Universidad Politécnica de Cartagena

Geography and location choices

José Miguel Navarro Azorín

Director: Andrés Artal Tur

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CONFORMIDAD DE SOLICITUD DEAUTORIZACIÓN DE DEPÓSITO DE TESIS DOCTORAL POR EL DIRECTOR DE LA TESIS

D. Andrés Artal Tur, Director de la Tesis doctoral "Geography and location choices".

INFORMA:

Que la referida Tesis Doctoral, ha sido realizada por D. José Miguel Navarro-Azorín, dentro del programa de doctorado en Economía (Programa DECIDE), dando mi conformidad para que sea presentada ante la Comisión de Doctorado para ser autorizado su depósito.

La rama de conocimiento en la que esta tesis ha sido desarrollada es:

- ☐ Ciencias
- ☒ Ciencias Sociales y Jurídicas
- ☐ Ingeniería y Arquitectura

En Cartagena, a 7 de Abril de 2016

EL DIRECTOR DE LA TESIS

[redacted]

Fdo.: Andrés Artal Tur

COMISIÓN DE DOCTORADO

Universidad Politécnica de Cartagena

DT-17

CONFORMIDAD DE DEPÓSITO DE TESIS DOCTORAL POR LA COMISIÓN ACADÉMICA DEL PROGRAMA

Dª. Arielle Beyaert Stevens, Presidenta de la Comisión Académica del Programa de Doctorado en Economía (Programa DECIDE).

INFORMA:

Que la Tesis Doctoral titulada, "Geography and location choices", ha sido realizada, dentro del mencionado programa de doctorado, por D. José Miguel Navarro.Azorín, bajo la dirección y supervisión del Dr. Andrés Artal Tur.

En reunión de la Comisión Académica de fecha 09/05/2016, visto que en la misma se acreditan los indicios de calidad correspondientes y la autorización del Director de la misma, se acordó dar la conformidad, con la finalidad de que sea autorizado su depósito por la Comisión de Doctorado.

La Rama de conocimiento por la que esta tesis ha sido desarrollada es:

☐ Ciencias
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En Cartagena, a 9 de mayo de 2016

LA PRESIDENTA DE LA COMISIÓN ACADÉMICA DEL PROGRAMA

[redacted]

Fdo:.....Arielle Beyaert

COMISIÓN DE DOCTORADO

Universidad Politécnica de Cartagena

Geography and location choices

José Miguel Navarro Azorín

Director: Andrés Artal Tur

Programa Interuniversitario de Doctorado en Economía

2016

En memoria de mi padre

Resumen

La tesis se concentra en las decisiones de localización por parte de las empresas y los individuos, con una especial atención a la influencia del espacio sobre las mismas. Un supuesto básico en el análisis implica que ambos tipos de agentes toman sus decisiones siguiendo un principio de maximización de la utilidad esperada como consecuencia de la localización en uno u otro lugar. En este contexto, la investigación está orientada a la cuantificación del impacto que tienen las características de cada destino sobre este tipo de decisiones.

En la primera parte de la tesis analizamos las decisiones de localización de las empresas. Tomando como punto de partida la especificación estándar en la literatura, basada en modelos de elección discreta, incorporamos de modo explícito la influencia potencial de los atributos que caracterizan al conjunto de localizaciones próximas a cada destino. La especificación econométrica propuesta permite así evaluar la relevancia del espacio como un factor explicativo adicional de las decisiones de localización de las empresas. Los resultados empíricos obtenidos en la estimación este modelo ampliado utilizando una base de datos que incluye una muestra de empresas españolas confirman la relevancia de este tipo de efectos espaciales. Las características de las localizaciones vecinas efectivamente contribuyen a reforzar el atractivo de cada destino particular. Sin embargo, la magnitud de la influencia de estos efectos varía según el sector de actividad considerado; en concreto, son especialmente relevantes en el proceso de localización de empresas manufactureras que desarrollan actividades con un alto contenido tecnológico. Adicionalmente, la propia accesibilidad del entorno donde se localiza la empresa es un factor que condiciona el alcance de los efectos espaciales: a mayor accesibilidad y conectividad con su entorno, es decir a mayor centralidad de la localización, los efectos espaciales de aglomeración son más intensos, pero se disipan con mayor rapidez y alcanzan una distancia menor.

La segunda parte de la tesis se concentra en diferentes aspectos relativos a las decisiones de localización de la población. En primer lugar, los flujos migratorios y sus determinantes se estudian en un marco teórico que distingue la decisión de cambiar de residencia y la elección del destino. Entre los determinantes de cada una de estas decisiones se pueden incluir toda una variedad de

motivaciones y características personales; sin embargo, el estudio se ha restringido a las características a nivel municipal, tanto del origen como del destino. Los resultados empíricos obtenidos para el caso de los flujos migratorios intermunicipales en España sugieren que éstos contribuyen decisivamente al proceso de suburbanización mediante la expansión de las áreas metropolitanas de las grandes ciudades. En cuanto a la relevancia de los diferentes factores explicativos considerados, son reseñables los resultados para las variables que describen las condiciones en el mercado de trabajo y el mercado de la vivienda. La prevalencia de elevadas tasas de desempleo en un municipio desincentiva la decisión de cambiar de residencia y además reduce su capacidad de atracción. De este modo, los flujos migratorios internos pueden caracterizarse como flujos entre municipios relativamente prósperos, donde el desempleo tiene menor relevancia, frente a la concepción tradicional como movimientos desde las localizaciones menos prósperas a las más prósperas. Por otra parte, se concluye que las características del mercado de la vivienda son un factor clave en las decisiones migratorias: residir en una vivienda en régimen de propiedad es el principal obstáculo a la movilidad de la población y, además, la disponibilidad de viviendas en alquiler en un destino contribuye decisivamente a incrementar su atractivo para los potenciales inmigrantes.

Finalmente, utilizamos los flujos migratorios como una fuente de información sobre la calidad de vida asociada a residir en cada municipio. La hipótesis central es que las personas deciden migrar de un lugar a otro en busca de mejores condiciones de vida y, en consecuencia, los flujos migratorios reflejan las diferencias en la calidad de vida según son percibidos por la población. La metodología desarrollada completa otras aproximaciones a la medición de la calidad de vida basadas en la elaboración de índices sintéticos, pero frente a estos últimos exigir mucha menos información estadística de partida, dado que utiliza exclusivamente datos sobre flujos migratorios interiores. Los resultados obtenidos más destacables en el caso de España son: primero, los municipios con una mayor calidad de vida percibida son los integrados en el Arco Mediterráneo; segundo, durante los últimos años se ha producido una reducción significativa de las disparidades en cuanto a calidad de vida entre los municipios españoles; tercero, se detecta una relación inversa entre tamaño del municipio y calidad de vida; y, por último, en general el público asocia una mayor calidad de vida a municipios más próximos frente a los más distantes de su residencia actual.

Abstract

This dissertation is focused on the location choices made by firms and people, with special emphasis on the role played by space. Central to this enquiry has been the hypothesis that in their decisions both type of agents maximise their expected utility from locating in one particular place or another. Within this basic framework, the research is aimed at the evaluation of the influence that the characteristics of a destination has on location choices.

The first part of the dissertation is devoted to the spatial location of firms. Our main hypothesis regarding this issue implies that the expected firm's profits associated to the location in a place is affected not only by the specific attributes of that destination, but also by the characteristics of nearby locations because of the likely presence of spatial effects or spillovers. Thus, we have extended the standard discrete choice model by introducing an additional term that captures the strength that neighbourhood effects exert in firms' location choices. Estimates from this econometric specification in a sample of Spanish firms show that the attributes of neighbours clearly influence the attractiveness of a municipality for new establishments. However, the empirical results also reveal significant differences in the relevance of spatial spillovers in the location decision depending on the type of activity the firm develops. In this respect, neighbouring area characteristics seem to be particularly important in the case of high-tech manufacturing industries. We also find that the geographical scope of the spatial spillovers are conditioned by the accessibility of the destination: more central locations have the ability to generate more intense spillovers over a shorter spatial range, however.

The second part of the dissertation shifts the focus of the analysis to issues relative to the location choices of people that are reflected by migratory flows. Firstly, we analyse the determinants of migrations within a theoretical framework that distinguished between the decision to leave the current location, and the choice of new place to live. Even though there may be countless individual motivations and migrant attributes affecting migration decisions, our main interest is on the role played by the characteristics of each municipality. Consequently, for each stage we have considered a discrete choice econometric model where both the probability of departure from a given municipality and its

probability of being chosen as destination by migrants are represented as functions of the attributes of the municipality itself. Estimates for internal migrations in Spain suggest that migratory flows are decisively contributing to the suburbanisation process that spans the metropolitan areas. Moreover, we have found that labour market and housing market conditions are particularly relevant as determinants of the migratory decisions. Regarding unemployment, destinations with the highest unemployment rates are avoided by migrants but, at the same time, a high level of unemployment at the origin also deters out-migration. On the other hand, home-ownership acts as a major obstacle to out-migration, while the availability of home accommodation in a municipality influences its attractiveness for migrants.

Finally, we exploit the pattern of migratory flows as a source of information about the quality of life associated with living in each destination. We assume that people migrates towards locations where quality of life is higher, so that migratory flows reflects differences in people's perceived quality of life. Thus we develop a methodology that allows us to compute quantitative measures of well-being in each municipality from the observed migratory flows. After applying this methodology to the Spanish municipalities we have found that municipalities in the Mediterranean Arc are those with the highest values of the index of quality of life. The empirical results also reveal the existence of a process of convergence in terms of quality of life among them. Furthermore, we have found that people expect the highest quality of life conditions from living in medium sized municipalities located within a rather short-distance range from the current place of residence.

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Introduction

The economic activity is unevenly distributed across the territory. While some regions stand out for their ability to attract human activity, other regions seem to be a much less attractive destination for the economic agents. This spatial heterogeneity can be analysed from two complementary points of view: on the one hand, it is the result of past decisions made by different economic actors; on the other, it is a key determinant shaping their future choices. This study focuses on the potential interaction between geographical space and the decisions of localization by firms and people. Accordingly, we will follow two basic threads associated to firms' localization and population migratory movements, respectively.

Regarding firms' localization, from a theoretical perspective the literature has commonly highlighted the role played by both agglomeration and urbanisation economies in explaining the spatial concentration of the economic activity. Main findings steaming in this field suggest that those destinations characterised by either a higher density of firms using a similar technology, inputs, or workforce with comparable qualification; or, alternatively, by a higher degree of diversification in their productive fabric, should be the most attractive for entrepreneurs. However, treating each localization as an island without connection with their neighbourhood is, at least, an unrealistic simplification; instead, entrepreneurs' objective function facing the decision to locate in a given place should also include the characteristics of other neighbouring places. The latter allows us to have a better understanding of the firm' localization decisions by considering this type of spatial determinants.

The first three chapters of this work are devoted to investigating the main driving factors of the localization decisions made by firms. This is achieved in the framework of discrete choice models derived under the premise of a utility maximising firm and therefore use random utility theory. In discrete choice models, a typical firm chooses the alternative (location) that maximises its utility over a set of alternatives, each one characterised by a vector of attributes. At this point, we deviate from the standard literature on this issue by allowing the possibility that the characteristics of neighbouring locations might be assigned a non-negligible weight in the utility function of the firm decision-makers. The resulting empirical model specification provides us with a tool to evaluate the ability of a given place to strength the attractiveness of their neighbours for new firms.

