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Regional Distribution of Foreign Manufacturing Investment in Spain Do agglomeration economies matter?

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REGIONAL DISTRIBUTION OF FOREIGN MANUFACTURING INVESTMENT IN SPAIN DO AGGLOMERATION ECONOMIES MATTER? [a]

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ABSTRACT: This paper examines the locational determinants of foreign direct investment (FDI) in manufacturing activities in the regions of Spain, with particular attention to agglomeration factors, and the effect of these determinants on three separate industries. The analysis reveals that agglomeration economies are significant determinants of the regional distribution of manufacturing FDI, and that the nature and importance of locational determinants vary according to the specific needs of each industry.

Key Words: Foreign direct investment, agglomeration economies, regional manufacturing location.

JEL Classification: R12, F21, F23

RESUMEN: El trabajo estudia los determinantes locacionales, con especial énfasis en los factores de aglomeración, de la inversión manufacturera directa en las regiones españolas, así como también en tres industrias específicas. El análisis revela que las economías de aglomeración constituyen determinantes significativos de la distribución regional de la inversión directa manufacturera, y que la naturaleza e importancia de los factores locacionales varía de acuerdo con las necesidades de cada industria.

Key Words: Inversión directa extranjera, economías de aglomeración, localización de manufactura regional.

Códigos JEL: R12, F21, F23

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Introduction

Globalization, in particular the increasing international economic integration brought about primarily by new technology, the reduction in transport costs and the easing of trade barriers, and the liberalization of an increasing number of economic sectors, underlies the restructuring of international production.

Multinational firms, key figures in foreign direct investment (FDI), lie at the heart of this globalization process. In Spain, FDI has played an important role in the development and modernization of the country's economy (Iranzo, 1991; Martínez Serrano & Miro, 1992; Merino and Salas, 1995; Martín & Velázquez, 1996a). Indeed, such investment is a critical complement to national capital, technology and know-how, and it has been highly influential in the country's economic and social environment.

Spain experienced a rapid growth in FDI following its 1986 entry into the European Community. The country is an active recipient in the world flow of FDI, doubling its participation from 3.7% in the period 1981-1986 to 7% in 1991 (OECD, 1991). Whereas, at the beginning of the seventies, FDI accounted for approximately 2% of gross fixed capital formation, twenty years later, at the beginning of the nineties, the figure was 9%. Spain, thus, shifted membership from the group of countries in which the incidence of FDI on gross fixed capital formation was low to the group in which the incidence could be considered high.

At the end of the nineties, there was a marked surge in FDI within Spain, with percentage increases of over 100% being recorded in 1999 and 2000 in both Effective Gross FDI[1] and Net FDI. This trend was favored by new legislation that offered fiscal advantages for foreign investment in holdings of foreign assets. The participation of such operations in the Effective Gross FDI increased from just 5% in 1998 to 42% in 1999, and to 63% in 2002. Yet, even if we were to ignore these operations, the Effective Gross FDI still grew 30% during the period 1998-2002 (Ministry of Economy, 2002). However, these figures are often masked by the rush of Spanish direct investment out of the country. Indeed the latter overtook FDI within Spain in 1997 and peaked in 2000 at 56,7 billion (10^9) euros to 39,4 billion euros of Effective FDI within Spain[2].

Between 1992 and 2000, Spain's cumulative FDI inflows were the seventh highest in the EU. In 2001, the country rose to sixth place behind the United Kingdom, the Netherlands, Benelux, France and Germany (OECD, 2002). The significance of this standing is considerable given that two of these countries (Netherlands and Benelux) are well-established locations for foreign investment due to their fiscal incentives. Looking at future trends, the UNCTAD World Investment Report (2002) predicts that Spain will be the fifth most popular EU location for transnational corporation investment in the period 2002-2005.

To date, few studies of locational determinants have examined the variables of new economic geography, and even fewer studies have examined the locational determinants of FDI in Spain at the regional and industrial level[3]. Therefore, the aim of this paper is to examine the nature and determinants of FDI in the regions of Spain, paying particular attention to agglomeration factors. The paper focuses on manufacturing investment as, until the mid-eighties, this constituted the bulk of FDI and, as such, has been a key factor in the country's economic transformation over the last 35 years. The analysis examines three industrial sectors - food and beverages, chemicals and transport equipment - in order to test the hypothesis that the importance of locational determinants varies according to the needs of a specific industry. These three manufacturing industries accounted for 51 percent of all foreign manufacturing investment in the period 1993-2000[4]. Their 1993 CNAE (National Classification of Economic Activities) numbers are: 15 for food and beverages, 24 for chemicals, 34 & 35 for transport equipment.

In a previous study Pelegrín (2002) undertook an empirical study of the more traditional determinants of regional FDI (including costs and access to markets) and reported a high geographical concentration of FDI, suggesting that agglomeration economies are crucial location factors. This study, therefore, examines a number of these agglomeration variables in order to test whether they are indeed decisive location factors in the regions of Spain.

The article is divided into four sections. The next section examines the locational determinants of FDI. The second section discusses these variables and reviews the literature on regional location factors. The third section describes the database and the

econometric methodology and reports the empirical results. The final section offers a summary and draws conclusions.

1. Locational determinants

In the literature on the determinants of multinational activity, Dunning's "Eclectic Paradigm" provides perhaps the best overall approach. Eclectic theory suggests that an enterprise's FDI is determined by three types of potential advantage: ownership-location-internalization (OLI) advantages (Dunning, 1981). In other words, FDI is determined, first, by the extent to which the enterprise possesses net ownership advantages (Hymer, 1960; Kidleberger, 1969; Caves, 1971); second, the extent to which it is able to internalize these advantages or, on the contrary, must leave them for other enterprises to exploit (Buckley & Casson, 1976); and, third, the profitability of locating its production units either at home or abroad (Vernon, 1966).

