. Here, we refer to the one developed in Section 6; this does not appear in Dumais et al (2002), the published version of the paper.

interesting to go a step farther and to analyze more precisely which are the characteristics of an industry that determine the incidence of localization or urbanization agglomerations on their location patterns. In other words, it seems interesting to test which industry characteristics make firms more interested in locate near other firms belonging to the same industry (localization economies) and which industry characteristics make firms more interested in locate in large and more diversified areas with the presence of firms belonging to other industries (urbanization economies). Rosenthal and Strange (2001) analyzed the sources of agglomeration economies that explained concentration of firms through the industry characteristics. Alternatively, we try to determine which industry characteristics explain the tendency of firms to locate in different environments dominated for localization and /or urbanization economies.

The objective of this paper is to test the influence of industry characteristics on the localization and urbanization agglomeration patterns of new firm location. First, at a city-level and for a 3-digit level we identify for each industry which type of agglomeration economies –localization or urbanization- explain new firm’s location. The results obtained in those estimations add new evidence on the influence of both types of agglomeration economies on new firm location. Second, we use the coefficients obtained in those estimations (for the localization and urbanization variables) to analyse which industry characteristics are the sources that explain differences in the strength of these localization or urbanization coefficients. To define these characteristics, we consider the industry attributes that relate to the importance of the three agglomeration mechanisms (labor market pooling, input sharing and knowledge spillovers). Our main results point out that for industries with high influence of localization economies on their location the important source of this agglomeration pattern is the labour market pooling. Alternatively, for the industries with higher effect of urbanization economies on their location patterns, knowledge spillovers and output sharing are clear sources of agglomeration. The dependence of natural resources is a negative source of urbanization agglomeration economies.

To our knowledge this is the first paper that tries to analyze the sources of localization and urbanization agglomeration economies focusing on industry characteristics. Another contribution of this paper is that we work at a high level of disaggregation of industries when most of the evidence use two-digit level databases. At this level we have enough

information and variability to test for the incidence of agglomeration economies on firm location and to analyze the sources of these economies. Finally, our econometric approach partially address the causality problems that most of the literature has not solved.

The remainder of the paper is organised as follows. In the next section we will describe the data. In section three we analyse the effect of localization and urbanization economies on new firm location of 75 manufacturing industries. In section four we examine the role of industry characteristics in explaining the localization and urbanization parameters. We describe the variables created to capture the industry characteristics, the empirical strategy and we report and discuss the results. Finally, the last section presents the concluding remarks.

2. The data

Previous empirical analyzes have concluded that the strength of agglomeration economies depends on the geographical level of analysis⁵. The general evidence show that small geographical units of analysis are the best units to test for the existence and scope of agglomeration economies. For that reason, we follow a city-level approach. We proxy the Spanish cities as the local labor market units⁶. Despite having 806 cities for the whole country, we select the ones that have more than 10.000 inhabitants. We work with 477 cities, which represent the 95% of the whole Spanish population and employment in 2001.

At the industry level we work with the three-digit level of the 1993 National Classification of Economic Activities (NACE 93 Rev.1). A sufficient level of disaggregation of industries is a key aspect in this type of research. At this level we have enough information and variability to test for the incidence of agglomeration economies on firm location. We work with 75 three-digit manufacturing industries. Industries with less than 15 new firms and those which are labelled as “others” are not considered. The pre-established employment levels are the underlying explanatory variables in the new firm location model. We use the

⁵ See Rosenthal and Strange (2004) for a review.

⁶ The cities we use were built by Boix and Galleto (2009) by aggregating municipalities to obtain self-contained local labor markets. There were 8,108 municipalities in Spain in 2001. The municipalities are political and administrative units. We exclude the municipalities of the regions of Ceuta and Melilla (the two Spanish enclaves in North Africa)

employment to measure the localization and urbanization economies. The dataset is obtained from the 2001 Census of Establishments carried out by the National Statistics Institute (INE). From this source data we know the employment level in each city at the three-digit industry level.

[INSERT TABLE 1 HERE]

The dependent variable in the model of firm location choice is the number of new firms. Data for new manufacturing firms are drawn from the Bureau van Dijk SABI database. Firm-level information is available including the location and the industry to which they belong. The information of the SABI dataset (the Spanish/Portuguese version of the Amadeus dataset) comes from the annual accounts of more than 1,5 million of Spanish firms. Although this database does not contain all Spanish firms, its coverage level is very high. For 2002, comparing this dataset with the INSS dataset (National Social Security Register, the Spanish administrative official dataset), on average the coverage of the SABI data is 80%. We take the manufacturing firms that started-up in the years 2002, 2003 and 2004. In this three-year period, 17,600 new manufacturing firms were created in Spain.

In Table 1 we summarize the pattern of new firm creation in Spanish cities. We report the maximum and the average count of new firms per industry and city for the five industries with most creations, the median industry in terms of creations, and the five industries with fewest creations. The industry *Manufacture of structural metal products* (NACE 281) created around 2,200 new firms during this period, which represents the 15.6% of the total amount of new firms. This industry is followed in the ranking by *Printing and service activities related to printing* (NACE 222) and the *Manufacture of furniture* (NACE 361) industries, which represent the 8.3% and the 7.9% of the new firms, respectively. The figure reported in the last column of the table is the share of cities with zero births in the industry and reflects the geographical concentration of the new firm creation along the Spanish geography. As an example, for the industries *Manufactures of insulated wire and cable* (NACE 313), *Manufactures of leather clothed* (NACE 181) and *Manufactures of sport goods* (NACE 364) around 97% of the Spanish cities do not have any new firm created in the whole period.