In the second part of this study we turn our attention to location decisions made by people in terms of migratory flows. We aimed to understanding why migrants are attracted to some locations rather than to others. In chapter 4, we adopt a modelling strategy which relates migratory behaviour to destination attributes. To this end, the migratory decision-making process is conceived as the result of two separate decisions: individuals decide, primarily, whether to stay at or leave from their current place of residence; and, once they have decided to migrate, they select a destination to go. Both decisions are modelled in terms of locations' characteristics which may act either as push or pull factors. For the destination choice we assume that individuals have only a limited ability of individuals to process the large amount of information so that they follow a hierarchical strategy: a migrant making a choice of destination first selects a cluster of destinations and then selects a location from within that cluster. The latter implies that the spatial relationship between destinations is a key ingredient in the migrant's destination choice, that is, there is a relationship between the choice of a particular destination and its proximity to other destinations. Either because individuals underrepresent the magnitude of large clusters or because they consider destinations in close proximity to others as less attractive, the probability that a given destination is chosen will decrease with the likelihood that the destination is in a large cluster. To capture this type of effects, the conventional discrete choice models may be adapted by the inclusion of an additional term that reflects the likelihood of being within a large cluster for each destination.

Finally, chapter 5 builds around the basic idea that individuals migrate to improve their situation or utility. Further, we assume that utility parallels the concept of quality of life defined in a wide sense, that is, including economic as well as non-economic aspects, such as socio-cultural and urban dimensions linked to spaces, ultimately influencing the well-being that people can attain by living in one or another place. Hence, migratory choices made by people reveal their assessment of utility differentials between destinations or, to put it another way, their perception of the relative quality of life linked to each destination. Under the latter view, we derive synthetic measures of quality of life from the information on preferences revealed by people in their moving decisions.

Chapter 1

Industrial location, spatial discrete choice models and the need to account for neighbourhood effects

Abstract: This research, following the original contributions of Vichiensan et al. (*J East AS Soc Trans Stud,* 6: 3789-3802, 2005; Mixed Logit Model Framework with Structuralized Spatial Effects: A Test of Applicability with Area Unit Systems in Location Analysis) and Autant-Bernard (*Eur Plan Stud*, 14: 1187-1208, 2006; Where do firms choose to locate their R&D? A Spatial Conditional Logit analysis on French data), employs a spatial conditional logit framework in order to explore the role that inter-territorial spillovers play in driving location choices of industrial firms. After introducing these neighbourhood effects in the theoretical model traditionally applied in location studies, we test this methodology by using data on 8,429 firms established in the municipalities making up the Spanish region of Murcia. Our results show that human capital, agglomeration economies and industrial land availability are the main factors driving entrepreneurs' decisions. Estimates of the spatial component of the model indicate that spillovers or externalities taking place between municipalities (inter-territorial spatial effects) have a remarkable influence on the location decisions of the firms, thus confirming the need to account for such spatial dependence pattern when studying location decisions of industrial companies at a local level.
Keywords: spatial econometrics, industrial location, spatial conditional logit, inter-territorial spillovers

1 Introduction

When deciding to start a new business, the choice of where to locate the facilities is one of the most crucial steps of the process. The decision is so important that it could determine the success not only of the firm's current activity but also its future (Strotmann, 2007). Increasing complexity is undoubtedly a feature of today's international economy with many variables affecting location decisions, making this a key issue in the firms' strategies. In this context, it is not difficult to understand why we have seen a renewal of interest in location studies in recent decades (McFadden, 2001; McCann and Sepphard, 2003).

Empirical studies of industrial location have been one of the most active lines of research in this field since the late 1980s, with academic contributions pursuing to identify the main factors driving firms' choices. One important field that have been pushing the industrial location literature is that of understanding the role that external economies or spillover effects play in influencing decisions of companies. The analysis of agglomeration economies and the role of space represent two of the pivotal research topics in this area of study, having yet attracted the attention of pioneer authors as Johann Heinrich von Thünen and Alfred Marshall, and continue inspiring the work of influential researchers (see, e.g., Ellison et al., 2007; Fujita and Thisse, 2002). In order to identify the role played by these variables, and from a methodological point of view, the literature on the determinants of industrial location has adopted two different econometric approaches: Discrete Choice Models (DCM) and Count Data Models (CDM) (Arauzo et al., 2008). Meanwhile DCM are focused on the firms' decision-making problem itself and analyse the way in which the characteristics of the decision-maker, such as firm size, sector of activity, etc., affect its choice, given the set of geographical alternatives available (McFadden, 1974; Carlton, 1983), CDM follow an alternative path and, by using the number of companies established in a particular location for a period of time as the dependent variable, they relate ex-post observed choices to the particular characteristics of the locations (Becker and Henderson, 2000).

As a corollary of this methodological debate, the important contribution of Guimarães et al. (2004) noted that both approaches essentially rely on the same theoretical framework, that is, a profit maximization problem in which firms choose the location that reports the highest expected profit. Moreover, these authors demonstrate that from a computational perspective both are similar models, because of the equivalence of the likelihood function for the conditional logit and the Poisson distributions. Their conclusion is that it is possible to recover conditional logit parameter estimates from CDM results. This contribution has stimulated a number of empirical studies on location choices in recent years, given that CDM appear to be tractable when the number of alternatives becomes too large, as in industrial location studies, not being this the case for DCM.[1]

In this context, one remaining limitation of the theoretical approach employed in location studies relates to the way in which spillover effects are modelled. In the traditional framework the decision-maker only uses information on every individual location when computing the expected profit function of establishing in that particular geographical unit, that is, the theoretical model is just defined for coping with intra-territorial spillovers, not being able to account for inter-territorial ones. However, as the spatial economy literature highlights, the value achieved by a variable (i.e. firm's profits) in one particular location may be affected by the realisation of the same, or other, variables in nearby locations because of spatial dependence effects (Anselin, 1988) and the presence of external economies and spillovers (Fujita and Thisse, 2002). Accounting for the role of inter-territorial external economies is then shown to be an important variable influencing location processes, especially when the territorial unit of study is increasingly smaller, as in local analysis. To this end, a natural extension of the theoretical model for location studies should be one that incorporates these potential spatial effects into the decision-making process.

Despite the importance that the topic of location choices has shown in guiding the decisions of entrepreneurs, managers and policy makers, and although this has proved to be a very fertile field of research, little work has been done to date on incorporating spatial dependence in these type of models, particularly for the discrete choice framework (Fleming, 2004). Early contributions in this literature take the simple form of spatial binary choice models (Murdoch et al., 2003; Marsh et al., 2000), with recent developments of spatial probit models (Coughlin et al., 2004) since the launch of the Spatial Econometrics toolbox

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[1] Particularly, when DCM include a significant number of location alternatives for the decision-maker, for example greater than 50, the computational needs for compiling the database as well as for running the estimation procedure use to exceed the possibilities of actual techniques, even for non-standard software and hardware. Additionally, other differences exist between both families of models, but as this topic do not constitute the real focus of the paper, we refer the interested reader to the excellent discussions of Kim et al. (2008), Arauzo et al. (2008), and Bradlow et al. (2005).

for MATLAB by professor James P. LeSage. Other recent contributions include the use of spatial multinomial logit models, with interesting applications to environmental and transport planning studies (Nelson et al., 2004; Mohammadian et al., 2003), but the literature is clearly at a very early stage concerning the use of spatial conditional logit models, the family of DCM usually employed in industrial location studies.

To the best of our knowledge, there are only two references in the literature that extend the conditional logit model to account for potential spatial effects. The first one is the paper of Vichiensan et al. (2005), which extends the conditional logit model by considering a spatial autoregressive structure in both the deterministic and the stochastic part of the model specification. The idea is to capture external economies that influence the decision-maker in his/her location choice. However, the exercise is devoted to a residential choice analysis in Senday City (Japan), and its focus is more on identifying how the geographical dispersion of alternatives affects the decision-maker's choice. In their exercise, the significance of the spatial variable of the model appears to be highly dependent on the spatial pattern that characterises location alternatives. The main drawbacks of this approach stem from the computational difficulties it poses with a large set of alternatives, as estimation would turn into a very complex, maybe unfeasible, task.

The second reference is that of Autant-Bernard (2006), who implements a conditional logit model in order to search for the location determinants of R&D laboratories in France. The unit of analysis employed is the administrative region (NUTS 2) and the model incorporates a spatially lagged term for every explanatory variable in order to determine the spatial scope of knowledge spillovers, both for public and private investments. The estimation results show that only private R&D expenditure appears to generate inter-regional knowledge spillovers that influence location decisions of R&D labs in France.

To this end, the aim of this paper is to introduce inter-territorial spillovers in the theoretical model employed in industrial location studies. Furthermore, and relying on the spatial conditional logit framework, we estimate the role played by external economies between neighbour territories when influencing the decision of firms choosing their preferred location. Two contributions are made to the literature. The first one is analytical, and pursues improving the empirical identification of such spatial effects or externalities. In coping with this objective, we employ local data on municipalities as our geographical unit of analysis, what supposes a novelty for this spatially extended literature, and constitutes the ideal empirical approach, as recent contributions have noted

(Arauzo, 2008; Holl, 2004; Fujita and Thisse, 2002). The second one is methodological, and consists in extending the theoretical model for coping with inter-territorial externalities, which now enter the information set of the firm's decision-maker. Further, we define an econometric specification that allows for estimating the role played by such spatial effects in industrial location processes. The proposed methodology may be used to substantiate a theoretical model of spatial dependence in industrial location studies.

In order to test this methodology, we study the factors driving location choices of 8,429 industrial establishments in the Spanish NUTS 2 region of Murcia. The availability of detailed micro-data on industrial firms and territorial characteristics of municipalities for this region offers an excellent opportunity for obtaining empirical evidence on the performance of our methodological proposal. The industrial tradition in this regional area also recommends the study. To anticipate some of the results, we find that human capital, agglomeration economies and industrial land availability are the main forces driving location decisions for industries in this region, with estimates on the spatial component of the model showing that inter-territorial externalities or spatial effects have a remarkable influence on firms' location decisions. Attributes of neighbouring municipalities are found to exert nearly the same influence as those of the selected municipality in guiding the decision-maker's choice, thus confirming the need to account for such spatial interdependences when studying location choices of industrial companies at a local level.

After this introduction, the remainder of the paper is organised as follows. Section 2 defines the theoretical framework of the paper. Section 3 describes the data set used in the investigation and discusses the empirical results obtained in the estimation process. Finally, section 4 summarizes the main conclusions of the research.