As the main objective of this paper is to identify the regional factors that attract FDI, our focus is on locational determinants. But while FDI theory discusses why firms invest abroad[5], it has little to say about how or why a particular location within the host nation is chosen. The factors determining a firm's location comprise all the characteristics of its home territory that give the firm comparative advantages, including factor endowments (capital and labor) and natural resources. A further group of characteristics includes the role of external economies, i.e. increasing returns external to the firm but internal to the territory, in the location of economic activity. Marshall's contribution at the end of the XIX century was pioneering in this respect. He identified three types of external economies that generate agglomeration (geographical concentration): specialized labor, specific inputs and technological spillovers.

The geographical concentration of an industry generates a specialized and qualified labor market that is beneficial to the interests of firms and workers alike. For firms, being able to call on a low cost, qualified labor supply within the same territory constitutes an external economy; for workers, the concentration of firms within the same sector signifies a reduction in uncertainty as the risk of unemployment is not so great. At the same time, the existence of a large, local market creates a cluster of

specialized input suppliers. Market size is clearly a fundamental factor in the appearance of specialized firms operating in complementary activities, which generate productive relationships between the firms. Such linkages will either be oriented to output (forward linkages) or to input requirements (backward linkages). Finally, technological spillovers, derived from knowledge and information about the innovations produced in the area, benefit all firms located in the same territory.

Marshall's ideas, combined with more recent contributions, have seen different approaches being taken to the study of agglomerations. Krugman (1991), for example, believes that technological spillovers are invisible and leave no trace, and so are difficult to quantify. He accepts that while technological spillovers might play an important role in industrial concentration, they are no more important than such factors as labor or other inputs. In the neoclassical model, resources are not considered to be mobile but, as there are no transport costs for goods, industrial location is determined by the comparative advantage derived from the country/region factor and technological endowments. However, for Krugman transactions do incur costs and scale economies do exist. Thus, as scale economies give firms an incentive to concentrate production in a limited number of locations, the places preferred will be those where demand is highest and the convenience of input supply is maximized. As a result, several firms will tend to choose the same location. Consequently, it is the interaction between transport costs, scale economies and demand that determines spatial location.

Audretsch (1998) centers his attention on technological spillovers and identifies the way in which knowledge spillovers promote a location's innovative activity and economic growth. He demonstrates that cultural differences between regions can contribute to differences in their innovative activity, which might be further influenced by the underlying structure of each region, i.e. the degree of diversity versus the degree of specialization, and the degree of monopoly versus the degree of local competition.

The approach typified in new economic geography is based, in part, on Marshall's ideas, but it draws also on other common elements such as increasing returns, transport and congestion costs and market access. As these elements interact, industry will either agglomerate or become dispersed in space depending on whether the resulting forces are centripetal or centrifugal respectively.

Fujita, Krugman and Venables (1999) identify the main centripetal forces leading to spatial agglomeration as: 1) linkages: forward linkages (output orientation) and backward linkages (input requirements), 2) the existence of thick markets and, 3) knowledge spillovers. Similarly, they identify the main centrifugal forces as: 1) immobile factors, frequently land and labor (international cases) and, 2) congestion diseconomies. In a world in which transport costs and increasing returns are of growing importance, forward and backward linkages can generate a process of agglomeration whereby producers wish to locate near their suppliers and customers and, therefore, near to one another. However, the immobility of certain resources and congestion costs can act as a powerful centrifugal force leading to the dispersal of firms in space. It is this tension between centripetal and centrifugal forces that ultimately determines the economic geography.

How does all this affect FDI in Spain? There is no doubt that an intensive process of spatial concentration occurred in the regional distribution of FDI during the nineties. In the period 1998-2000, the regions of Madrid and Catalonia received 80% of total FDI while Madrid, Catalonia, the Basque Country and the Canaries together received 90%.

In dynamic terms, a comparison of the periods 1998-2000 and 1986-1988 (López and Mella, 1990) reveals major changes in the regional level of concentration[6]. Madrid increased its concentration by 70%, while Catalonia lost over 50% (Pelegrín, 2002). This process of concentration in Madrid reflects the firms' own decision-making processes, but also the recent tendency to locate near the main policy institutions with which foreign firms must deal, such as the regulatory commissions for telecommunications, transport, energy and banking. Indeed, foreign firms often decide to establish their headquarters in Madrid as it is the country's capital.

A similar pattern of concentration can be observed in FDI in the country's manufacturing sector. Madrid and Catalonia receive more than 70% of manufacturing investment and, in common with total FDI, there is a recent (1998-2000) tendency towards concentration in Madrid, which accounts for about 40%. Catalonia, the region that has traditionally attracted most foreign direct investment in manufacturing, lies second with about 30%.

A possible explanation for this concentration in the two regions is that, unlike domestic investors, foreign investors face substantial asymmetry of information. A rational response to the cost of information and business uncertainty is to locate in specific areas where the cost of information can be minimized. This means that the assets of foreign firms tend to be more concentrated than those of the local firms. From the mid-1990s on, information has become increasingly more important in the decisions of multinationals when choosing a location in a host economy (Mariotti & Priscitello, 1995; He, 2002). He (2002) identifies several regions in which information costs are low: a) economic centers where communication infrastructure, administrative institutions and business services are readily accessible for FDI, b) coastal regions that are open to international markets, c) areas with previous foreign investment, where information can be transmitted through business relationships to new foreign investors, and d) cities implementing policies that encourage foreign investment.

2. Variables influencing the location decisions of manufacturing foreign investment

Studies of the variables influencing the location decisions of manufacturing foreign investment have been hindered by the failure to develop, to date, a structural model of FDI determinants that can identify which of these factors might be considered pivotal and should therefore be included in any further analysis. Researchers have had to rely on empirical studies that offer only certain insights into the variables and the way that they behave and interact.

Empirical studies of multinational locational choices at the regional level have mainly examined entry into U.S. markets (Luger & Shetty, 1985; Coughlin et al., 1991; Woodward, 1992; Friedman, 1992 and 1996; Head et al., 1999). Following Carlton (1983) and Bartik's (1985) approach to branch plant location, most of these studies use discrete choice models to analyze new-investment decisions.