3. New firm location and agglomeration economies

We formalize the firm creation process using the random profit function approach (Carlton 1983). A linearized expected profit function can be written as:

$$\pi_{kic} = \beta_{loc} \cdot (L_{ic}) + \beta_{urb} \cdot (L_{-ic}) + x_{ic}' \gamma + \varepsilon_{kic} \quad (1)$$

where π_{kic} denotes the firm's k profit in geographical unit c in manufacturing industry i . This profit level is determined by localization economies (agglomeration of own industry firms in a geographical unit) and urbanization economies (overall agglomeration in a geographical unit). Employment in the own industry in the area, L_{ic} , is used in the literature to proxy localization economies. The common proxy used to reflect the economic dimension of the area has been total employment, L_{-ic} ⁷. Let x_{ic} be a set of variables added to control for other location determinants. These factors are beyond agglomeration mechanisms, and they can influence the choice of a firm of being located in a certain area. ε_{kic} is unobservable and varies across firms and locations.

In practice, it is impossible to observe π_{kic} (Ellison and Glaeser, 1997). If we assume an i.i.d. Weibull distribution on ε_{kic} we obtain a conditional logit (CL) model (see Carlton, 1983). Unfortunately, it has two problems. The estimation of the CL model cannot deal with very large sets choice. Second, it cannot deal with information from locations that do not experience any new firms. However, Guimarães *et al.* (2003) have shown that these two problems do not longer bind given that the CL coefficients can be equivalently estimated using exponential mean Poisson regression.

Following Guimarães *et al.* (2003), we define the dependent variable as the number of new firms in each industry that choose a particular city c as its location. Following Rosenthal and Strange (2003) we measure the dependent variable some period ahead to avoid simultaneity. To interpret the results as elasticities, we measure the variables in logs⁸. The first econometric specification we consider is (one for each industry i):

⁷ Nakamura (1985) and Henderson (1986) first used employment in the industry as a proxy for localization economies and the total employment in the city for the urbanization economies.

⁸ We follow Crépon and Duguet (1997) when transforming variables with zero values into logarithms. We create a dummy variable that takes the value of one if employment is zero in a given municipality and year. We sum this dummy variable to the employment level and take the log of this sum. Additionally, we include separately this dummy variable as a separate regressor.

$$E(N_{ic,t+1}) = \exp(\beta_{loc,i} \ln(L_{ic,t}) + \beta_{urb,i} \ln(L_{-ic,t}) + \gamma \ln(land_c) + a_r) \quad (2)$$

The dependent variable $N_{ic,t+1}$ is the number of new firms in the industry i and location c . The variables $L_{ic,t}$ and $L_{-ic,t}$ are covering agglomeration economies. The employment in industry i in area c is used to identify localization economies ($L_{ic,t}$ attracts industry i 's new firms into geographical unit c). In particular, β_{loc} measures the elasticity of new firms to own industry employment. The rest of the employment in the geographical unit c is used to identify urbanization economies and β_{urb} measures the elasticity of new firms to whole industry employment excluding the own industry employment. Regressions include *regional fixed effects* (a_r) and the control variable *land*⁹. *Land* controls for the size of area c in squared kilometres (in logs). We follow Bartik (1985) who emphasizes the idea that geographical units with more available land are more likely to be chosen. The *regional fixed effects* are included to control for location determinants that are common to all locations within a region such as the market potential (in terms of consumers), the regional policy or the remoteness of an area. This amounts to control for the spatial correlation that ε_{is} may suffer across nearby geographical units. In a way, the regional fixed effects are controlling for the shared observable and unobservable characteristics that attach new firms to different areas within a region. We estimate equation 2 for each one of the 75 industries. That means we obtain 75 $\hat{\beta}_{loc}$ and 75 $\hat{\beta}_{urb}$ coefficients.

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[INSERT TABLE 2 HERE]

A summary of the results for the 75 estimations –one for each manufacturing industry- is presented in Table 2. The first column (Model I), presents the results for the estimates of equation 2 when only including as explanatory variable the localization economies; the second column includes the results when the explanatory variable is the urbanization economies variable (Model II); the third column presents the results when both variables are included (Model III). Finally, the last column (model IV) presents the results when all the explanatory variables are included (localization and urbanization economies, control variables and regional fixed effects). In Models I and II we obtain significant coefficients

⁹ Regions comprehend NUTS2 units in the city level analysis. There are 17 regions in Spain.

for the localization and urbanization economies for all the 75 manufacturing industries. In Model III for some estimations, the $\hat{\beta}_{loc}$ and the $\hat{\beta}_{urb}$ coefficients are not significant. The mean coefficient value decreases from Model I to Model III. Our preferred model is Model IV, because it has the highest explanatory capacity and it includes the control variables and the fixed effects. We obtain 75 $\hat{\beta}_{loc}$ parameters, 77% of which are statistically significant. In summary, the mean value of these parameters is 0.475, the maxim value is 1.143, the minim value is 0.185 and the variance is 0.114. On the other hand, we obtain 75 $\hat{\beta}_{urb}$ parameters, 73% of which are statistically significant. These coefficients have a mean value of 0.426, a maxim value of 1.570, a minim value of -0.306 and a variance of 0.181. All the coefficients and their standard deviation are reported in the Annex (Table A1). Additionally, Graphs 1 and 2 illustrate the significant elasticities for both variables, respectively.