2 Spatial discrete choice models and location processes

Our theoretical model builds on the standard random utility maximisation (RUM) framework employed to analyse the firms' location behaviour. In this framework, firm i decides where to locate, among a finite set of J alternatives (municipalities), according to the expected profit that every location (j) is reporting. The choice could be described as a maximisation problem of the profit function of the firm, a function given by:

$$\pi_{ij} = X_j\beta + \varepsilon_{ij}, \qquad i = 1,...,N; j = 1,...,J \,. \tag{1}$$

where X_j is a $1 \times M$ vector of local geographic and socio-economic conditions, β is a vector of parameters, and ε_{ij} is a random error term capturing the characteristics of the decision-maker or unobservable attributes of the choices.[2] Under profit-maximising behaviour, municipality j is chosen by the firm i as the preferred location always that,

$$\pi_{ij} \geq \pi_{ik}, \quad \forall k \neq j,\ k = 1,...,J\ , \tag{2}$$

that is, the alternative j is chosen when its attributes ensure the greatest expected profit to the firm. Therefore, the probability that a firm i is located in the municipality j yields

$$P_j = \Pr\left(\pi_{ij} \geq \pi_{ik}, \forall k \neq j, k = 1,...,J\right). \tag{3}$$

It can be shown that, if disturbances are independent and identically distributed following a Weibull distribution, then the probability that the firm i chooses alternative j is (Greene, 2008),

$$P_j = \frac{\exp\left(X_j\beta\right)}{\sum_{k=1}^{J}\exp\left(X_k\beta\right)}. \tag{4}$$

At this point, it is important to observe that meanwhile in the standard theoretical framework employed in location studies the firm counts altogether on information about the characteristics of the chosen location (j) and those of the alternatives (k), in order to decide where to locate the business' facilities (see equations (2), (3), and (4)), however, when computing the expected profit function of locating in a particular municipality (j), the decision-maker information set only includes the characteristics of such particular location, losing in this way all other information on neighbouring locations affecting the profit function (see equation (1)). This feature of the standard theoretical approach shows an important limitation for dealing with the concept of inter-territorial spillovers affecting the choice of companies, just allowing for the

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[2] The error term is assumed to be uncorrelated across choices, what leads to the usual assumption on the independence of irrelevant alternatives (Carlton, 1983; McFadden, 1974).

possibility of accounting for those externalities occurring inside the spatial limits of every particular location.[3]

Moreover, recent empirical evidence and theoretical developments of the literature suggest that such spatial effects are playing an important role in driving entrepreneurs' decisions, given that the expected profits from locating in a particular municipality would also be influenced by the characteristics of the neighbouring areas, given the existence of inter-territorial spillovers and other important linkages among firms (Ellison et al., 2007; Arauzo et al., 2006; Fujita and Thisse, 2002; Arbia, 2001). In this context, one main aim of the present research is to improve the theoretical framework employed in location studies by introducing the possibility of dealing with this type of externalities or spatial effects in empirical studies. In order to do so, we extend the specification of the standard profit function by introducing a new set of variables, that we label as *"neighbouring area attributes"*, which include the surrounding area characteristics which could influence the firm's profit function and consequently its location choice.[4] This new set of variables allows us to extend the information available for the decision-maker when computing the profit function, by including a term that captures the presence of inter-territorial spillovers, extending in this way the systematic part of equation (1) as follows:[5]

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[3] This is an important limitation faced by the standard theoretical framework in location studies, especially for empirical exercises employing local (municipal) data in their analysis, given that such inter-territorial spillovers or spatial effects use to play an important role in driving firms' location choices. Further, if we note that the literature considers the "local dimension" as the best "spatial unit of analysis" for capturing such type of spillovers (Arauzo, 2008; Holl, 2004), this feature of the standard framework turns out to be an important limitation of the location literature itself.

[4] It is important to note that although dozens of social and economic characteristics of nearby locations could influence the firm's behaviour, we are interested in including in our extended model only those that have a direct impact on the firm's expected profits, because only those matter when building the firm's choice probability function (Train, 2003).

[5] Note that this specification resembles the spatial cross-regressive model (Anselin, 2003; Florax and Folmer, 1992).

$$\pi_{ij} = X_j\beta + \delta\sum_{l=1}^{J} w_{jl}X_l\beta + \varepsilon_{ij}, \quad i = 1,...,N; j = 1,...,J \,, \tag{5}$$

where $\left\{w_{jl}\right\}_{l=1,\ldots,J}$ is a weighting sequence defined in terms of the distance between municipalities j and l. In general, we still do not address any precise definition of distance, which could be based on economic, geographic, or socio-cultural considerations.[6]

In this way, our theoretical framework specified in equation (5) allows the decision-maker to count on information about the attributes of the particular municipality (j), collected by variables in X_j, together with information on the *spatially weighted average* of the attributes of geographical alternatives or surrounding locations, captured by the term $\sum_{l=1}^{J} w_{jl}X_l$, both terms now included in the extended profit function. At the same time, when estimating equation (5) we assume by convenience that the parameters β are the same across the whole equation. That is, we assume that each explanatory variable (or local territorial characteristic) of the model, belonging to the own chosen location j or to the $J-1$ surrounding municipalities, exert the same *relative* effect on the expected profits of the firm i.[7] This working assumption allows us to specify a parameter δ in equation (5), common to all explanatory variables, that would now be capturing the average influence of the whole spatial dimension on the location choice of firms. Concretely, this parameter captures, from a theoretical point of view, the *relative* strength that spatial inter-territorial spillovers have when affecting the choice of firm i, by influencing its expected profit function. In specifying this new spatial parameter, we are able to econometrically estimate the theoretical concept of inter-territorial spatial

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[6] Note that this initial approach offers the theoretical model an opportunity of becoming a valid framework for different types of location studies, as, e.g., those devoted to industrial location, marketing or even industrial organisation studies.

[7] This appears to be a reasonable working assumption, because location or explanatory factors use to share a similar capacity of attraction of new firms inside a limited territorial space (local neighborhood). This is the case, for example, for municipalities belonging to a metropolitan area, where labor market conditions, accessibility to markets, infrastructures or other factors of attraction of start-up's companies use to show a similar level of development in the eyes of the decision-makers. Also, and more important for our investigation, the introduction of this assumption allows us to clearly specify and estimate our spatial parameter of interest "δ", what constitutes one of the main goals of the present paper.

effects affecting location choices of companies, achieving in this way one of the main goals of the paper.

Our approach departs from previous contributions in the literature, improving them in two ways: first theoretically, allowing for the inclusion of these neighbourhood effects in the expected profit function (McFadden, 1978, 2001; Carlton, 1983), and second empirically, providing a single measure of the influence that inter-territorial spillovers exert on the firm's choice. It is worth noting that a similar parameter which allows for globally retrieving the spatial dimension in location models is not present in this still scarce literature (Vichiensan et al., 2005; Autant-Bernard, 2006). Estimates showing a positive value of the spatial parameter, $\delta > 0$, would be implying that external economies among municipalities play a significant role in the firm's choice, while a negative value of the parameter, $\delta < 0$, would be reflecting the existence of congestion/dispersion externalities which affect the firm's choice (Viladecans, 2004).[8]

Furthermore, if we assume that the error terms in equation (5) are independent and identically distributed following a Weibull distribution, now the probability of firm i to choose municipality j is now:

$$P_j = \frac{\exp\left(X_j\beta + \delta\sum_{l=1}^{J} w_{jl} X_l \beta \right)}{\sum_{k=1}^{J} \exp\left(X_k\beta + \delta\sum_{l=1}^{J} w_{kl} X_l \beta \right)}, \tag{6}$$

from which it is straightforward to compute marginal effects as:

$$\frac{\partial P_j}{\partial X_l} = \begin{cases} P_j\left(1 - P_j\right)\beta & \text{if } l = j \\ P_j\left[\delta w_{jl}\left(1 - P_j\right) - P_l\right]\beta & \text{if } l \neq j \end{cases} \tag{7}$$

[8] It is important to understand that our spatial parameter δ is defined to capture spatial effects affecting the decision-maker by using a single spatial measure, in contrast with previous contributions in the literature which estimate a spatial parameter for every characteristic of the surrounding area affecting the firm's choice (see, e.g., Autant-Bernard, 2006). In this sense, it seems that this specification of the spatial parameter stays closer to the theoretical notion of spatial dependence, which constitutes the basis of the spatial econometrics literature.

We can also define marginal effects with respect to the spatially weighted attributes, denoted by $X_j^W = \sum_{l=1}^{J} w_{jl} X_l$,[9] as:

$$\frac{\partial P_j}{\partial X_j^W} = \delta P_j \left(1 - P_j\right)\beta \,. \qquad (8)$$

By comparing expressions (7) and (8) for $l = j$ we can conclude that, for the m-th attribute,

$$\delta = \frac{\partial P_j \big/ \partial X_{j,m}^W}{\partial P_j \big/ \partial X_{j,m}}, \qquad m = 1,\ldots,M \,, \qquad (9)$$

which means that from a theoretical point of view, and by construction, the parameter δ is measuring the *relative importance* that neighbourhood attributes have as compared to specific local attributes (of the chosen j-th alternative) in the decision-making problem. A value of δ greater than one would now be implying that the neighbourhood attributes affecting the decision of a firm located in the municipality j appear to be of greater importance than those of municipality j itself; that is, the firm locating in municipality j is intending to benefit more from neighbourhood advantages than from its own local advantages. In contrast, a positive value of δ but below unity implies that, even though spatial effects are important for the firm, they appear to be less important as location attractors than the specific attributes of the chosen location, what seems a more plausible expected result from a theoretical point of view.[10]

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[9] Note that under this notation we can rewrite the expected profit of a firm i of establishing in municipality j as $\pi_{ij} = X_j\beta + \delta W X_j \beta + \varepsilon_{ij}$, for $i = 1,\ldots,N$ $j = 1,\ldots,J$.

[10] One must also be aware that this new spatial measure in our proposal opens interesting research possibilities to studies analysing the effects of congestion (negative spatial externalities) on location choices, a research line which is still underrepresented but increasingly necessary in this literature (see Arauzo, 2008, footnote 14).

3 Empirical results

3.1 Data

Once defined our theoretical model, we are now interested in identifying the factors that influence the firms' location choices, as well as in capturing the role that external (inter-territorial) economies are playing in this process. In our preferred econometric specification, the dependent variable will be the number of industrial establishments operating at the municipality level in the Spanish region of Murcia in 2006. This information is obtained from the Business Directory (DAERM) of the Regional Statistical Office of Murcia, which reports data on 8,429 industrial establishments classified by municipality of location and sector of activity.

The use of municipalities as the geographical unit of analysis introduces a novelty in the spatial conditional logit literature, given that the only contribution relying on this framework for industrial location studies, that of Autant-Bernard (2006), focus in a regional -NUTS 2- approach for France. This spatial dimension also represents the ideal or appropriate approach in order to capture spatial spillovers or externalities, given that a great share of them use to be influenced by local spatial effects rather than by inter-regional or inter-national ones in their location decisions, as noted by recent contributions of the literature (Arauzo, 2008; Holl, 2004) and particularly by the New Economic Geography literature (Fujita and Thisse, 2002; Fujita et al., 1999; Krugman, 1991). Another advantage of applying this geographical focus is that it allows us to overcome a common error in spatial analysis, the so-called "error measurement problem", which appears when the spatial dimension of the variable we want to measure does not properly match that of the chosen spatial unit of analysis in the research (Haining, 1995; Rosenthal and Strange, 2003). Moreover, the use of an appropriate territorial unit, which correctly resembles the decision-maker problem, contributes to obtain more precise estimation results, both in the parameters of the model and in its spatial component, because it reduces the omitted variables problem and allows to better account for the role of spatial effects or externalities mainly influencing the choice of firms (Arauzo, 2008; Arauzo and Manjón, 2004).

The dataset al.so comprises information on the geographic and socio-economic characteristics of the 45 municipalities making up the Spanish region of Murcia, obtained from the Regional Statistical Office of Murcia, which allows us to conform the explanatory variables set of the model. Detailed information on social and economic characteristics of small territorial units is not usually available with such a degree of detail, so the existence of a richer dataset in this respect for the Region of Murcia has guided the decision of applying this theoretical framework to the analysis of industrial location choices in this region.