Similarly, a number of studies have examined the locational determinants of FDI within Europe. Scaperlanda and Balough (1983) analyzed the locational determinants of US investment in the EEC; Culem (1988) studied bilateral FDI flows between the USA and

five European countries; Yamawaki (1991) and Thiran and Yamawaki (1995) focused on Japanese FDI in European countries and regions. Hill and Munday (1991 & 1992) sought to identify FDI determinants in the United Kingdom, as did Mariotti & Pricitello (1995) in Italy, Guimaraes et al. (2000) in Portugal, López & Mella (1990), Egea & López Pueyo (1991b), and Pelegrín (2002) in Spain. With the exception of Guimaraes et al. (2000), who adopted a discrete choice model approach for new plant investment, the other studies employed a multiple regression or panel data approach, using all forms of FDI, not just greenfield investment, as their dependent variable.

The dependent variable

FDI involves the ownership and control of productive physical assets by foreign residents or firms[7]. Yet, as Hill & Munday (1992) point out, problems of definition have increased due to the growth in cross-border technical, licensing and production-sharing agreements, as well as in management contracts, in which the nature of control and ownership becomes blurred.

The measurement of a region's inward investment is not easy. In Spain, foreign investment data broken down by regional destination is provided by the Department of Trade and Investment. Royal Decree 664/1999 introduced modifications concerning foreign investment, which in turn affected the availability of FDI statistics in Spain. The decree ruled that potential projects were no longer subject to advance verification or authorization, but rather firms had now to declare foreign income to the Register of Investment (Ministry of Economy) once it had been invested[8]. The Department of Trade and Investment's information is drawn from this Register. These changes mean that the information is now much more reliable as all foreign investments are registered (not just foreign investments subject to verification or authorization). An investment must be registered within a month of its having been made.

In July (2003), the Department of Trade and Investment presented a new series of statistics, one of them was the “gross effective foreign investment” (see note one), which is the nearest proxy to FDI for the period 1993-2000. The variable is expressed per capita and in real terms[9].

To improve the analysis, we ran a second regression using gross effective foreign investment in the food and beverages industry, a third one for the chemical industry, and a fourth one for the transport equipment industry. The results were then compared to determine whether there were any significant differences in the location determinants of these industries.

Independent variables

The independent variables can be divided into three groups: first, the so-called traditional determinants, i.e. access to markets and labor; second, variables related to agglomeration economies in their broadest sense, including manufacturing and service agglomerations, population density and the concentration of R&D activities; and, third, variables introduced by government policy, such as incentives, taxes and regulation policies.

Here, we focus our attention on the first two groups, since the taxes that might affect FDI have either a national application, as is the case of corporate income tax, or a regional/local application, in which case the information is incomplete and unreliable.

In the case of incentives a number of studies have reported that these policies positively affect the choice of location in US states (Couglin et al., 1991, Friedman et al., 1992), in the British regions (Hill and Munday, 1992). In Woodward (1992), state industrial promotion is measured through an index (similar, in fact, to that used by Luger & Shetty, 1985), but any findings were inconclusive. Here, in the case of Spain, this variable could not be considered as no reliable regional information was available.

Traditional variables

The variables related to market demand, including size and growth rate, have traditionally been considered critical determinants in host countries, and are frequently included in studies of FDI location. These variables acquire particular importance in developed areas, in areas where trade barriers are being eliminated and in the integration of markets (Hood and Young, 1979). Their significance and value are expected to correlate positively with FDI.

The most frequently used variable as a proxy of market demand is regional income (GDP) (Scapelanda & Baloug, 1983; Culem, 1988; Head et al., 1999; Woodward, 1992; Thiran & Yamawaki, 1995; Mariotty & Priscitello, 1995; Martín & Velázquez, 1996b). All these studies reported a positive and significant correlation between the regional market and FDI.

In the case of Spain, empirical studies have similarly found a positive and significant correlation between GDP and FDI, though most were conducted at the sector level (Bajo, 1991; Bajo & Sosvilla, 1992; Martínez Serrano & Miro, 1992; Egea & López-Pueyo, 1991a). Bajo-Rubio & López-Pueyo (2002) tested the market size of each industry, using the yearly percentage growth of their domestic markets, approximated by the apparent consumption for each industry, and obtained a positive and significant correlation. Regionally, Egea & López-Pueyo (1991b) used the regional per capita GPD and found a positive relationship with FDI, employing a cluster analysis.

However, some studies suggest that the explanatory power of this variable tends to be lower at the local level, because it is unlikely that the market served by the foreign firm will coincide with the boundaries of the region under consideration, given the ease of access to neighboring zones (Mariotty & Priscitello, 1995; Guimaraes et al., 2000).

Similarly, Head et al. (1999) measured a state's market potential by adding another variable to its personal income, i.e. the personal income of adjacent states, and obtained positive results. Mariotty & Priscitello (1995) used two proxies: per capita consumption and the growth rate of consumption. Coughlin et al. (1991) suggest a further variable that might serve as a proxy for market demand, namely, manufacturing density. The authors point out that states with a higher degree of manufacturing activity might attract foreign investors who are already serving existing manufacturers in the area.

Here, we use personal income at regional level, in constant terms, as a proxy for market demand. However, as manufacturing density is included within the agglomeration variables, we use this variable as an additional proxy of market demand.

The labor market is described by two variables: labor costs and the quality of the labor force. Imperfect labor markets and poor labor mobility can lead to differences in real

labor costs (Hood & Young, 1979). When technology levels and product quality are standardized, and cost is the priority, production may be transferred to another area with lower labor costs (Vernon, 1966). Thus, labor costs can act as a deterrent to FDI (Bartik, 1985; Luger & Shetty, 1985; Hill and Munday, 1991; Coughlin et al., 1991).