It is interesting to look more in detail the manufacturing industries with higher or smaller incidence of localization or urbanization economies when deciding the location of new firms. For the localization economies, the top 5 manufacturing industries with the highest coefficients are: *Manufacturing of jewellery and related articles* (NACE 362), *Manufactures of games and toys* (NACE 365), *Manufacture of footwear* (NACE 193), *Preparation and spinning of textile fibres* (NACE 171) and *Manufacture of knitted and crocheted articles* (NACE 177). The industries with the smallest incidence of localization economies on the location of new firms are *Manufacture of bodies for motor vehicles, manufacture of trailers and semi-trailers* (NACE 342), *Manufacture of builder's carpentry and joinery* (NACE 203), *Manufacture of machinery for the production and use of mechanical power* (NACE 291), *Casting of metals* (NACE 275) and *Manufacture of basic chemicals* (NACE 241). For 17 manufacturing industries the localization economies variable is not significant. Among them we find industries like *Manufactures of pulp, paper and paper board* (NACE 181) or *Manufactures of cement, lime and plaster* (NACE 265) in a sense both very dependent of natural resources; and other industries like *Manufactures of instruments and appliances of measuring* (NACE332) or *Manufacturing of electric motors* (NACE 311) classified as technologically advanced industries. In fact, twelve over the these seventeen industries are classified as intermediate or advanced manufacturing industries.

On the other hand, for the urbanization economies, the industries that obtain the highest estimated coefficients are *Manufacture of sports goods* (NACE 364), *Manufacture of electric motors*,

generators and transformers (NACE 311), *Reproduction of recorded media* (NACE 223), *Manufacture of instruments and appliances for measuring* (NACE 332) and *Manufacture of motor vehicles* (NACE 341). For four manufacturing industries we obtain negative coefficients, what means that urbanization diseconomies affect the location of new firms belonging to these activities. These industries are *Manufactures of footwear* (NACE 193), *Manufactures of beverages* (NACE 159), *Production, processing and preserving of meat and meat products* (NACE 151) and *Manufacture of agricultural and forestry machinery* (NACE 293). For 20 manufacturing industries urbanization economies do not influence the location of their new firms. Among them we find industries like *Manufacture of ceramic tiles* (NACE 263), *Manufacture of processing and preserving fish* (NACE 152) or *Manufactures of grain mill products* (NACE 156), all of them related to the proximity of natural resources. But at the same time, we find in this group industries with high influence of localization economies on their location like *Manufacturing of jewellery and related articles* (NACE 362), *Manufactures of games and toys* (NACE 365), *Manufacture of furniture* (NACE 361) or *Preparation and spinning of textile fibres* (NACE 171) and that have no influence of urbanization economies.

These results are in line with what the empirical literature has evidenced for the last twenty years. First, the results confirm the importance of agglomeration economies on the location of new firms. Second, the results show that for most of the industries, firm's location decisions are influenced simultaneously for localization and urbanization economies going beyond the debate focussed only on the dichotomy between both types of agglomeration economies (Duranton and Puga, 2001). And third, localization economies seem to be the ones that provide best favourable conditions for the location of traditional (or less technological intensive) industries. Some of the articles that confirm this evidence are the ones of Henderson et al (1995) Boardsell and Henderson (1999), Roosenthal and Strange (2003), Viladecans (2004), Arauzo-Carod (2005) or Jofre-Monseny (2009).

4. The role of industry characteristics in explaining the sources of localization and urbanization economies

After estimating the influence of localization and urbanization economies on the location of new manufacturing firms, our interest is to find the influence of industry characteristics on the localization and urbanization agglomeration patterns of new firm location. With this

objective, we regress the estimates of the localization economies' coefficients (the $\hat{\beta}_{loc}$'s) and the urbanization economies coefficients (the $\hat{\beta}_{urb}$'s) on the variables that measure industry characteristics. We will test if industries with high localization and/or high urbanization economies are industries that: 1) have workers with industry specific skills (labor market pooling), 2) are intensive in the use of manufactured inputs (input sharing), and/or 3) are intensive in the use of knowledge (knowledge spillovers). In that way, we will be able to assess which industry characteristics are more relevant to explain why firms prefer to locate where there is more presence of firms within the same industry (localization economies) or where in large and diversified environments (urbanization economies).

4.1 Labour market pooling

A first approach describing the labour market pooling mechanism considers that if workers have skills that are industry-specific, the incentives for firms and employees in the same industry to locate near to each other in space are stronger. Some empirical papers have tested this labor pooling mechanism with the hypothesis that firms and employees in a large and specialized local labor market are in a better position when faced with a firm specific shock. As an example, Fallick *et al* (2006) demonstrate that the mobility between workers in specialized areas is higher than elsewhere and Overman and Duranton (2010) find that industries with more risk tend also to concentrate in some areas. On the other hand, a second approach of the labor market pooling advantage is related to the idea that agglomeration economies allow better matching between firms and workers. Costa and Khan (2000) agree that large cities favors matching and Andersson *et al* (2007) conclude that in dense areas there is better matching. So it is not clear whether labour pooling could be a source of localization economies, urbanization economies or both.

Our strategy is, thus, to create a proxy which measures how specific in terms of skills are the workers of each industry. We do so by computing a measure of occupational dissimilarity between an industry and the rest of the economy. The use of workers' occupations can turn out to be a meaningful perspective when approaching the differences

among the industry-specific skills¹⁰. To capture the specificity of each job in terms of skills, we look at the three-digit level of the 1994 National Classifications of Occupations (CNO 94). We use the second quarter of the Spanish 2001 and 2005 Labor Force Survey (EPA).