We begin by introducing agglomeration variables in the explanatory set, given their central role in the literature on industrial location. In general, agglomeration effects can be defined as external effects including all economies that are an increasing function of the number of nearby firms (Head and Swenson, 1995). If the firms belong to the same industry, we define these economies as localisation economies, and in the case that they belong to different industries we label them as diversity economies.[11]

The concept of localisation economies is intended to capture all firm's advantages generated by the concentration of industries from the same sector close one another, due to the existence of information spillovers derived from informal contacts between the staff of the firms or whatever other externalities arising because of the firms' proximity (Arauzo et al., 2008; Figueiredo et al., 2002; Head and Swenson, 1995). These type of agglomeration economies are generally identified in the recent literature as Marshall-Arrow-Romer (MAR) externalities (Glaeser et al., 1992). To measure localisation economies we use a standard index capturing the degree of industrial specialisation of municipality *j*, in terms of employment, in comparison with the specialisation that characterises the whole regional area (*INDUSTRIAL SPECIALISATION*).[12]

On the contrary, the existence of a considerable number of different industrial activities in the same location generates diversity economies, also named Jacobs' external economies (Jacobs, 1969; Duranton and Puga, 2000). The concept captures those external economies improving the firm's performance that stem from the diversity of industries (or services) surrounding the firm. Externalities arise because of enhanced local competition or due to the added-

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[11] A general characterisation of agglomeration economies is due to Hoover (1936), whom defined localisation economies as those arising because of the concentration of firms from the same sector of activity, while terming as urbanisation economies to those deriving from a concentration of economic activity, whatever their source. In order to differentiate from localisation economies, we have preferred to use the concept of diversity economies developed by Jacobs, given the importance shown by this type of externality in today's post-industrial economies (see, e.g., Jacobs, 1969).

[12] See the Appendix for a more detailed description of the explanatory variables and statistical sources employed in the econometric study.

value it provides to the activities of the firm by improving access to new industrial inputs or services. In this paper, industrial diversity economies are captured by an index (*DIVERSIFICATION*) computed as one minus the Herfindalh-Hirschman concentration index. Higher values of this index are associated with a more diversified local industrial environment.

Secondly, and together with the agglomeration forces, we also include some supply-side factors in our explanatory variables set, following the literature on industrial location (Arauzo et al., 2008; Ellison et al., 2007). This covariate is approached through a human capital variable (*HUMAN CAPITAL*), computed as the percentage of the labour force that has completed secondary and tertiary level education in every municipality, what constitutes a standard approach of this type of variable in the literature (Arauzo et al., 2008; Coughlin et al., 2000; Coughlin et al., 1991). The importance of human capital, proxied by levels of education among the local workforce, for firms' location choices is well documented in the empirical literature. Some contributions even note the important role played by this variable in attracting industries with high knowledge content (Audrestch and Lemman, 2005).

Thirdly, other municipal characteristics are included as explanatory variables, such as the total municipal population (*POPULATION*) which acts as a demand-side variable, plus other labour market (supply-side) conditions, proxied by the ratio of local industrial employment to regional industrial employment (*INDUSTRY SHARE*) and the corresponding measure for the service sector (*SERVICES SHARE*). An institutional factor is also used in our final equation (10), capturing the availability of industrial land in every municipality (*INDUSTRIAL SURFACE*). This serves as an endowment variable, reflecting the commitment of local and regional authorities in providing the necessary conditions for attracting new industrial establishments (Woodward, 1992; Guimarães et al., 1998). In general, the pool of location factors we specify in our preferred equation basically is composed by typical neoclassical covariates, within a profit maximising framework, also including an institutionally-driven measure corresponding to the endowment variable (Arauzo et al., 2006).[13]

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[13] We have test for the role of additional explanatory variables in our original specification, such as a distance variable (to the capital of the region, to some transport infrastructures as port, airport, etc.), demand-side variables (income per capita, population density), as well as other supply-side variables (several definitions of human capital by levels of education, workforce qualification, wage levels, etc.).

All expected coefficients for the explanatory variables of the model are assumed to be positive, as all of them strengthen the relative position of a municipality as a potential location for firms, as pointed out by the literature (Arauzo et al., 2008; Viladecans, 2004).

Our final specification for the expected profit of firm i when establishing in municipality j is then given by,

$$\begin{aligned}
\pi_{ij} = {} & \beta_1\, INDUSTRIAL\, ESPECIALISATION_j + \beta_2\, DIVERSIFICATION_j \\
& + \beta_3\, HUMAN\, CAPITAL_j + \beta_4\, POPULATION_j + \beta_5\, INDUSTRY\, SHARE_j \\
& + \beta_6\, SERVICES\, SHARE_j + \beta_7\, INDUSTRIAL\ SURFACE_j \\
& + \delta\, \big(\beta_1\, INDUSTRIAL\, ESPECIALISATION_j^W + \beta_2\, DIVERSIFICATION_j^W \\
& + \beta_3\, HUMAN\, CAPITAL_j^W + \beta_4\, POPULATION_j^W + \beta_5\, INDUSTRY\ SHARE_j^W \\
& + \beta_6\, SERVICES\, SHARE_j^W + \beta_7\, INDUSTRIAL\ SURFACE_j^W \big) + \varepsilon_{ij}
\end{aligned} \tag{10}$$

where the spatially weighted averaged variables (denoted by the *"W"* superscript) are computed using a weight matrix *W*, what constitutes a standard of the spatial econometrics approach (Anselin, 1988).

The weighting scheme of our neighbourhood attributes will obviously depend on the definition of distance used. Here we adopt a standard spatial econometrics approach by defining the weights in terms of the inverse Euclidean distance between municipalities. The exact definition then yields:

$$w_{jl} = \begin{cases} 0 & \text{if } j = l \\ \dfrac{d_{jl}^{\,-1}\, \mathbf{1}_{(d_{jl} \leq R)}}{\sum_{l=1}^{J} d_{jl}^{\,-1}\, \mathbf{1}_{(d_{jl} \leq R)}} & \text{if } j \neq l \end{cases}$$

where d_{jl} is the Euclidean distance between municipalities j and l; $\mathbf{1}_{(d_{jl} \leq R)}$ is an index function that equals 1 when the municipality l is within a circle with radius R and centre in the municipality j, and zero otherwise. It is equally important to note that this definition of distance implies that in the decision of locating in municipality j, the firm is just taking into account the characteristics of the nearby municipalities which lie inside the defined circle, which we term as neighbours. This approach allows us to calibrate the extent

Nonetheless, many of them have not worked in a satisfactory way, so we finally have chosen as our preferred set of explanatory variables the one presented in this section.

to which spillovers exert an effect on the firm's profits function, adding some rationale in line with the most recent industrial location literature on spatial spillovers (Arauzo, 2005).

3.2 Some econometric issues about the estimation procedure

The parameters β and δ in equation (10) can be estimated by maximising the log-likelihood function,

$$\log L_{cl} = \sum_{i=1}^{N} \sum_{j=1}^{J} y_{ij} \log P_j = \sum_{j=1}^{J} n_j \log P_j \, , \qquad (10)$$

where y_{ij} is an indicator function which selects out the appropriate response probability for each observation i, and n_j is the number of firms which have chosen municipality j.

As we have mentioned, from a computational point of view, estimating the resulting spatial conditional logit by maximum likelihood methods may be cumbersome, especially when the number of alternatives or locations becomes too large.[14] Although this feature of the DCM is not shared by our present empirical exercise, we decide to follow the estimation procedure proposed by Guimarães et al. (2003) when estimating our spatially extended model, that is, we will recover the conditional logit parameter estimates obtained from our CDM results. We decide to follow this methodology because the main contribution of the present paper is methodological and, in this way, our proposal could be easily generalised to other empirical studies which certainly have to deal with this usual problem of DCM. We must note that, as demonstrated by Guimarães et al. (2003), estimation results for parameters of the models are the same for both methods of estimations, so our choice renders no effect for the results of the research.

Guimarães et al. (2003) demonstrate the existence of an equivalence relationship between the conditional logit and Poisson likelihood functions. It then would follow that the parameters in the spatial conditional logit model (5) can be estimated departing from those using a Poisson regression. After

[14] See the introductory part of the paper, together with the footnote 1.

applying this methodological proposal, in the next subsection we discuss the estimation results of our econometric model.

3.3 Results

A first look at the distribution of industrial establishments in the region of Murcia shows the existence of an important degree of firm clustering, with four municipalities, Murcia, Cartagena, Lorca and Yecla, accounting for more than half (56%) of the total number of establishments (DAERM database). This clustering pattern is also reflected by the percentile map in **Figure 1** Percentile Map on the distribution of industrial firms by municipality in the Region of Murcia (Spain), which includes information on the distribution of industrial establishments over regional municipalities. In this figure, one municipality, the city of Murcia, stays in the upper percentile, appearing to be the more attractive location for establishing an industrial company in the regional space. Other four municipalities Cartagena, Lorca, Yecla and Molina de Segura stay in the percentile range immediately below it, showing a similar capacity for attracting new establishments.[15] The other regional municipalities do not show this central position in the regional arena, although we must distinguish between the intermediate group, made up of 19 municipalities, and the three other percentile groups ranging in the last positions of the regional industry distribution. The last group is composed by 21 municipalities nearly half of the total 45 making up the whole region but just accounts for 10% of total regional establishments (DAERM database). **Table 1** also shows us the important degree of sectoral specialisation that characterises the regional industry, with just three industries accounting for 50.5% of total establishments: food industries, steel and metal products, and furniture and other manufactured goods. The geographical distribution of industries shows that these are mainly located in the city of Murcia and Cartagena, with the furniture industry traditionally established in Yecla and the food industry showing an important presence in Cartagena and Lorca.

Parameter estimates of the conditional logit model are shown in **Table 2**.[16] The first and second columns summarise the estimation results obtained from applying the standard conditional logit specification; that is, without

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[15] The city of Murcia is the red-coloured municipality in **Figure 1**, with Molina de Segura located just above this municipality, Cartagena just below, Lorca on the left and Yecla right at the top of the map.

[16] Estimation was carried out by using the GAUSS™ CML module.

including cross spatial dependences between firms. The third and fourth columns include estimates of the model once a spatially weighted average of the neighbour's attributes has been incorporated as an additional explanatory variable, as described in the theoretical section. **Table 2** also reports a collection of statistical measures of the goodness-of-fit for the model, and an additional test for the value of our spatial parameter of interest δ .

At this point, we must define the value of the radius *R* we are going to use for computing the spatial weight sequence of the spatially extended covariates in the model. Given that we do not have any *a priori* information on the true value of the parameter, we decide to follow a statistical criterion by choosing the value of the parameter that maximised the likelihood function for the proposed specification of the model. After implementing a grid search procedure, over an interval that varies between 25 km and 125 km as the shorter and the longer distance between two municipalities in the region, our preferred specification is that one with a correspondent value for radius *R* of 43.6 km (see **Figure 2**).[17]

Turning now to the estimation results (**Table 2**, columns 1 and 2), it is interesting to note that all our covariates shown the expected signs of the estimated parameters, except for the case of the variable *SERVICES SHARE,* remarking that our econometric specifications renders consistent results in comparison with previous findings of the literature (Arauzo et al., 2006). The estimated coefficients also appear to be highly significant. In general, goodness-of-fit measures for our standard non-spatial model are equally comparable to empirical contributions in the literature, with an important level of significance for the joint model. At this respect, our results seem to capture the relevance that traditional neoclassical factors have in influencing firms' choices at the local level.