However, elsewhere, labor costs would appear to have a significant positive correlation with FDI (Bajo 1991; Head et al., 1999; Thiran & Yamawaki, 1995; Guimaraes et al., 2000). In these studies, it seems that labor costs reflect the availability of skilled workers in the region, acting as a proxy for qualifications and skills. Finally, in a number of studies (Hill & Munday, 1992; Friedman et al., 1992; Woodward, 1992; He, 2002; Bajo & López-Pueyo, 2002) labor costs appear to have no significant effect on FDI. Thus, the empirical evidence is somewhat inconclusive.

The variables most frequently used as a proxy for industrial labor costs are manufacturing wages, earnings and unit labor costs. Here, two proxy variables for labor costs are used: a) the regional value of industrial wages[10] per employee, in real terms, and b) unit labor cost measured by the ratio of industrial wages to labor productivity (value added per employee), in real terms. However, the best results were obtained using the former.

In our study of the different industrial sectors, the proxy used is the regional value of wages per employee in each industry (food and beverages, chemicals and transport equipment industry), in real terms.

The other labor variable to take into consideration is the quality of the labor force. The availability of a skilled labor force, or skilled human capital, is important in attracting FDI, especially in manufacturing activities, and more specifically when this investment is made in technology-intensive activities of medium to high demand. Porter (1988) claims that multinational firms attach greater value to the existence of labor with a good knowledge level than to a cheap labor market, which makes it a relevant labor market characteristic of FDI in developed regions.

This variable is generally expected to have a positive correlation with FDI. Woodward (1992) reports that Japanese investors favor counties with a high level of educational attainment. In Spain, Egéa & López-Pueyo (1991b) reported higher knowledge levels

among the population in those regions receiving more FDI. Similarly, Martín & Velázquez (1996b) found a positive and significant correlation between human capital and FDI among OECD countries.

However, for Bartik (1985), the level of educational attainment of the population, measured as the median number of years of schooling, seemed to have a significant negative effect. The author attributes this to the negative effect of wages on FDI location, captured by the educational variable, which acts as an exogenous determinant of wages.

Here, we use two proxy variables for human capital: the percentage of the labor force having completed secondary schooling and the percentage of the labor supply having completed higher education.

Agglomeration variables

As discussed above, one determinant of location is the existence of agglomeration economies, or external economies, resulting from the geographical concentration of economic activity. Hoover (1936) identifies two major types of agglomeration economies: first, location economies, or externalities derived from industry-specific location, obtained when firms in the same industry share a pool of skilled labor and specialized input suppliers, so that there are economies external to the firm but internal to the industry; and, second, urbanization economies, in which the economies are external to the industry, but internal to the territory, and so benefit all the firms in the area. In this second case, the economies are generally related to the concentration of services (professional, banking and communication services, and the provision of scientific and technological assets) in urban areas.

Driffield & Munday (2000) explore the dynamic relationship between inward investment, agglomeration, improvements in the comparative advantages of industry and their role as determinants in the location of FDI by using two models and adopting a panel-type approach. In the first model, they test the significant positive effect of inward foreign investment and agglomeration economies on an industry's competitive advantage. Then, in the second model, they test the significant positive effect of an

industry's competitive advantage, as well as other specific characteristics (primarily, research and development and market access), as determinants of FDI. The authors conclude that previous FDI and agglomeration are determinants of an industry's competitive advantage, and that these factors, along with research and development and market access, determine new foreign investment.

Little empirical evidence exists to demonstrate the effects of agglomeration on FDI. This paper sets out to test four types of agglomeration economies and discusses some of the research conducted to date. Manufacturing agglomerations are the most general in nature and the most frequently studied. The presence of existing manufacturing activity in a region, with its large cluster of consumers and suppliers, has often been considered a significant factor in attracting firms whose demand for specialized labor and other inputs is low, but which seek to locate in areas with a strong industrial heritage (Bartik, 1985; Luger & Shetty, 1985; Coughlin et al., 1991; Woodward, 1992; Guimaraes et al., 2000; He, 2002).

A number of proxies have been used to measure manufacturing density. Head et al. (1999), Woodward (1992) and He (2002) use the existing number of manufacturing establishments, while Coughlin et al. (1991) and Guimaraes et al. (2000) use manufacturing employment rates per square mile and per square kilometer respectively. Bartik (1985) uses the number of manufacturing hours per square mile in a state and Luger & Shetty (1985) use the total number of annual production man hours. Here, we choose to use the manufacturing employment rate per square kilometer. However, a number of authors (Head et al., 1999 and Guimaraes et al., 2000) consider this measure to be somewhat crude since the variable should be, at least in part, industry-specific, especially when it is the only variable being used to calculate agglomeration economies.

The second type of economies are industry-specific agglomerations. As mentioned above, locating a firm in an area in which there is a high concentration of enterprises from the same industry can be beneficial as specialized inputs of labor, raw materials and intermediate goods are more readily available. This increases the efficiency of production and generates strong forward and backward linkages in an area.

Here, in our specific industry study, the proxies for this external economy are the three variables: food and beverage agglomeration, chemical agglomeration and transport equipment agglomeration, calculated as the share of regional industrial employment in the sectors of food and beverages, chemicals and transport equipment respectively (Guimaraes et al., 2000).

The third type of agglomeration are urbanization economies as defined by Hoover, 1936 (see above). As a proxy for these economies, Guimaraes et al. (2000) use service agglomerations, calculated as the share of total employment in tertiary sectors. These authors reported a positive and significant correlation with the location of FDI.

A further variable used as a proxy for urbanization economies is population density. Luger & Shetty (1985) and He (2002) consider that a high population density acts as a centripetal force and report a positive and significant effect on foreign investment. However, Woodward (1992) found the coefficient not to be statistically significant. Indeed, population density might act as a centrifugal force, reflecting a congestion diseconomy, with land prices serving as a proxy. This variable was applied by Bartik (1985) and Guimaraes et al. (2000). The former, reported a non-significant negative correlation, while the latter found a positive and statistically significant relationship.

Given these two potential interpretations of population density, we tested another variable: the regional share of total, or national, population. However, the correlation between both variables was 0.9, with the best results being obtained with population density.