We use the Duncan and Duncan (1955) dissimilarity index. Our variable *Labor market specificity* compares the occupational structure (o) of each industry (i) with the rest of the economy ($-i$).

$$Labor\ market\ specificity_i = \frac{1}{2} \sum_o \left| \frac{L_{oi}}{L_i} - \frac{L_{o-i}}{L_{-i}} \right| \quad (3)$$

This variable goes from zero to one. The more different is the occupational structure, the more specific is the industry in terms of workers skills (and the closer to one will be the index). That is to say, a value of one means that all employees should change occupations within the industry in order that industry i replicates the occupational structure of the economy. Table 3 describes the variables measuring industries' attributes. The manufacturing industry which workers are more industry specific is 'Manufacture of furniture' (NACE 361). 'Manufacture of machinery for the production and use of mechanical power' (NACE 291) has the least specific occupational structure, so it means that this industry does not demand industry-specific skills.

4.2 Input sharing

The input sharing theory claims that firms are more efficient when they are placed close to input suppliers since they can save on transport costs. This second theory suggests that those industries highly dependent on manufactured inputs will be located where there are more firms, so in agglomerated areas. Good empirical examples are the works of Holmes and Stevens (2002) or Li and Lu (2009) which corroborate the relevance of the input sharing theory by proving that co-localization of firms reduces transportation costs in purchasing inputs and selling outputs.

¹⁰ Currid and Stolarick (2010) stress the relevance of an occupational analysis in explaining firm location choices.

To quantify the industry supplier, we look at the 2001 Catalan Input-Output Table from the Statistical Institute of Catalonia (IDESCAT)¹¹. We use this regional table instead of the Spanish one because it is more disaggregated (the Catalan Input-Output table has 54 manufacturing industries whereas the Spanish table that only has 32 industries). We assume that relationships among and within industries in Spain are the same to those in Catalonia. Following Holmes (1999) and Rosenthal and Strange (2001), we construct a variable that measures input intensity of each industry. To do that, we divide purchased manufactured inputs by sales for each manufacturing industry. *Manufactured inputs per € of sales* is the ratio of the manufactured inputs purchased to total sales of the industry. This variable measures the relative importance of manufactured inputs for the industry. Table 3 shows that the ‘Manufacture of knitted and crocheted articles industry’ (NACE 177) is the one with a highest dependence on manufactured inputs (0.547). The ‘Manufacture of dairy products industry’ (NACE 155) is the least dependent (0.112). Following the literature, to measure the input sharing mechanism, some authors also introduce the output sharing (Glaser and Kerr (2009) and Ellison et al (2010)). The idea is to control for the customer relationships of each industry. The variable in this case is *Manufactured outputs per € of sales* and is obtained dividing the purchased manufactured outputs by sales for each manufacturing industry. This variable measures the relative importance of manufactured outputs for the industry.

4.3 Knowledge spillovers

Finally, the third agglomeration mechanism considered by Marshall (1920) is that geographical proximity facilitates the transmission of knowledge (*knowledge spillovers*). The last Marshall’s mechanism claims that firms will locate in the territory next to each other in order to share knowledge, even if they belong to different industries. There are two complementary empirical research lines that try to test for the role knowledge spillovers. First, one line relates city growth with innovation. The idea is very well illustrated in the “nursery of cities” of Duranton and Puga (2001) and has been tested from different perspectives (Jaffe *et al* (1993) or Carlino *et al* (2007) are good examples). Second, some empirical papers relate city growth and skills. Glaeser and Ressenager (2010) admit a strong complementarity between cities, skills and learning. These knowledge spillovers are more

¹¹ Catalonia is a big region in the north-east of Spain. In 2001 the population of Catalonia represented the 15.5% of the Spanish population, 17.5% of its overall employment and 24% of its manufacturing employment.

difficult to measure than labor pooling or trade in goods since there are no explicit flows of knowledge among industries. However, these flows are intangible, and there have been different strategies to measure knowledge spillovers in the literature (see Rosenthal and Strange, 2004). We assume that knowledge spillovers are more important in more knowledge intensive industries. That is to say, the ones with higher human capital needs. We measure it by the share of workers in an industry with a degree. We use the Spanish 2001 and 2005 Labor Force Survey (EPA) to compute this variable. This database contains information on the educational level achieved by each worker in each industry. The variable *knowledge intensity* is the share of graduates in each manufacturing industry. Table 3 shows that Publishing (NACE 221) has the largest share of skilled workers (0.474).

4.4 First nature agglomeration factors

The literature has highlighted that natural advantages affect the location of economic activities (Ellison and Glaeser, 1999). Firms may prefer one location because of the abundance of a specific natural resource or the availability of cheap energy. Following Rosenthal and Strange (2001), in order to control for first nature agglomeration factors, we create two control variables *Natural resources inputs per € of sales* and *Energy inputs per € of sales*. They are created using the 2001 Catalan Input-Output Table. *Natural resources inputs per € of sales* is the ratio of natural resources inputs purchased from the primary industries to total sales. *Energy inputs per € of sales* is the same ratio but with energy inputs purchased to the energetic industries. These two variables are also described in Table 3. ‘Production, processing and preserving of meat and meat products’ (NACE 151) and ‘Manufacture of cement, lime and plaster’ (NACE 265) are the more intensive industries in natural resources and energy, respectively. ‘Manufacture of parts and accessories for motor vehicles and their engines’ (NACE 343) and ‘Manufacture of office machinery and computers’ (NACE 300) are the manufacturing industries that are less dependent on natural resources and energy, respectively.