Both types of defined agglomeration economies in our preferred specification, namely localisation and diversity effects, appear as key variables in driving

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[17] In order to better motivate the chosen value for radius *R*, we must note that the average distance between the municipalities in the Region of Murcia is of 45.3 km, a value certainly close to our choice. Alternatively, two studies on the Spanish economy estimate an average radius of 15-30 km for the local markets of the municipalities of Catalonian and Valencian regions (Viladecans, 2001, 2004). At this respect, and given that the municipalities of the region of Murcia are slightly larger on average in terms of geographical dimension in comparison with those of the two regions mentioned, our estimated value for radius *R* appears to be a plausible one.

firms' choices, with our results showing that traditional, locally bounded, spillovers have an important attraction capacity over new industrial establishments. The principal urban centres of the region generate important agglomeration forces, with diversity economies appearing as the most salient agglomeration factor in the region. This result reinforces previous findings of the literature, which confers an increasing role to this type of externalities as an important location factor in this new century. Entrepreneurs identify the existence of a diverse industrial environment as a positive attribute for industrial locations, the same occurring in the services sector (Fujita and Thisse, 2002; Ellison et al., 2007). Equally, we observe that the two urban centres endowed with more than 100,000 inhabitants in the regional space, the cities of Murcia and Cartagena, appear to be the main destinations of industrial firms (DAERM). This evidence is also in line with our estimation results, given that it is precisely in these urban locations where new business can benefit from larger existing diversity economies.

Results for the *INDUSTRIAL SPECIALISATION* variable show that these intra-municipal externalities also play an interesting role, appearing to be significant for the decision-maker when choosing the location of a new firm. Firms clustering together can benefit from existing externalities, especially important being those generated by informal contacts among workers of the same industry, as well as other immaterial assets obtained in this way by the companies. At this respect, the region of Murcia is characterised by existence of historically consolidated industrial clusters, as it is the case of Yecla with the furniture industry, and Lorca and Cartagena for the agro-food industry. Additionally, the specialisation on industrial activities of a municipality appears as another relevant factor of attraction for new industrial firms in the region, as the estimated coefficient for the variable *INDUSTRY SHARE* shows. It then follows, that the companies in this region do appreciate locations with an important presence of industrial firms and industrial employment, together with an interesting amount of agglomeration economies both of diversity and localisation types. In addition, the variable *SERVICES SHARE* not appears to be statistically significant, although it presents the expected positive value in its sign.

Qualification of the labour force through educational training emerges as the most important factor influencing the location of firms in the region of Murcia, a result that points to the relevance that this factor has in the local (municipal) approach. Also, it seems to indicate that new firms confer a high value to education as a tool for developing and consolidating their activities, in an increasingly competitive global economy. Remaining results for our non- spatial model indicate that firms prefer those most populated municipalities in comparison to less populated ones, with the *POPULATION* variable acting as a demand-side location factor, although the variable shows a small elasticity value. Similarly, the institutional variable of the model (*INDUSTRIAL SURFACE*), that captures the availability of industrial land in municipalities where the firm's plant is built, is found to be another important factor influencing location decisions, becoming the third factor in importance in guiding such choices, just below human capital and the degree of specialisation in industrial activities of the municipality where the firm establishes. This result reflects again the important role that public authorities could play in managing local and regional development policies by providing a suitable environment where industrial firms can start and consolidate their activities, as other authors have shown (Woodward, 1992; Gabe and Bell, 2004).

Extending the conditional logit by introducing the spatially extended set of covariates allows us to test for the influence of inter-territorial (neighbourhood) spillovers in firms' location choices. Results from estimating the spatial conditional logit model are collected in **Table 2** (columns 3 and 4). In general, we observe that the results for the extended model closely follow those of the non spatial one, except for the *SERVICES SHARE* variable which now shows a negative sign in its coefficient, although it continues to be insignificant. The rest of coefficients appear to be highly significant, showing a reduction in their absolute values in comparison with those of the non-spatial model, except for *INDUSTRIAL SURFACE* and *DIVERSIFICATION* variables which show a slight increase in their estimated values. As a summary, we can conclude that the spatially extended conditional logit model employed in the research performs well, highlighting the important role played by our location factors in line with previous findings of the literature (Arauzo et al., 2008).

Regarding our spatial coefficient of interest δ, we obtain an estimated value of 0.83 which also shows highly significant. Moreover, we have tested whether the value of the spatial coefficient is above or below unity value, and we have been unable to reject the hypothesis that it is equal to or below one, that is, $\delta \leq 1$, what reinforces our theoretically-informed perception on what this value should be (**Table 2**).[18] According to the theoretical framework summarized in equation (5), this value implies that the characteristics of the chosen municipality appear to be more relevant than those of the

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[18] Test for checking robustness of the results are carried out along the empirical study, with all of our slightly modified specifications showing similar results.

neighbourhood for the decision-maker's choice, what seems to be a plausible result. In comparison with the results of Autant-Bernard (2006), and although we do not share the same methodological approach, a pseudo-δ can be inferred from her paper for the only particular spatially lagged location factor that appears to be statistically significant. It would render an inferred parameter of around 0.25-0.33 for the NUTS 2 regions of France.[19] Combining her and our results, we would infer that spillovers appear to be more important (three times as important) at a local (municipal) level than at a regional one. In Autant-Bernard's own words, that would add new evidence "*supporting the hypothesis of a decline of knowledge diffusion over space*" (*ibid*, p. 1196). In this way, this is a pivotal result of the investigation because it confirms the usefulness of the parameter δ in location studies, and the need to account for inter-territorial effects in the industrial location analysis.

Further results are obtained by computing elasticities for the estimated model for every municipality in our sample, making up the whole region of Murcia.[20] Note that we have calculated elasticities for both the standard conditional logit (**Table 3**) and the spatially extended model (**Table 4**). A detailed analysis of the elasticities by municipalities provides us with richer information useful in guiding local policy in this regional environment. Our results suggest that the most important factor at a municipal level is the existence of an important stock of human capital, here proxied by the fraction of the labour force which has completed secondary courses and upper levels of the education system. In fact, the estimated elasticity for this variable (*HUMAN CAPITAL*) is above a value of 2 for all the municipalities, according to the results of the spatial conditional logit model. The second variable in terms of importance for the firm's choice is the ability to benefit from agglomeration economies, with diversity economies playing a more important role than specialisation ones.

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[19] This exercise implies introducing our working assumptions in her framework of analysis, that is, assuming equality of her estimated β's between the own region's covariates and that of the spatially extended variables, and then extracting the inferred δ from her spatial parameter outcomes.

[20] Elasticity values are computed employing (evaluating) the observed value of every explanatory variable in the correspondent municipality. Elasticities are common in economics, providing unit-free measures of the degree of responsiveness of the dependent variable to changes in covariates. In our case, computed elasticities gives the percentage change in the probability of a firm locating in a given municipality as a result of a 1% increase in one of the municipality's attributes.

It is worth noting that the provision of urban land for new industries by the public sector (*INDUSTRIAL SURFACE*) is also a very important location factor, particularly for firms establishing in certain municipalities of the region, such as Lorca, Jumilla or Moratalla, which are rather distant from the administrative centre of the region (city of Murcia). On the contrary, the presence of a considerable number of industrial jobs in the chosen municipality, what reflects some municipal specialisation in industrial activities, as well the level of demand for products, approached by the population factor, turn out to be the least important factors in driving firms' choices. Notwithstanding, the level of demand appears to be important as a location factor for companies locating in the most populated municipalities of the region: Lorca, Cartagena and the city of Murcia, which show a value for their respective elasticities of 0.3, 0.7, and 1.0, for this factor. Comparing elasticities for the spatial and non-spatial specifications in **Table 2**, it is noted that, in general, the introduction of inter-territorial spatial effects in the model results in an increase in the value of estimated elasticities for *DIVERSIFICATION* and *INDUSTRIAL SURFACE* variables, and a reduction in the value for the other elasticities, with the coefficient of the corresponding *INDUSTRY SHARE* variable showing a remarkable decrease.

Finally, we have computed using estimated coefficients of the model the corresponding value of the probability of locating in every individual municipality of the region that the decision-maker assigns, including them in the last column of **Table 3** and **Table 4**. From these probabilities, and as a summary result, we can conclude that the main urban locations appear to maintain a higher capacity of attracting new industrial firms, with probabilities ranging from 30 per cent for the city of Murcia and 8 and 6 per cent for Yecla and Cartagena. In general, these municipalities also usually show higher elasticity values for each individual location factor included in the model, also being the main urban centres of the region.

4 Conclusions

Industrial location literature has experienced a boom in the last two decades, with a primary focus on identifying which are the main factors driving location choices of firms in an increasingly globalised world economy. The refinement of empirical methods employed in such studies has helped scholars to better understand the circumstances characterising these processes. The role played by externalities or spatial effects in influencing the choice of companies is one of the most vibrant topics of the literature.

In this context, the present investigation has been directed to continue extending the analysis of this central variable in two ways. In first instance, we have employed the local approach, using municipality data as our spatial unit of analysis. This has been proven as an appropriate empirical focus in dealing with spillovers, as noted by the literature on New Economic Geography, and we have shown that such spatial effects play a key role in influencing firms' decision- makers, confirming in this way the findings of previous investigations. In second term, we have extended the theoretical framework employed in industrial location studies in order to cope with inter-territorial spillovers, a spatial dimension of externalities not allowed for by preceding contributions. We have also observed the importance of such amendment in this type of studies, especially for the local approach. Confirmation of the existence of intense spill over effects and the relevance that inter-territorial externalities exert on firms' location choices at the local level are two primary contributions of the investigation, constituting a novelty for the spatial approach of industrial location studies.

After introducing our theoretical framework, we have empirically tested this methodology by employing a conditional logit model with spatially lagged explanatory variables. In the specification of the econometric model, we have introduced a spatial coefficient as another novelty in this literature. This parameter has served us to quantify the strength that neighbourhood effects (inter-municipal spillovers) exert in the firms' choice, thus allowing for a better understanding of the role played by such spatial effects at a local level. Definition of distance in our spatially extended conditional logit model have added another singularity to the paper, contributing to the debate on how to build the weight matrix and treating distances and space in extended models, an important and still open debate in the spatial econometrics literature.

The estimation results for our model, using detailed data on 8,429 firms located in the municipalities of the Spanish region of Murcia, appear to be largely consistent with previous studies on industrial location. Estimates of the spatial conditional logit have shown the important role played by local attributes in order to increase the attractiveness of a particular location for new industrial establishments. The presence of a highly educated and qualified workforce appears to be the most important factor in driving firm's decision-maker choices, followed in importance by the availability of industrial land at the municipality level, and the presence of important agglomeration economies, both of diversity and localisation. An important domestic local market or service specialisation of the municipality not appears to be important in general. However, the size of the local market appears to be relevant for industries located in the main urban centres of the region of Murcia.

Our findings have shown that accounting for inter-territorial spillovers are important in this type of studies, with attributes of neighbouring municipalities showing nearly the same importance as those of the chosen municipality itself for the decision-maker. Similarly, our results seem to reflect that local spatial spillovers are of greater extent at a local level than at a regional one, what reinforces the empirical evidence of a decline of spatial externalities over space. This point to the need of accommodating the spatial unit of analysis to the theoretical concept one wants to capture empirically in the study of such spatial effects. In this sense, the use of the municipality as the geographical unit of analysis has proved appropriate in order to capture spatial spillovers in the conditional logit approach.

Finally, our results have important implications in terms of regional policy. Firstly, they highlight the need to continue improving supply-side factors in order to push industrial development at a regional scale, showing that improving the educational training of the labour force appears as the most salient policy a locality could pursue. Secondly, agglomeration economies and other spatial spillovers not locally-bounded continue to be first order factors influencing industrial location processes, so policies directed to promote spatial clustering of firms continue to be important as an instrument to consolidate industrial areas at a local level. Promoting a rich and diverse industrial environment is even more important for pursuing this objective. Institutional factors also appear to be important, so industrial policy at a regional and local level should be more proactive if it wants to affect location choices, especially in a time of crisis. And thirdly, demand-side factors, such as the magnitude of potential demand, are shown again to be important once a certain threshold level has been exceeded. In summary, the results of the research show that this new framework of analysis serves to gain a deeper understanding of the firms' location decisions which in turn may help in the design of more efficient regional policy measures.