Here, the proxies adopted for urbanization economies are service agglomeration, measured as the share of total employment in the tertiary sector, and population density.

The fourth type of agglomeration economies are technological activities (R&D). The emergence of intellectual capital as a key strategic asset in the wealth creation process is one of the most significant changes over the last two decades. The result has been a progressive shift in the location needs of enterprises, from traditional requirements, such as access to markets and natural resources, to the need to have access to knowledge-intensive assets so as to enhance a firm's ownership advantages (Dunning, 1998).

Just as geographic proximity is significant in transmitting knowledge (Audretsch, 1998), location in an area of scientific and technological assets ensures access to spillovers of economic knowledge. The regional promotion of knowledge spillovers and how they operate is subject to various interpretations. One model, known as MAR externalities - from the approaches of Marshall (1920), Arrow (1962) and Romer (1986), assumes that most learning and knowledge spillovers take place within a particular industry. The concentration of the industry promotes knowledge spillovers among firms thereby facilitating innovative activity. An important assumption of the model is that knowledge externalities only exist for firms in the same industry. Therefore, while the relevant unit of analysis can be extended from the firm to the region, spillovers are limited to a particular industry (Audretsch,1998).

By contrast, Jacobs (1969) argues that the most significant knowledge spillovers are external to the industry in which the firm operates. This exchange of complementary knowledge across a range of firms and economic agents forms the basis of innovation. Furthermore, cities are an important source of knowledge externalities because typically the diversity of their knowledge sources is that much greater. Jacobs claims that the more varied the industries in a region, the greater will be the generation of knowledge spillovers, innovative activity and economic growth.

In the context of this debate, it is unclear as to whether technological agglomerations should be considered location economies, as argued by Marshall, Arrow and Romer, or urbanization economies, as argued by Jacobs.

Knowledge is an important source of ownership advantage for multinationals investing in foreign regions and countries, and so R&D spending may not represent a barrier to foreign firms (Driffield & Munday, 2000). On the contrary, it may be an attraction. As a proxy for this variable we used two regional data sources: the number of patents, as a measure of innovative output; and a firm's internal expenditure on research and development activities, assumed to be a key input in generating new knowledge. As the correlation between the two variables was 0.9, we selected a firm's R&D expenditure, primarily because the data series were longer and more homogeneous, and because the variable values are more accurately allocated to the region in which the expenditure

occurs, rather than to the Spanish headquarters in Madrid. This variable is expressed as a relative magnitude, divided by regional GDP, and in constant terms.

Finally, we introduced two dummies - the effects of location in the capital city and information costs - for the two regions attracting most FDI, i.e. Madrid and Catalonia. The dummy for the Madrid region includes all the determinants not taken into consideration above, such as the tendency to locate a firm's headquarters in the capital because of Madrid's administrative and political importance and the minimization of information costs due to previous FDI. Similarly, the dummy for Catalonia also minimizes information costs due to previous FDI as, up until the last decade, the region attracted the most manufacturing FDI. Moreover, Catalonia has a large coastline, with major ports, and is traditionally more open to international transactions. The presence of foreign investors in these two regions has a marked effect on other investors, thereby reducing their information costs (Dunning, 1998) and contributing to positive agglomeration economies.

3. Empirical results

The methodology used was to calculate the coefficients of regression of the dependent variable, effective FDI in manufacturing activities, against the independent variables, using a panel data of 136 observations for an eight-year period (1993-2000) in 17 regions. The panel data was estimated by considering an individual effect non-observed for each region. Once the non-existence of the correlation between the individual effects and the independent variables had been tested by running a Hausman test, a random effect model was used and more efficient estimations made using the generalized least squares (GLS) method. Finally, estimation by ordinary least squares (OLS) was run to introduce the two dummies so as to measure the effects of location in the capital city and information costs.

A log-linear functional form was adopted to transform the relationship between FDI and the explanatory variables into a linear relationship. The regression model took the following form, in which i denotes regions and t denotes time, β are vectors of

regression coefficients, α_i and μ_{it} are regional random effects, time invariant, and error term time varying.

$$\text{Log FDI}_{it} = \beta + \beta_1 \text{LogDemand} + \beta_2 \text{LogWage} + \beta_3 \text{LogEducation} + \beta_4 \text{LogManufacturing Aggl.} + \beta_5 \text{LogService Aggl.} + \beta_6 \text{LogPopulationDensity} + \beta_5 \text{LogR\&D} + \alpha_i + \mu_{it} \quad (1)$$

The empirical results obtained from the regressions are shown in Tables 2 and 3 (see Appendix)**.** Table 2 shows the results for the total manufacturing FDI analysis, and Table 3 shows the results for the specific industries analysis: food and beverages, chemicals and transport equipment.

Table 2 includes the regression results for the dependent variable, manufacturing FDI, following function 1. Estimations in columns 1, 2 and 3 were obtained by generalized least squares (GLS), and estimation in number 4 by ordinary least squares (OLS) having introduced the dummies for Madrid and Catalonia.

An analysis of the correlation matrix for the variables (see Table 4, Appendix) shows the existence of a close correlation between four of the variables: demand (GDP), manufacturing agglomeration, education and R&D activities. These results are not surprising: Coughlin et al. (1991) suggested that manufacturing agglomeration was a good proxy for market demand, Head et al. (1999) found a correlation between demand (GDP) and manufacturing agglomeration of 0.9, and Mariotti & Priscitello (1995) recorded a strong correlation between the metropolitan areas of Milan and Rome and R&D, wages and market. Furthermore, the areas with a high level of manufacturing agglomeration and GDP are those with the most R&D activities and the highest levels of education.

To solve this problem, GDP was eliminated from the regression analysis and manufacturing agglomeration was used as a proxy of demand instead. Better results were obtained as a consequence and the estimation improved. Subsequently, each specification was used for just one of the correlated variables. Thus, the manufacturing agglomeration variable was introduced in specification number 1, the education variable in number 2, and the R&D variable in specification number 3. The panel of 136

observations explains 67% of foreign manufacturing investment in specification number 1, 64% in number 2, and 63% in specification number 3.