4.5 The empirical estimation

Hence, the estimated equation is:

$$\hat{\beta} = \alpha + \beta_{LMP} \cdot Labor_i + \beta_{IS} \cdot Input_i + \beta_{KS} \cdot Knowledge_i + \beta_{NR} \cdot Natural_i + \beta_E \cdot Energy_i + \varepsilon_i \quad (4)$$

where $Labor_i$ is the variable *Labor market specificity*, $Input_i$ is the variable *Manufactured inputs per € of sales* and $Knowledge_i$ is the variable *Knowledge intensity*, which capture agglomeration factors through the industry characteristics. $Natural_i$ and $Energy_i$ correspond to *Natural resources inputs per € of sales* and *Energy inputs per € of sales*, respectively, the first nature agglomeration factors. We estimate equation 4 for two different dependent variables: the $\hat{\beta}_{loc}$ and the $\hat{\beta}_{urb}$ coefficients obtained from the estimation of equation 2 (Model IV). This methodology is similar to the one that developed by Rosenthal and Strange (2001) trying to explain the determinants of industry concentration.

We use the 75 estimated coefficients obtained both for the $\hat{\beta}_{loc}$ and the $\hat{\beta}_{urb}$ variables in the 75 estimated equations. In some of the cases, the coefficients are not significant so we estimate equation (4) with the **weight least squares method**.

AMPLIAR: explicar com s'ha fet WLS.

In Tables 3 and 4 we report the results that we obtain when we regress the estimates of the localization economies' coefficients (the $\hat{\beta}_{loc}$'s) and the urbanization economies (the $\hat{\beta}_{urb}$'s) on the proxies that measure the industry characteristics as the sources of agglomeration economies.

[INSERT TABLES 3 AND 4 HERE]

We estimate six different models. The first three are bivariate regressions. In Model IV we include the four variables for the different agglomeration theories at the same time. Model V adds the variables that control for the industry natural resources and energy intensity. As a robustness check, in Model VI we add the variable *Average firm size* calculated as the quotient between the number of employees over the number of firms for each industry. With this variable we control for industry characteristics related to the size of firms of an industry that could affect the results. The results do not change with the inclusion of this variable.

When using the localization economies as the dependent variable (Table 4), the results for the variable *Labor market specificity* shows a significant positive result in all the specifications. This evidence means that, *ceteris paribus*, the more specific (dissimilar to the rest) the occupations in an industry are, the more the firms within this industry locate next to each other. The effect is quantitatively large. For the Model VI, which has the highest explanatory capacity, if the standard deviation of the labor market specificity variable increases in one unit, the expected localization economies' estimate increases in 1.710 standard deviations. On the opposite, the estimated coefficients for the variables *Manufacturing outputs per € of sales* and *Knowledge intensity* are negative and significant. This means that the industries that value the localization economies in their firm location, have

.....

The first nature variables do not result significant.

For the urbanization economies estimations (Table 5)

.....

5. CONCLUSIONS

- 1) resumir principals resultats fent ènfasi en loc i urb
- 2) explicar com sectors amb diferents caract perceben les econo d'aglome loc I urb de forma different. Exemples?
- 3) Policy lligar resultats amb la política de promoció de clusters (referències US i UE) poasant en dubte que tingui sentit

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Table 1: New firms in Spain. Years 2002-2004. 75 three-digit manufacturing industries

Industry	New firms	New firms (%)	Mean	Cities with zero births (%)
<i>The five industries with the highest number of new firms</i>				
(281) Manufacture of structural metal products	2,188	15.65%	4.58	26.21%
(222) Printing and service activities related to printing	1,159	8.29%	2.43	61.64%
(361) Manufacture of furniture	1,108	7.92%	2.32	49.06%
(221) Publishing	971	6.94%	2.04	73.38%
(182) Manufacture of other wearing apparel and accessories	593	4.24%	1.24	69.81%
<i>Median</i>				
(192) Manuf. of luggage, handbags and the like, saddler and harness	73	0.52%	0.15	94.76%
<i>The five industries with the lowest number of new firms</i>				
(341) Manuf. of motor vehicles	19	0.14%	0.04	96.86%
(156) Manufac. of grain mill products, starches and starch products	18	0.13%	0.38	96.44%
(364) Manuf. of sports goods	17	0.12%	0.36	97.90%
(181) Manuf. of leather clothes	16	0.11%	0.34	97.48%
(313) Manuf. of insulated wire and cable	16	0.11%	0.34	97.69%

Notes: (1) NACE code in parenthesis.