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Tables

Table 1 Number of firms by sectors

Sectors	Number of firms	NACE Rev.1 classif. (R93)
Food, drinks and tobacco	1500	15+16
Textiles	319	17(p)
Clothing	350	17(p)
Leather and shoes	290	18+19
Wood and cork products	552	20 (p)+36
Printing, and publishing	515	21+22 +23
Chemical	332	24
Rubber and plastic	247	25
Non-metallic minerals	637	14
Steel and metal products	1458	13+27+28
Agricultural and industrial	611	29
Office machinery, electric and electronic products	315	30+31+32+33
Furniture and other manufactures	1303	20(p) + 26
Total	8429	

Source: DAERM database.

Table 2 Conditional Logit estimates (with and without space)

	Conditional Logit		Spatial conditional Logit	
	coeff.	s.e.	coeff.	s.e.
SPECIALISATION	0.2005 ***	0.0189	0.1537 ***	0.0167
DIVERSIFICATION	0.7806 ***	0.0664	0.8920 ***	0.0711
HUMAN CAPITAL	6.8039 ***	0.2783	5.6948 ***	0.2716
POPULATION	0.0036 ***	0.0002	0.0038 ***	0.0002
INDUSTRY SHARE	1.2593 ***	0.1424	0.6599 ***	0.0990
SERVICES SHARE	0.2546	0.1717	-0.0309	0.0773
INDUSTRIAL SURFACE	0.8737 ***	0.0308	1.0377 ***	0.0272
δ			0.8307 ***	0.0446
Log-likelihood	−25179.98		−25026.98	
Pseudo-R^2	0.2106		0.2154	
AIC	0.1358		0.1350	
LR	13433.92 ***		13739.90 ***	
Number of obs.	370876		370876	
χ^2 ($\delta = 1$)			14.4236	
p-value ($\delta = 1$)			0.0001	
p-value ($\delta < 1$)			0.9999	
p-value ($\delta > 1$)			0.0001	
R (in km)			43.650	

Table 3 Conditional Logit model: elasticities

Municipality (j)	Explanatory variables							Prob.
	IND. SPEC.	*DIVERS.*	*HUMAN CAP.*	*POP.*	*IND. SHARE*	*SERV. SHARE*	*IND. SURF.*	
ABANILLA	0.3368	0.6573	2.8063	0.0227	0.4295	0.1154	0.2054	0.0083
ABARAN	0.1202	0.5598	3.3075	0.0465	0.0872	0.1759	0.0989	0.0069
AGUILAS	0.0673	0.5176	3.6184	0.1168	0.0996	0.1319	0.2179	0.0102
ALBUDEITE	0.0728	0.4560	2.7197	0.0051	0.4517	0.0609	0.0148	0.0037
ALCANTARILLA	0.3351	0.6320	3.9319	0.1362	0.5309	0.0875	0.0136	0.0281
ALEDO	0.1825	0.0000	3.0274	0.0036	0.6469	0.0981	0.0435	0.0046
ALGUAZAS	0.4433	0.3173	3.2806	0.0295	0.5968	0.0936	0.0208	0.0103
ALHAMA	0.6740	0.3360	3.3415	0.0672	0.2557	0.1705	0.2686	0.0148
ARCHENA	0.2002	0.5203	3.7612	0.0598	0.4068	0.1175	0.0138	0.0143
BENIEL	0.3610	0.5156	3.4333	0.0363	0.3622	0.1342	0.0086	0.0111
BLANCA	0.1651	0.5529	3.1974	0.0220	0.3911	0.1022	0.0754	0.0077
BULLAS	0.2548	0.2160	3.0548	0.0430	0.1635	0.0717	0.0714	0.0040
CALASPARRA	0.3374	0.2989	2.7199	0.0361	0.5774	0.0603	0.1616	0.0056
CAMPOS DEL RIO	0.8138	0.0773	3.1479	0.0075	0.9310	0.0272	0.0405	0.0137
CARAVACA	0.3439	0.5502	3.6377	0.0874	0.6507	0.0813	0.7143	0.0483
CARTAGENA	0.1076	0.1951	3.9902	0.7120	0.6516	0.0769	0.4584	0.0597
CEHEGIN	0.3882	0.5485	3.3239	0.0556	0.6803	0.0753	0.2563	0.0188
CEUTI	0.4905	0.4763	3.9409	0.0315	0.5412	0.0629	0.0085	0.0244
CIEZA	0.1388	0.6371	3.2752	0.1247	0.1871	0.1014	0.3173	0.0103
FORTUNA	0.3565	0.6262	2.6482	0.0314	0.5843	0.0471	0.1293	0.0071
FUENTE ALAMO	0.3428	0.5371	3.1798	0.0513	0.4624	0.0732	0.2366	0.0115
JUMILLA	0.2791	0.6482	3.3654	0.0854	0.1976	0.1207	0.8283	0.0236
LA UNION	0.1280	0.6066	3.4656	0.0579	0.2993	0.0948	0.0216	0.0092
LAS TORRES	0.6178	0.4878	3.5339	0.0665	0.8148	0.0466	0.0332	0.0259
LIBRILLA	0.2425	0.5400	2.5435	0.0152	0.5904	0.1014	0.0496	0.0050
LORCA	0.1767	0.6364	3.2818	0.3086	0.2287	0.1205	1.3841	0.0542
LORQUI	0.3396	0.6307	3.3279	0.0233	0.5285	0.1077	0.0138	0.0127
LOS ALCAZARES	0.0752	0.5769	3.9380	0.0480	0.1358	0.1648	0.0173	0.0125
MAZARRON	0.0527	0.5874	3.4644	0.1108	0.0585	0.1209	0.2762	0.0092
MOLINA	0.3037	0.6432	4.0433	0.2000	0.4984	0.1107	0.1426	0.0403
MORATALLA	0.4099	0.4428	2.8927	0.0298	0.8785	0.0266	0.8153	0.0228
MULA	0.3115	0.3116	3.4656	0.0582	0.4594	0.0712	0.5447	0.0167
MURCIA	0.0832	0.4731	3.2862	1.0432	0.1358	0.1204	0.5335	0.3108
PLIEGO	0.1390	0.3461	2.6446	0.0134	0.0219	0.1447	0.0253	0.0023
PTO LUMBRERAS	0.1059	0.6458	3.1490	0.0465	0.1335	0.1166	0.1259	0.0064
RICOTE	0.1536	0.4355	2.9494	0.0054	0.1568	0.0127	0.0766	0.0037
SAN JAVIER	0.0757	0.6167	4.1262	0.0985	0.0935	0.1517	0.0644	0.0168
SAN PEDRO	0.1030	0.5333	3.4407	0.0764	0.1404	0.1609	0.0191	0.0075
SANTOMERA	0.2255	0.6744	3.6588	0.0497	0.3077	0.1563	0.0379	0.0147
TORRE-PACHECO	0.1260	0.6312	3.4728	0.1014	0.1193	0.1052	0.1635	0.0097
TOTANA	0.2272	0.6054	3.0009	0.1022	0.3170	0.1071	0.2503	0.0086
ULEA	0.3073	0.0000	3.4147	0.0036	0.0534	0.1456	0.0348	0.0044
VILLANUEVA	0.0607	0.0000	3.7458	0.0069	0.0256	0.1190	0.0113	0.0044
YECLA	0.6703	0.3181	3.6592	0.1166	0.8229	0.0601	0.4979	0.0550

Table 4 Spatial Conditional Logit model: elasticities

Municipality (j)	Explanatory variables							Prob.
	IND. SPEC.	*DIVERS.*	*HUMAN CAP.*	*POP.*	*IND. SHARE*	*SERV. SHARE*	*IND. SURF.*	
ABANILLA	0.2579	0.7505	2.3465	0.0237	0.2250	0.0138	0.2437	0.0091
ABARAN	0.0922	0.6400	2.7696	0.0487	0.0457	0.0210	0.1175	0.0063
AGUILAS	0.0515	0.5902	3.0218	0.1219	0.0521	0.0157	0.2583	0.0123
ALBUDEITE	0.0558	0.5211	2.2759	0.0053	0.2368	0.0073	0.0176	0.0037
ALCANTARILLA	0.2575	0.7240	3.2992	0.1429	0.2791	0.0105	0.0162	0.0255
ALEDO	0.1400	0.0000	2.5352	0.0038	0.3394	0.0117	0.0517	0.0039
ALGUAZAS	0.3398	0.3628	2.7466	0.0308	0.3131	0.0112	0.0247	0.0099
ALHAMA	0.5183	0.3853	2.8061	0.0706	0.1345	0.0205	0.3201	0.0114
ARCHENA	0.1540	0.5969	3.1599	0.0628	0.2141	0.0141	0.0164	0.0104
BENIEL	0.2765	0.5889	2.8716	0.0379	0.1898	0.0160	0.0103	0.0117
BLANCA	0.1267	0.6328	2.6802	0.0230	0.2054	0.0122	0.0897	0.0061
BULLAS	0.1952	0.2468	2.5561	0.0450	0.0857	0.0086	0.0847	0.0042
CALASPARRA	0.2587	0.3417	2.2772	0.0378	0.3029	0.0072	0.1920	0.0051
CAMPOS DEL RIO	0.6273	0.0889	2.6500	0.0079	0.4910	0.0033	0.0484	0.0079
CARAVACA	0.2654	0.6330	3.0654	0.0921	0.3436	0.0098	0.8542	0.0417
CARTAGENA	0.0827	0.2237	3.3505	0.7476	0.3428	0.0092	0.5463	0.0565
CEHEGIN	0.2985	0.6290	2.7915	0.0584	0.3579	0.0090	0.3055	0.0154
CEUTI	0.3784	0.5479	3.3200	0.0332	0.2856	0.0076	0.0102	0.0179
CIEZA	0.1063	0.7279	2.7407	0.1304	0.0981	0.0121	0.3769	0.0104
FORTUNA	0.2731	0.7153	2.2151	0.0328	0.3062	0.0056	0.1534	0.0076
FUENTE ALAMO	0.2622	0.6126	2.6562	0.0536	0.2420	0.0087	0.2805	0.0134
JUMILLA	0.2139	0.7410	2.8175	0.0894	0.1036	0.0144	0.9841	0.0233
LA UNION	0.0977	0.6901	2.8874	0.0603	0.1562	0.0113	0.0256	0.0136
LAS TORRES	0.4763	0.5609	2.9759	0.0700	0.4298	0.0056	0.0397	0.0198
LIBRILLA	0.1858	0.6171	2.1285	0.0159	0.3095	0.0121	0.0589	0.0050
LORCA	0.1362	0.7317	2.7631	0.3250	0.1206	0.0145	1.6538	0.0485
LORQUI	0.2604	0.7212	2.7870	0.0244	0.2773	0.0129	0.0164	0.0120
LOS ALCAZARES	0.0574	0.6572	3.2855	0.0501	0.0710	0.0196	0.0204	0.0155
MAZARRON	0.0403	0.6690	2.8897	0.1155	0.0306	0.0144	0.3269	0.0125
MOLINA	0.2345	0.7406	3.4094	0.2109	0.2633	0.0133	0.1706	0.0330
MORATALLA	0.3136	0.5052	2.4169	0.0311	0.4598	0.0032	0.9667	0.0245
MULA	0.2397	0.3575	2.9119	0.0611	0.2418	0.0085	0.6495	0.0127
MURCIA	0.0636	0.5392	2.7428	1.0888	0.0710	0.0144	0.6319	0.3127
PLIEGO	0.1065	0.3953	2.2122	0.0140	0.0115	0.0173	0.0300	0.0028
PTO LUMBRERAS	0.0807	0.7341	2.6215	0.0484	0.0696	0.0139	0.1487	0.0116
RICOTE	0.1177	0.4976	2.4680	0.0057	0.0822	0.0015	0.0910	0.0038
SAN JAVIER	0.0579	0.7031	3.4450	0.1028	0.0489	0.0181	0.0763	0.0191
SAN PEDRO	0.0786	0.6073	2.8693	0.0797	0.0733	0.0192	0.0226	0.0110
SANTOMERA	0.1728	0.7706	3.0616	0.0520	0.1613	0.0187	0.0450	0.0148
TORRE PACHECO	0.0960	0.7174	2.8906	0.1055	0.0622	0.0125	0.1932	0.0150
TOTANA	0.1741	0.6915	2.5104	0.1069	0.1661	0.0128	0.2972	0.0090
ULEA	0.2359	0.0000	2.8623	0.0038	0.0280	0.0174	0.0414	0.0028
VILLANUEVA	0.0465	0.0000	3.1396	0.0072	0.0134	0.0142	0.0135	0.0029
YECLA	0.4981	0.3525	2.9695	0.1184	0.4184	0.0070	0.5734	0.0836