Specification number 1 shows that manufacturing agglomeration and industrial wage present a significant and positive correlation. By contrast, population density presents a significant but negative correlation, while service agglomeration is negative but not statistically significant.

Specification number 2 excludes manufacturing agglomeration from the results of the analysis but includes higher education, which, together with wages, presents a positive and significant correlation, indicating that higher education entails higher wages.

Specification number 3 includes R&D activities which present a positive and significant correlation, while industrial wages retain a positive and significant result.

Manufacturing agglomeration is found to be a significant variable in most of the studies discussed up to this point, indicating that a major factor in the choice of location selection is the existing activity in the manufacturing sector. The regional concentration of industry increases comparative advantage at the aggregate industry level (Driffield & Munday, 2000). In addition, existing manufacturing activity may reflect the demand variable (GDP), which was omitted here due to its 0.9 correlation with this variable. Thus, the existing level of manufacturing activity seems to attract manufacturing FDI to locations near existing manufacturers and near new potential consumers.

Population density presented a negative value, but this was only statistically significant when manufacturing agglomeration was included in the regression. This, as Bartik (1985) points out, probably reflects congestion costs. Manufacturing investment was, therefore, more strongly attracted to locations of comparatively low population density, such as Catalonia, Asturias, Valencia, Navarra or Andalucía, which together accounted for around 50% of all manufacturing FDI during the period 1993-2000.

Industrial wages presented a positive and significant value, which suggests that investment is attracted to high wage locations. This would seem to be because investment is attracted by other labor characteristics, such as quality, and probably

reflects the availability of skilled workers in the region. The latter can therefore be said to act as a proxy for quality of labor, as in the studies conducted by Bajo 1991; Head et al., 1999; Thiran & Yamawaki, 1995; and Guimaraes et al., 2000. This empirical result is consistent with the descriptive analysis: the areas that attracted more FDI per capita during the period of analysis are the same areas that recorded higher levels of wages per worker, as well as higher rates of education (Madrid, Catalonia and the Basque Country).

The spatial concentration of technology facilities enhances productivity growth, because knowledge spillovers occur more readily. The R&D variable is, therefore, highly significant (see, for example, Yamawaki et al., 1993 and Driffield & Munday, 2000). Dunning (1998) claims that a recent, significant change in the reasons underlying FDI is the growth in strategic asset-seeking FDI[11], aimed at protecting or increasing the ownership advantage of the investing firm, rather than at exploiting this advantage as is the case of traditional FDI. Thus, the location preferences of firms have shifted towards more innovative activities, confined mainly to developed countries, and which are characterized by a greater geographical concentration than other kinds of activity.

Finally, service agglomeration was not statistically significant, while its negative value would appear to indicate that the three regions with the highest service agglomeration (Madrid, Balearics and Canary Islands) did not reach 41% of effective FDI in manufacturing.

Specification number four, the last specification, involves an estimation of manufacturing FDI by pooled least squares in order to test the effects of Madrid being the capital, as well as other effects not specified in the explanatory variables, and which can be broadly summarized as information costs for Madrid and Catalonia. As Table 2 shows, the variables of Madrid and Catalonia present positive and significant values, indicating that there are unobserved advantages, such as the effect of Madrid being the country's capital and the prior accumulation of FDI in Madrid and Catalonia, which attract FDI to these regions[12]. They might also reflect the existence of public incentives; a variable that was not included as an explanatory factor as reliable information was unavailable. However, it would seem that these dummies do not reflect transport infrastructure[13].

Thus, in the case of FDI in manufacturing activities, centripetal forces, such as the agglomeration of manufacturing activity, the high density of innovation activities and the concentration of higher level education, are more important locational determinants than are centrifugal forces, such as population density, which is a reflection of congestion costs.

The empirical results obtained from the regression analyses for the specific industrial sector analysis are shown in Table 3. The results for the dependent variable, manufacturing FDI, in the food and beverages industry are in column 1; those for the chemical industry are in column 2, while the results for transport equipment are in column 3. All estimations were obtained by generalized least squares (GLS).

The results in column 1 appear to show that the food and beverages industry is only sensitive to labor costs. This industry shuns location economies, given that food and beverage agglomeration is negative and statistically significant. Similarly, the sector ignores urbanization economies as neither population density or service agglomeration are significant. Likewise, it is not interested in manufacturing agglomeration or in R&D activities either[14].

An inspection of these columns suggests that the food and beverages industry is mainly interested in low labor costs, but that it is not interested in lower wages in the food and beverages industry, because when the specification is run with this variable the result is not statistically significant. This, perhaps, is unsurprising as FDI is not attracted by location economies in the food and beverages industry.

A similar situation occurs with education. Thus, when the higher education variable is used, no significant results are obtained for wages; however, when secondary schooling is used as a proxy of education, then industrial wages present a negative and significant value, while secondary education is also negative and statistically significant. The latter value probably reflects the effect of industrial wages.

The results for the chemical industry are shown in Table 3, column 2. Unlike the food and beverages sector, the chemical industry is sensitive to agglomeration economies. Location economies, measured by agglomeration in chemical industries, are positive

and significant, which demonstrates the importance for industrial FDI of forward and backward linkages. As Fujita, Krugman and Venables (1999) claim, manufacturers seek to locate near their suppliers and their customers. Manufacturing agglomeration is also positive and significant. The concentration of quality labor, measured by higher education, and agglomeration of R&D activities also appear positive and significant when the model is run with these variables rather than with the manufacturing agglomeration variable. Again, this is unsurprising given the high correlation between the three variables.

Unlike the food and beverages sector, the chemical industry does not seem interested in labor costs: chemical wages, or industrial wages[15]. Urbanization economies, measured by service agglomeration and population density, are not significant either. Finally, column 3 shows the results for the transport equipment industry. This industry is sensitive only to manufacturing agglomeration, presenting a positive and significant result. The remaining variables, with the exception of population density, are positive but none are statistically significant.