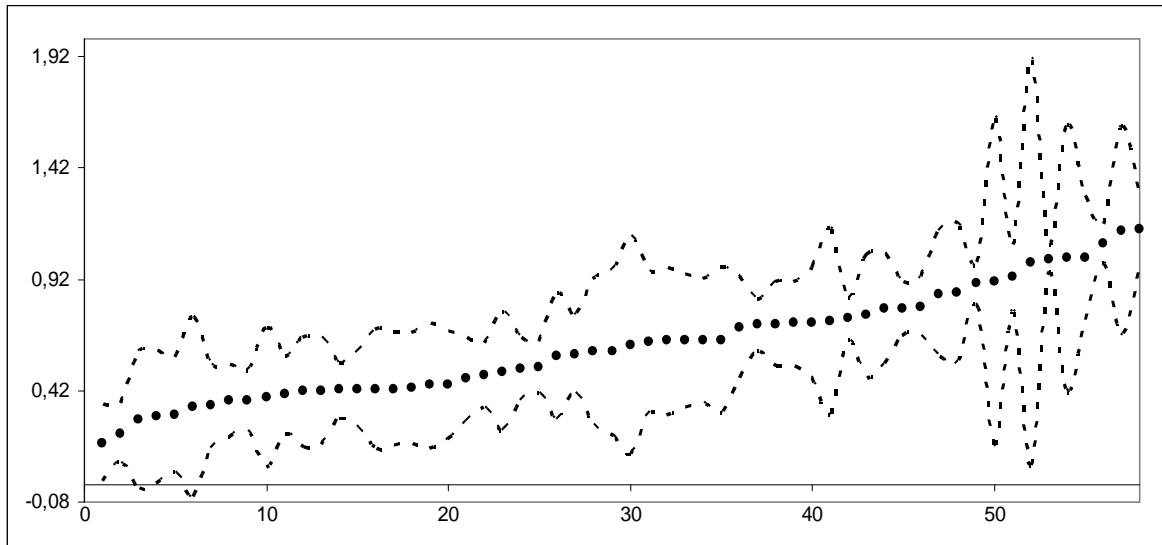
Source: Bureau van Dijk Electronic Publishing (SABI).

Table 2: Agglomeration economies and new firm location. Poisson estimates
The dependent variable is the count of new firms created by industry and city.

	I	II	III	IV
Localization economies (β_{LOC})	0.774 (75)	---	0.511 (67)	0.475 (58)
Urbanization economies (β_{URB})	---	0.928 (75)	0.360 (64)	0.426 (55)
Distribution of β_{LOC}				
Min	0.433	---	0.105	0,185
Max	1.087	---	1.206	1,143
Distribution of β_{URB}				
Min	---	0.348	-0.244	-0,306
Max	---	1.456	1.204	1,570
Distribution of R^2				
Mean	0.448	0.386	0.492	0.551
Min	0.140	0.028	0.177	0.229
Max	0.896	0.888	0.898	0.909
Control variables	No	No	No	Yes
Regional fixed effects	No	No	No	Yes
N° Observations	477	477	477	477

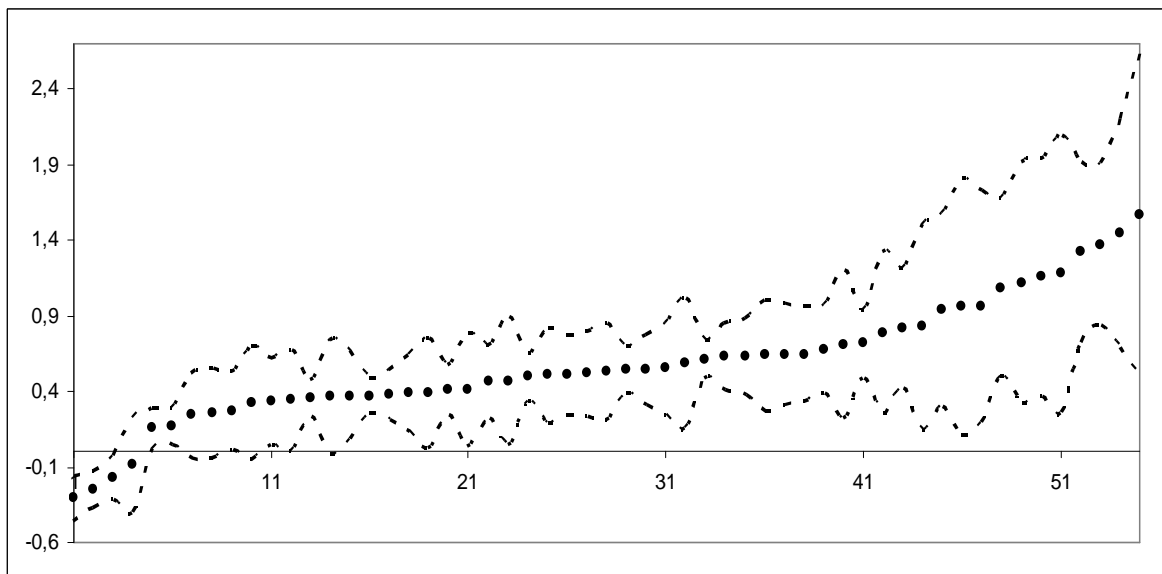
Notes: (1) The coefficients for the localization and urbanization economies (first and second rows of the table) are the mean of the coefficients obtained for the 75 estimations. (2) Figures within parenthesis are the number of industries for which the coefficient is significant.

Graph 1: Localization elasticities



Notes: The dots in the Graph are the significant coefficients of the localization economies variable in the estimation of Model IV (58 manufacturing industries) ranked from the smaller to the higher. The dotted lines are the confidence range for each estimated coefficient.

Graph 2. Urbanization elasticities



Notes: The dots in the Graph are the significant coefficients of the urbanization economies variable in the estimation of Model IV (55 manufacturing industries) ranked from the smaller to the higher. The dotted lines are the confidence range for each estimated coefficient.