Figures

Figure 1 Percentile Map on the distribution of industrial firms by municipality in the Region of Murcia (Spain)

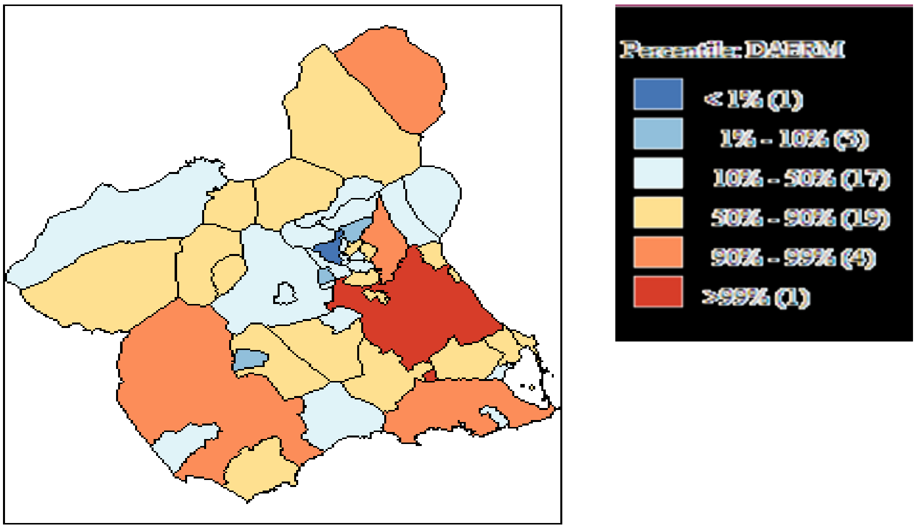
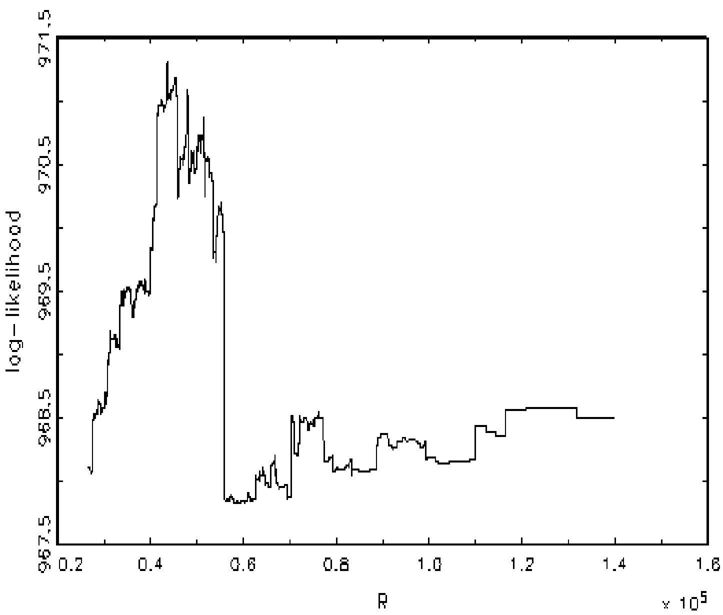


Figure 2 Grid search for radius (R) following the maximum-likelihood criterion



Appendix

Table A.1 Definition of the explanatory variables

Variable	Definition	Source
INDUSTRIAL SPECIALISATION	Industrial specialisation index computed as $$\frac{E_j^s \Big/ \sum_{s'=1}^{S} E_j^{s'}}{\sum_{j'=1}^{J} E_{j'}^s \Big/ \sum_{s'=1}^{S} \sum_{j'=1}^{J} E_{j'}^{s'}}$$ where E_j^s denotes sector s employment in the municipality j	DAERM (Regional Statistical Office of Murcia).
DIVERSIFICATION	Diversification index computed as $$1 - \sum_{r \in I} \left(E_j^r \Big/ \sum_{r' \in I} E_j^{r'} \right)^2$$ where E_j^r denotes industrial employment in sector r and municipality j over total industrial employment in the municipality j. The index takes values in the interval (0,1), where 0 indicates the lowest degree of diversification while 1 is associated to the highest degree of diversification	DAERM (Regional Statistical Office of Murcia).
HUMAN CAPITAL	Percentage of labour force with secondary and tertiary levels of education by municipality	Population Census, Spanish National Statistics Institute (INE)
POPULATION	Total population by municipality	Population Census, Spanish National Statistics Institute (INE)
INDUSTRY SHARE	Share of local industrial employment over regional industrial employment	DAERM (Regional Statistical Office of Murcia)
SERVICES SHARE	Share of local services employment over regional services employment	Regional Accounts (CRE), Spanish National Statistics Institute (INE)
INDUSTRIAL SURFACE	Industrial land availability by municipality	sueloindustrial-murcia.com

Chapter 2

The role of destination spatial spillovers and technological intensity in the location of manufacturing and services' firms

Abstract: Focusing on the characteristics of destinations, in this paper we seek for identifying the relevance of spatial spillovers while driving location choices of manufacturing and services' firms. With this objective, we apply a spatial conditional logit equation to empirically modelling the behaviour of 1,092,864 firms established in 316 municipalities of the Spanish Mediterranean Arc (SMA) during the period 1998-2008. Our econometric specification allows us to identify both types of external spatial effects, direct or locally bounded, and indirect or associated-neighbourhood spatial effects**.** Further, we propose a broad indicator of spatial spillovers generated by a given destination. Empirical findings show that spatial spillovers generated by destinations have greater impacts on location decisions of industrial companies relative to those of services. When we break down the sample by technological intensity of activities, we observe that spatial spillovers are more willing to affect decisions of high-tech companies relative to those of low-tech ones, which stay more locally bounded.
Keywords: spatial spillovers, location choice, technological intensity, spatial conditional logit.

1 Introduction

Examining the forces driving geographical concentration of economic activity is one of the most active topics in today's regional and urban studies. The New

Economic Geography, with the explicit consideration of the role of distance and transport costs (Fingleton, 2007), or the more recent Spatial Econometrics contributions (Anselin, 2010) provide good examples of it. That focus has converted external economies into one of the more scrutinised variables in economics, particularly when analysing location choices of firms and people (Glaeser, 2010). However, external effects seem to be traditionally approached as *local* in nature, that is, the spatial scope of those effects has been theoretically constrained to the spatial area defined as the unit of analysis, say a country, a region or a municipality. In this world, theoretical models did not allowed spatial effects to cross geographical boundaries, as one could observe in reality, with the fertile literature on location studies being the best example of this.[1]

As a natural extension, recent contributions in the literature try to escape this administrative constrain, highlighting the importance that inter-territorial externalities exert in agents' choices, leaving locally bounded space and focusing on the role played by relevant neighbourhood effects (Alamá et al., 2011; Autant-Bernard and LeSage, 2011). It would entail the fact that external economies emanated from a given destination does not only affect profits of firms localized in that destination, but also could be (and should be) affecting those of firms located in nearby destinations. Firms usually care for resources existing around the place where they decide to locate, and consequently the literature try to deal with effects arising in the proximity of the chosen location, that is in the local nearby environment.

Despite the attractiveness of this new focus for location analysis, contributions are still scarce given the difficulties of developing spatial extensions in traditional location models. Pioneer studies were mainly centred in transportation analysis, logistics, contracts theory, and housing decisions (Bhat and Guo, 2004; Mohamadian and Kanaroglou, 2003; Miyamoto et al., 2004). Turning to the industrial location topic, while stylized facts point to obvious effects of neighbouring areas on companies' decisions, mainstream literature have not integrated that issue in models until recent years, following the early work of Rosenthal and Strange, 2003. Some other authors, departing from such spatial econometrics extensions for discrete choice models, have started to extend the conditional logit specification in this direction, building on the Profit Maximization Framework of McFadden (Autant-Bernard, 2006; Jofre-Monseny, 2009; Alamá et al., 2011). Autant-Bernard (2006) studies the factors influencing the location of R&D laboratories in NUTS 2 regions of France within a conditional

[1] See Arauzo et al. (2010) for a recent and comprehensive review.

logit framework which incorporates spatially lagged explanatory variables. Jofre-Monseny (2009) focuses on the scope of agglomeration economies in municipalities belonging to the Spanish region of Catalonia. This work also relies on the conditional logit framework and includes industrial characteristics of the surrounding municipalities computed for concentric rings from each municipality. Finally, Alamá et al. (2011) estimate a spatially extended conditional logit model for explaining location decisions of manufacturing firms in municipalities of the Spanish region of Murcia. All three contributions are seminal in this literature and propose ways of progressively accounting for the spatial dimension in location analysis, an issue that at first sight could seem evident for another scientist outside from economics.

At this point, and with the main aim of continue extending the spatial location literature, the present paper abounds on the analysis of the role played by spatial spillovers in the location choices of new firms. As a novelty, we concentrate here in studying how local shocks affecting some characteristic of one particular municipality spills over neighbouring locations, with effects on their attractiveness as a potential location. In doing so, first we model such behaviour at a municipal level, following location literature recommendations in order to optimally deal with such spatial effects. Second, we employ a spatially extended discrete choice framework to model the location decisions of new firms as a function of both, the own location and its neighbourhood characteristics. Such new approach allows us to accommodate and describe interactions which take place among neighbouring locations and that affect agent's decisions. Further, we pursue to isolate pure spatial effects by defining a relative index of inter-municipal spatial spillovers. As a novelty here, we control for all covariates susceptible of inflating spatial effects parameters, given that departing from previous contributions we are not interested in identifying the role of every particular locational factor, but the role in this process of spillovers as opposed to traditional agglomeration economies locally bounded.

Third, we employ a rich dataset comprising more than 1 million of new firms establishing in 316 municipalities of the Spanish Mediterranean Arc (SMA) for the period 1998-2008, what allows us to clearly investigate the role of inter-municipal spatial effects in location choices. Fourth, as locational decisions may differ among industries, we also explore the potential differences that may arise in firms' behaviour depending on the technological content of the sector of activity they belong to.[2] All of these contributions are novelties in this literature: how we model spillovers and build our spatial effect measure, the spatial level of analysis employed in the study, the joint analysis of industrial and services firms' locational behaviour, and the richness of the dataset. Anticipating some of the results, empirical findings show that spatial spillovers generated by destinations have greater impact on location decisions of industrial companies relative to those of services. When we breakdown the sample by technological intensity of activities, we observe that spatial spillovers are more willing to affect decisions of high-tech companies relative to those of low-tech ones, whose business appear to be more locally bounded.