These results broadly coincide with those reported by Luger & Shetty (1985). The latter analyzed the effect of agglomeration economies, urbanization economies, and labor market conditions on FDI in three industries: drug manufacturing, industrial machinery, and motor vehicle production. They found agglomeration economies, measured as the total number of annual man hours in a specific industry, to be positive and significant in the three industries. Urbanization economies, measured by population density, were not significant in the three industries. The quality of the labor market, measured as the percentage of white collar workers in the labor force, was reported as being positive and significant in the motor vehicle sector, but negative and not significant in the other two industries. Finally, labor costs, measured as the wage rate in each industry were negative and significant in the three industries. Here, in our study, this variable was only negative and significant in food and beverages and not significant in chemicals and transport equipment.

Of interest in understanding the situation in Spain is the study undertaken by Costa and Viladecans (1999) in which the existence of a relationship between external economies and the firms' competitiveness are tested empirically. The authors found positive

evidence of the influence of location economies and urbanization economies in the chemical industry. By contrast, they did not find any such evidence in vehicles and motors, and the food industries. Thus, in the chemical industry, location economies would appear to be a strong determinant of competitiveness and of manufacturing FDI, while in the food and in transport equipment industries this is not the case.

Consequently, the nature and importance of locational determinants varies with the specific needs of each industry. Centripetal forces, or agglomeration forces, such as market (manufacturing agglomeration), linkages (location economies) and knowledge spillovers (R&D activities) are important locational determinants in the chemical industry. In the case of the transport equipment industry, manufacturing agglomeration is similarly an important locational factor. By contrast, the food and beverages industry seems only to be sensitive to centrifugal forces, such as lower labor costs. Thus, agglomeration economies are important locational factors for the chemical and transport equipment sectors - industries that are characterized by greater dynamism in terms of demand and technology. On the other hand, the food and beverages sector, which can be considered a traditional industry with a low level of demand and a low level of technology (according to the European Union Commission and OECD industry classification), looks for lower costs. Here, agglomeration economies have no relevance and even present a negative value[16].

4. Concluding remarks

Agglomeration factors are not often included in studies of FDI locational determinants. Most empirical studies working with data from the '60s, '70s and early '80s found that FDI was, at that time, mainly in greenfield form, and was resource-and market-oriented. However, during the last two decades, FDI has undergone steady changes and as it has become more and more oriented towards strategic assets, such as intellectual capital, its location needs have also changed. In the case of strategic investment, the objective of which is to maintain and increase ownership advantage, the external economies generated by agglomeration factors have increased their weight in location decisions. The economic and institutional facilities offered by these new locations are also important. Thus, as Dunning (1998) suggests, while globalization separates ownership

and the location of production geographically, agglomeration forces concentrate activity within particular regions and countries.

This study has sought to analyze the locational determinants of regional FDI, with particular emphasis on the variables of new economic geography. Our analysis suggests that agglomeration economies are important determinants of regional FDI distribution. Manufacturing agglomeration, concentration of R&D activities and the availability of skilled labor are important determinants of manufacturing foreign direct investment, but congestion costs can sometimes act as a centrifugal force, leading to the rejection of foreign investment.

At the industry level, our empirical evidence indicates that location determinants vary between industries. Manufacturing agglomeration is a significant location factor in the chemical and transport equipment industries. Location economies, concentration of R&D activities and skilled labor are also important in the chemical industry. In the food and beverages industry empirical results are consistent with theories that stress the importance of costs, especially labor costs.

In the European Union, where national boundaries are becoming less important, regional factors would appear to be gaining in importance as determinants of investment location. Consequently, more regional empirical research is needed in a number of areas. One line of study, once the information becomes available, is the analysis of the role of regional incentives in location decisions. Another is to explore the possibility that locational determinants vary across regions and industries, which would require the detailed study of the effect of industry-specific variables on location choices. Finally, there is a need for further research into location preferences for plant investment.

Notes

1. The Effective Gross FDI is obtained by subtracting from the registered value of gross foreign manufacturing investment: first, the acquisitions of shares by foreign investors from other non residents in Spain, and second, the multiple accounting of this same operation caused by the restructuring of business groups in Spain. Obviously these last two operations do not represent an increase in foreign assets in Spain,
2. Outward investment has been particularly active during this period, especially within South America, and then mainly in primary industries (oil and gas extraction), transport and communication, banking and insurance, and real estate sectors.
3. Regional and sector analyses of FDI locational determinants in Spain can be found in Bajo-Rubio & López-Pueyo (2002), Pelegrín (2002), Martín & Velázquez (1996b), Egéa & López-Pueyo (1991a&b), Bajo (1991).
4. Chemicals represented 21.2% of effective FDI in the manufacturing sector, food and beverages 15.5% and transport equipment 14.3%.
5. Excellent overviews of foreign direct investment theories can be found in: Hood & Young (1979), Cantwell (1991) and Dunning (1993).
6. Comparisons are only approximate as intended investment (the data source for 1986-1988) was replaced by registered investment in the period 1998-2000. In addition, and equally important, total FDI for the period 1998-2000 includes the value of investments in holdings of foreign assets, a capital source that only seeks fiscal advantages but does not stay in the country. This phenomenon has increased dramatically since 1999. During the period 1993-1998, the value of foreign investment in holdings of foreign assets accounted for only 26% of investment in holding assets (foreign and Spanish), but during the period 1999-2000 this figure jumped to 79% (which represented 38% of total FDI).
7. Influence in or control of the firm is said to exist when a foreign investor's ownership is 10% or more of the capital.
8. Except in some special cases of investment originating from tax havens, in which case the declaration has to be made prior to the investment.
9. The dependent variable is specified in gross terms because the aim of this paper is the identification of the locational determinants of FDI, not the effects that foreign

capital has on the productive structure. It is, in fact, interesting to note that the effective net FDI in manufacturing industry has been negative in 1999, 2000 and 2002.