Table 3. Summary of the industry-characteristics variables. 75 three-digit level industries

	Mean	Median	S.d	Max.	Min.
Labor market specificity	0.370	0.367 Processing and preserving of fruit and vegetables (NACE 153)	0.467	0.492 Manufacture of furniture (NACE 361)	0.286 Manufacture of machinery for the production and use of mechanical power (NACE 291)
Manufactured inputs per € of sales	0.305	0.307 Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials (NACE 205)	0.103	0.547 Manufacture of knitted and crocheted articles (NACE 177)	0.112 Manufacture of dairy products (NACE 155)
Knowledge intensity	0.126	0.097 Manufacture of ceramic tiles and flags (NACE 263)	0.950	0.474 Publishing (NACE 221)	0.000 Manufacture of leather clothes (NACE 181)
Natural resources inputs per € of sales	0.034	0.001 Manufacture of games and toys (NACE 365)	0.073	0.406 Production, processing and preserving of meat and meat products (NACE 151)	0 Manufacture of parts and accessories for motor vehicles and their engines (NACE 343)
Energy inputs per € of sales	0.008	0.005 Manufacture of beverages (NACE 159)	0.009	0.055 Manufacture of cement, lime and plaster (NACE 265)	0.001 Manufacture of office machinery and computers (NACE 300)

Table 4. Localization economies from industry characteristics. City level analysis. WLS

	I	II	III	IV	V	VI
Agglomeration mechanisms:						
Labour market specificity	2.272*** (0.753)			1.546* (0.784)	1.793** (0.829)	1.709** (0.829)
Manuf. inputs per € of sales		-0.090 (0.342)		-0.918 (0.325)	-0.002 (0.353)	-0.055 (0.357)
Manuf. outputs per € of sales		-0.698*** (0.232)		-0.474** (0.202)	-0.429* (0.220)	-0.408* (0.225)
Knowledge intensity			-1.066** (0.466)	-0.778** (0.323)	-0.747** (0.343)	-0.631* (0.360)
First nature variables:						
Natural resource inputs per € of sales					0.379 (0.346)	0.303 (0.340)
Energy inputs per € of sales					-0.319 (3.133)	-0.681 (3.105)
Control variables:						
Average firm size						-0.001 (0.000)
N° Observations	75	75	75	75	75	75
R-squared	0.183	0.116	0.083	0.264	0.274	0.292
F	9.115***	4.522***	5.234***	5.024***	4.093***	3.656***

Notes: 1) Weighted least squares estimations.; 2) Robust standard errors ???; 3) ***, ** and * statistically significant at 1, 5 and 10%;

Table 5. Urbanization economies from industry characteristics. City level analysis. WLS

	I	II	III	IV	V	VI
Agglomeration mechanisms:						
Labor market specificity	-1.126 (0.919)			0.032 (0.945)	-0.747 (1.007)	-1.532 (1.038)
Manufactured inputs per € of sales		0.354 (0.342)		0.339 (0.346)	0.127 (0.368)	0.385 (0.390)
Manufactured outputs per € of sales		0.732*** (0.257)		0.719*** (0.248)	0.651** (0.263)	0.643** (0.267)
Knowledge intensity			1.495*** (0.549)	1.468*** (0.4979)	1.341** (0.503)	1.313** (0.544)
First nature variables:						
Natural resource inputs per € of sales					-0.864** (0.399)	-0.845* (0.419)
Energy inputs per € of sales					-3.670 (4.293)	-3.571 (4.370)
Control variables:						
Average firm size						0.001 (0.001)
N° Observations	75	75	75	75	75	75
R-squared	0.031	0.095	0.110	0.201	0.255	0.256
F	1.501**	4.152***	7.404***	5.446***	5.829***	5.094***

Notes: 1) Weighted least squares estimations.; 2) Robust standard errors ???; 3) ***, ** and * statistically significant at 1, 5 and 10%;

Annex:

Table A1: β_{loc} and β_{urb} coefficients for estimations for Model IV (Table 1)

Manufacturing Industries		β_{LOC}		β_{URB}	
151	Production, processing and preserving of meat and meat products	0.797***	(0.066)	-0.172**	(0.071)
152	Processing and preserving of fish and fish products	0.856***	(0.141)	0.173	(0.200)
153	Processing and preserving of fruit and vegetables	0.473***	(0.096)	0.273**	(0.131)
154	Manufacture of vegetable and animal oils and fats	0.791***	(0.124)	0.119	(0.125)
155	Manufacture of dairy products	0.419***	(0.122)	0.257*	(0.150)
156	Manufacture of grain mill products, starches and starch products	0.908**	(0.371)	0.279	(0.298)
157	Manufacture of prepared animal feeds	0.731***	(0.210)	0.344**	(0.168)
159	Manufacture of beverages	0.800***	(0.048)	-0.246***	(0.060)
171	Preparation and spinning of textile fibres	1.016***	(0.139)	0.0301	(0.143)
172	Textile weaving	0.425***	(0.086)	0.546***	(0.115)
173	Finishing of textiles	0.586***	(0.088)	0.468***	(0.122)
176	Manufacture of knitted and crocheted fabrics	0.861***	(0.158)	0.0906	(0.156)
177	Manufacture of knitted and crocheted articles	1.015***	(0.301)	0.240	(0.253)
181	Manufacture of leather clothes	0.0645	(0.389)	0.961**	(0.422)
182	Manufacture of other wearing apparel and accessories	0.791***	(0.061)	0.357***	(0.062)
183	Dressing and dyeing of fur; manufacture of articles of fur	0.646***	(0.139)	0.338**	(0.144)
192	Manufacture of luggage, handbags and the like, saddlery and harness	0.931***	(0.073)	0.243*	(0.140)
193	Manufacture of footwear	1.082***	(0.042)	-0.306***	(0.073)
201	Sawmilling and planing of wood; impregnation of wood	0.418***	(0.123)	0.634***	(0.110)
202	Manuf. of veneer sheets; manufacture of plywood, laminboard, ...	0.429***	(0.126)	0.391**	(0.180)
203	Manufacture of builders' carpentry and joinery	0.229***	(0.066)	0.614***	(0.064)
204	Manufacture of wooden containers	0.446***	(0.121)	0.390***	(0.125)
205	Manuf. of other products of wood; manufacture of articles of cork, ...	0.375***	(0.068)	0.545***	(0.077)
211	Manufacture of pulp, paper and paperboard	0.149	(0.148)	0.647***	(0.166)
212	Manufacture of articles of paper and paperboard	0.725***	(0.124)	0.372**	(0.145)
221	Publishing	0.645***	(0.150)	0.471**	(0.211)
222	Printing and service activities related to printing	0.401***	(0.086)	0.719***	(0.113)
223	Reproduction of recorded media	-0.147	(0.272)	1.374***	(0.267)
241	Manufacture of basic chemicals	0.310**	(0.128)	0.647***	(0.157)
243	Manuf. of paints, varnishes and similar coatings, printing ink ...	0.217	(0.174)	0.711***	(0.244)
244	Manuf. of pharmaceuticals, medicinal chemicals and botanical products	0.291	(0.282)	0.738	(0.448)
245	Manuf. of soap and detergents, cleaning and polishing preparations, ...	0.428***	(0.134)	0.638***	(0.183)
251	Manufacture of rubber products	0.393**	(0.157)	0.817***	(0.199)
252	Manufacture of plastic products	0.715***	(0.060)	0.156**	(0.070)
261	Manufacture of glass and glass products	0.351***	(0.095)	0.517***	(0.138)
262	Manuf. of non-refractory ceramic goods other than for construction, ...	0.723***	(0.095)	-0.0440	(0.119)
263	Manufacture of ceramic tiles and flags	0.703***	(0.115)	-0.118	(0.193)
264	Manufacture of bricks, tiles and construction products, in baked clay	0.573***	(0.143)	0.0434	(0.200)
265	Manufacture of cement, lime and plaster	0.0504	(0.201)	0.791***	(0.265)
266	Manufacture of articles of concrete, plaster and cement	0.374***	(0.081)	0.375***	(0.082)
267	Cutting, shaping and finishing of stone	0.743***	(0.049)	0.171***	(0.062)
268	Manufacture of other non-metallic mineral products	0.347*	(0.202)	0.286	(0.205)
271	Manufacture of basic iron and steel and of ferro-alloys	0.163	(0.113)	0.681***	(0.148)
272	Manufacture of tubes	0.559	(0.342)	0.403	(0.354)
274	Manufacture of basic precious and non-ferrous metals	0.595***	(0.164)	0.363*	(0.190)
275	Casting of metals	0.303**	(0.149)	0.413**	(0.185)
281	Manufacture of structural metal products	0.525***	(0.057)	0.373***	(0.059)
282	Manuf. of tanks, reservoirs and containers of metal; central heating, ...	0.505***	(0.134)	0.551***	(0.150)
284	Forging, pressing, stamping and roll forming of metal, ...	0.444***	(0.140)	0.533***	(0.161)
285	Treatment and coating of metals; general mechanical engineering	0.518***	(0.070)	0.412***	(0.085)
286	Manufacture of cutlery, tools and general hardware	0.433***	(0.125)	0.507***	(0.155)
287	Manufacture of other fabricated metal products	0.423***	(0.062)	0.495***	(0.078)
291	Manuf. of machinery for the production and use of mechanical power	0.289*	(0.153)	0.590***	(0.216)
293	Manufacture of agricultural and forestry machinery	0.639***	(0.160)	-0.0837	(0.157)
294	Manufacture of machine-tools	0.596***	(0.187)	0.326*	(0.186)
295	Manufacture of other special purpose machinery	0.720***	(0.095)	0.107	(0.116)
297	Manufacture of domestic appliances n.e.c.	0.0393	(0.216)	0.941***	(0.320)
300	Manufacture of office machinery and computers	0.171	(0.228)	1.087***	(0.295)
311	Manufacture of electric motors, generators and transformers	-0.0568	(0.292)	1.446***	(0.377)
312	Manufacture of electricity distribution and control apparatus	0.0859	(0.287)	0.965**	(0.386)
313	Manufacture of insulated wire and cable	0.102	(0.248)	1.117***	(0.399)
315	Manufacture of lighting equipment and electric lamps	0.646***	(0.165)	0.261	(0.228)
321	Manuf. of electronic valves and tubes and other electronic components	0.625**	(0.246)	0.825**	(0.339)
322	Manuf. of TV radio transmitters and apparatus for line telephony, ...	0.999**	(0.457)	0.527	(0.579)
331	Manuf. of medical and surgical equipment and orthopedic appliances	0.157	(0.288)	1.156***	(0.395)
332	Manuf. of instr. and appliances for measuring, checking, testing, ...	0.247	(0.203)	1.321***	(0.300)

Notes: (1) Figures in parenthesis are robust standard errors. (2) Statistical significance reported by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.