10. Wages includes all labor costs such as unemployment, illness and disability insurance costs.
11. This phenomenon is reflected in the increasing number of mergers and take-overs.
12. The results of the pooled least squares were largely the same (signs and significance) when estimations were run with the education variable and with the R&D variable instead of the manufacturing agglomeration variable.
13. This study attempted to estimate a specification (eventually not included) using an independent variable that represented the stock value of roads, railways, ports and airports by region. The variable was not significant in all specifications, and the dummies for Madrid and Catalonia remained significant. Finally, it was decided to remove the variable because of multicollinearity problems and because the data series was not complete.
14. The results of the specification are the same when estimates are run with the R&D variable (positive and not significant) rather than with the manufacturing agglomeration variable. This is unsurprising as the correlation between manufacturing agglomeration and R&D activities is 0.9.
15. When the specification is run with industrial wage, the variable was also not significant.
16. The average increase in overall demand for Spanish industry during the period 1966-2001 was 4.5%; while by industry it was: chemicals 6.2%, transport equipment 6.2%, and food and beverages 3%. The average internal expenditure on R&D activities in GDP for all Spanish industry was 0.6%; while by industry it was: chemicals 1.5%, transport equipment 1%, and food and beverage 0.2% (Myro & Gandoy, 2003).

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Appendix

Table 1. Description of explanatory variables

Variable	Definition	Expected Effect
Demand	Regional personal income 1993-2000, constant terms of 1995	+
Industrial Wages	Manufacturing wages per manufacturing wage earner, 1993-2000, constant terms of 1995	?
Food & Beverage Industry Wages	Wages in food & beverages industry per wage earner in the same industry, 1993-2000, constant terms of 1995	?
Chemical Industry Wages	Wages in chemical industry per wage earner in the same industry, 1993-2000, constant terms of 1995	?
Transport Equipment Industry Wages	Wages in transport equipment industry per wage earner in the same industry, 1993-2000, constant terms of 1995	?
Higher Education	Share of labor supply with higher education (university studies), 1993-2000	+
Secondary Education	Share of labor supply with secondary schooling, 1993-2000	+
Manufacturing Agglomeration	Manufacturing employment per square kilometer, 1993-2000	+
Food & Beverages Agglomeration	Share of regional industrial wage earners in food and beverages sector	+
Chemicals Agglomeration	Share of regional industrial wage earners in chemical sector	+
Transport Equipment Agglomeration	Share of regional industrial wage earners in transport equipment sector	+
Service Agglomeration	By share of total employment in tertiary sectors, 1993-2000	+
Population Density	Population per square kilometer, 1993-2000	?
R&D Activities	Share of firms' internal expenditure on R&D activities in regional GDP, 1993-2000, constant terms of 1995	+
Capital Effect & Information Costs	Dummy (1:Madrid, 0: Rest of regions) (1:Catalonia, 0: Rest of regions)	 + +

*Sources:

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Table 2. Regression Results for dependent variable: manufacturing FDI

	(1) GLS	(2) GLS	(3) GLS	(4) OLS
Constant	-7.518	-3.754	-4.203	-6.932
	(-5.934)	(-3.804)	(-4.364)	(-10.306)
Industrial Wages	2.195[b]	2.630[a]	2.452[a]	1.074
	(2.180)	(2.598)	(2.357)	(1.282)
Higher Education		0.961[a]		
		(2.584)		
Manufacturing	1.514[a]			1.849[a]
Agglomeration	(3.383)			(5.772)
Service Agglomeration	-0.967	-2.830	-1.329	-1.315
	(-0.561)	(-1.639)	(-0.768)	(-0.966)
R&D Activities			0.391[b]	
			(2.068)	
Population Density	-1.267[a]	1.148	-0.011	-1.988[a]
	(-2.752)	(0.537)	(-0.040)	(-5.317)
Madrid				1.461[a]
				(5.168)
Catalonia				0.725[a]
				(2.923)
R^2	0.666	0.641	0.625	0.493
Adjusted R^2	0.656	0.630	0.613	0.469
F- statistic				20.870
Hausman Test[*]	6.790			

Significance at [a]1%, [b]5%, [c]10%.
[*]The fixed effect model is rejected in favor of a random effect model.

Table 3. Regression Results for Specific Industries Generalized Least Squares (GLS)

Industry	(1)	(2)	(3)
	Food & beverage	Chemical	Transport equipment
Constant	-10.902	-8.332	-16.924
	(-2.931)	(-1.475)	(-2.795)
Industrial Wages	-5.399[c]		
	(-1.895)		
Specific industry wages		-1.368	4.204
		(-0.575)	(1.024)
Secondary Education	-13.036[a]		
	(-2.783)		
Manufacturing	1.276	2.973[c]	3.104[c]
Agglomeration	(0.877)	(1.769)	(1.725)
Specific Industry	-2.787[c]	2.745[b]	1.228
Agglomeration	(-1.667)	(1.931)	(0.904)
Service Agglomeration	1.695	2.744	2.045
	(0.367)	(0.449)	(0.294)
Population Density	-0.369	-1.435	-1.030
	(-0.277)	-0.866	-0.540
R^2	0.436	0.646	0.532
Adjusted R^2	0.410	0.633	0.514
Hausman Test[*]	6.694	3.239	5.198

Significance at [a]1%, [b]5%, [c]10%.
[*]The fixed effect model is rejected in favor of a random effect model.

Table 4. Correlation Matrix of Independent Variables

	GDP	Manufac. Agglom.	Secondary Education	Service Agglom.	Population Density	R&D Activities	Industrial Wages	Higher Education
GDP	1.000							
Manufac. Agglom.	0.967	1.000						
Secondary Education	0.853	0.796	1.000					
Service Agglom.	0.545	0.413	0.783	1.000				
Population Density	-0.026	-0.021	-0.047	0.123	1.000			
R&D Activities	0.950	0.948	0.738	0.324	-0.255	1.000		
Industrial Wages	-0.353	-0.133	-0.510	-0.610	0.004	-0.218	1.000	
Higher Education	0.933	0.922	0.911	0.551	-0.279	0.930	-0.305	1.000

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