After this introduction, the structure of the paper is as follows: In section 2 we present the analytic framework employed along the study. In Section 3 we discuss the choice of the explanatory variables set, run out our empirical routines and discuss the main findings of the investigation. Section 4 finally concludes.

2 Model setting

This section introduces a location model based on the standard that the firm will choose the municipality with the highest expected profit among several alternatives. From the point of view of a firm i which operates in industry s, each municipality j in the set of possible locations offers an expected profit of π_{ij} such that

$$\pi_{ij} = x_j\beta + z_{sj}\gamma + \delta\left(WX_j\beta + WZ_{sj}\gamma\right) + \eta_j + \varepsilon_{ij}\,, \tag{1}$$

where the variables in x_j include those characteristics of the municipality affecting the location decisions of firms in *all industries* (population, accessibility of the municipality, availability of skilled labour force, etc.), while z_{sj} just account for those local characteristics affecting the location decisions of firms *belonging to the industry s* (mainly, the degree of specialization of the municipality in industry s); WX_j and WZ_{sj} are spatially weighted averages of the

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[2] We follow the Eurostat and OECD classification of industries, according to global technological intensity (measured by the R&D expenditure to value added ratio), and resulting in the definition of high-technology, medium high-technology, medium low-technology and low-technology manufacturing industries, together with knowledge-intensive services (here referred as *high-tech services*) and less knowledge-intensive services (*low-tech services*).

characteristics of the municipality's neighbours, either common to all industries or relative to a particular one, respectively;[3] η_j is a municipality random effect capturing the *unobservable* locational advantages of those municipality,[4] while ε_{ij} is a random term capturing other unobservable factors which determine the expected profits from locating in municipality *j* for firm *i*.[5]

The specification shown in equation (1) implies that the expected profits from establishing in a given location *j* does not solely depends on its capability to offer an appropriate environment, but also on its neighbourhood characteristics. It might affect new firms by enlarging their potential demand, for example providing skilled labour force, or by stimulating knowledge spillovers beyond municipality's limits. So, in this setting the higher the value of δ, the more decisive the neighbourhood would be for the decision-maker, relative to the municipality *j*'s own attributes. Moreover, we assume that these spatial externalities decline with geographical distance, this feature being captured by the use of an inverse-distance weighting scheme (implicit in the definition of our spatial weight matrix *W*).[6] Conversely, it is assumed that the relative importance of each covariate remains the same in x_j and z_{sj} and dissipates with

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[3] Defined as: $WX_j = \sum_{k \neq j} w_{jk} X_k$, and $WZ_{sj} = \sum_{k \neq j} w_{jk} Z_{sk}$, with weights w_{jk} inversely related to geographical distances among locations and corresponding to the elements of a spatial weight matrix (see Section 3 for details).

[4] It is assumed that the $\exp(\eta_j)$'s are *i.i.d.* with a Gamma distribution with parameters (η, η) so that $\mathrm{E}\left(\exp(\eta_j)\right) = 1$ and $\mathrm{Var}\left(\exp(\eta_j)\right) = \eta^{-1}$.

[5] The theoretical model builds on the original contribution for location analysis of Guimarães et al. (2004).

[6] Our modelling strategy assumes that spillovers locally disseminate around a small circular neighbouring area, then dissipating from a threshold distance. Evidence for this issue in the case of Spain is provided by Alañón et al. (2007), whom obtain a circle of 100-150 km. Rosenthal and Strange (2003) calculate a similar distance value for its exercise with US counties data. Recently, Arauzo (2011, p. 9), assume a circle of 60 km when building their distance-based W matrix for Catalonian municipalities, given previous empirical findings for the SMA. In addition, Arauzo (2008) employing spatial econometric techniques concludes that local/municipal level of spatial aggregation is the best focus for dealing with the type of externalities we intend to capture in our model. All of this evidence informs us when choosing the municipality as the unit of analysis for our empirical exercise and also explains the method we have

distance for their spatially-lagged counterparts, WX and WZ_s, with effects of shocks just propagating until a certain threshold, and then dissipating. Such an assumption implies that we would have the same β and γ parameters multiplying both location j own characteristics and those of its neighbours.

The basic idea underlying this framework is straightforward: the firm chooses locating the plant in the most profitable location, as it is common in a discrete choice model location framework. Thus, location j is chosen by a firm if the (expected) profit of choosing such a location is higher than those(expected) of locating in any alternative place. Hence, the probability of choosing location j is:

$$\Pr\left(\pi_{ij} > \pi_{ik}\right), \text{ for } j \neq k, \text{ and } j,k = 1,2,\ldots,J\ , \tag{2}$$

and it can be shown that if the error term ε_{ij} is *i.i.d.* according to a type I extreme value distribution, the probability that a firm chooses municipality j conditional on the η_j's can be written as:

$$P_{j|s,\eta} = \frac{\exp\left\{x_j\beta + z_{sj}\gamma + \delta\left(WX_j\beta + WZ_{sj}\gamma\right) + \eta_j\right\}}{\sum_{k=1}^{J}\exp\left\{x_k\beta + z_{sk}\gamma + \delta\left(WX_k\beta + WZ_{sk}\gamma\right) + \eta_k\right\}}. \tag{3}$$

The main focus of the paper is then on identifying how spatial spillovers emanating from each municipality j, affect their associated neighbourhood characteristics, and then their attractiveness for potential new firms. Shocks then arise to municipality j changing some of its characteristics (specified in covariates) and impact on the probability of their neighbours for attracting new firms. To create an operational definition of such theoretically defined spatial spillovers, we consider the derivative:

$$\frac{dP_{k|s}}{dx_j} = \frac{\partial P_{k|s}}{\partial x_j} + \sum_{r\neq j}\frac{dWX_{r|s}}{dx_j}\frac{\partial P_{k|s}}{\partial WX_{r|s}}, \quad k \neq j\ , \tag{4}$$

which measures the impact of a marginal change in the covariates of the municipality j on the expected probability of the municipality k to attract firms

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selected for defining the W matrix as a distance-based one, with spatial effects declining with distance. It must be said that this method of defining the W matrix has yet become a standard in spatial econometrics studies (see, e.g., LeSage and Pace, 2009 for a wider theoretical approach to the issue).

operating within the sector of activity s, $P_{k|s} = E(P_{k|s,\eta})$.[7] From equation (4) it is clear that only the second term on the right-hand side of the equation represents a truly change of the probability $P_{k|s}$, induced by changes in neighbourhood characteristics. That is, the spatial cross regressive terms enter the expected profits function of the other municipalities given by equation (1)and, therefore, represents the appropriate measure of the spatial spillovers that being searched, which will be denoted as $SSE_{j \to k|s}$. From equations (1) and (3), it follows that

$$SSE_{j \to k|s} = \delta P_{k|s} \left(w_{kj} - \sum_{r \neq j} w_{rj} P_{r|s} \right) \beta, \quad k \neq j \, . \tag{5}$$

Note that the intensity of this spatial spillover effect depends on two key elements: First, in the value of δ, where the higher the value of this parameter, the more intense the spatial effects provided that, being this the case, the characteristics of the neighbourhood would be more relevant in determining the expected profit from locating in a given municipality. And second, on the relevance of the municipality j as a neighbour of municipality k, given by the elements of the spatial weigh matrix, W. In this sense, closer neighbours to location k would be characterized by a higher value of the corresponding element of the k-th row of W and, consequently, the term in parenthesis in equation (1) would be also higher.[8] Finally, it must be highlighted that the magnitude of the spatial spillover from municipality j to municipality k is proportional to the probability $P_{k|s}$; that is, the location k would benefit more from spillovers from municipality j whenever it tends to concentrate a higher amount of firms operating in the particular industry s.

Since spatial spillovers arising from changes in a single municipality j depend on the (size and distance) of municipality k benefiting from them, it is interesting to define a summary measure of total spatial spillovers generated by

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[7] We acknowledge an anonymous referee for his/her help in order to improve our specification of the spillover measure.

[8] Note that the term w_{kj} is inversely related with geographical distance between locations k and j, while $\sum_{r \neq j} w_{rj} P_{r|s}$ is a weighted average of elements of the terms in the k-th row of the W matrix. Thus, if w_{kj} is greater than the average, the spatial spillover would be positive, and negative otherwise.

each municipality j in the sample. Accordingly, we construct a summary index by integrating the terms $SSE_{j \to k|s}$ over every location $k \neq j$:[9]

$$SSE_{j|s} \equiv \sum_{k \neq j} SSE_{j \to k|s} = \delta P_{j|s} \sum_{k \neq j} w_{kj} P_{k|s} \beta \,. \qquad (6)$$

Furthermore, as the total spatial spillovers generated by a municipality depends on its relative position as an attractor of firms ($P_{j|s}$), it also seems appropriate to use a relative measure of spatial spillovers, defined as the ratio of spatial indirect effects $SSE_{j|s}$ to direct effects $DE_{j|s} = \frac{dP_{j|s}}{dx_j}$, in order to avoid size bias. That ratio does not depend on the β coefficients and thus is able to provide a standardised (scale-free) measure of the spatial spillovers associated to each municipality in the sample.

3 Estimation results

This section is devoted to quantify emanating spatial spillover effects affecting firms' location choices in the analysed area. To this end, we start by introducing our data set and explanatory variable. Further, estimates of the spatially extended conditional logit model specified in equations (1)–(3) are used to construct the summary indices $SSE_{j|s}$ for each municipality in the model (see equation (6)).

3.1 Data description

Our analysis draws on a data set for the population of firms established in the Spanish Mediterranean Arc (SMA, henceforth) provided by the Spanish National Statistics Institute (INE). The SMA is here defined as the territory of the Spanish Mediterranean seaboard stretching from the French frontier to the Straits of Gibraltar, that is, between the regions of Catalonia and Andalusia. Because of differences in levels of economic development, infrastructures, and competitiveness, Catalonia and Valencia show a more favourable position in a wide range of economic indicators in comparison with the other two regions making the SMA (Murcia and Andalusia).

[9] This summary measure of generated spatial spillovers resembles the *Total Impact from an Observation* measure introduced in LeSage and Pace (2009).

The areas that make up the SMA constitute 40.9% (approximately 19 million inhabitants) of the population of Spain (3.8% of EU-27); 18.9% of the surface area of Spain (2.2% of EU-27); and their GDP represents 40.6% of Spain (3.7% of EU-27). Thus, the SMA as a geographical unit concentrates more than 40% of Spanish population and economic activity in less than 20% of the total country surface. During the last decades the area has registered an important demographic growth (boosted by migratory flows), resulting in high population densities, particularly on the seaboard. Other distinctive characteristics of the SMA include a strong specialization in tourism and leisure related activities which exploit environmental advantages (climate, landscape, etc.). Moreover, the manufacturing sector rests on SMEs mainly concentrated on traditional activities.

A detailed analysis of the spatial configuration of the SMA reveals the existence of two territorial imbalances which are in turn reinforced by a deficient articulation of the transport infrastructures. First, there is a remarkable contrast between the active and densely populated seaboard and the rather inhabited inland. Secondly, there exists a discontinuity in the urban network. Southwards, we will find the Barcelona's urban agglomeration, the metropolitan area of Valencia, and a set of coastal cities from Benidorm to Cartagena. At this point it takes place a marked decline of urbanized areas in the extension of the SMA to Andalusia (except for the metropolitan area of Málaga). Furthermore, in the whole area under study two cities, Barcelona and Valencia, make the difference in terms of global connectivity, both of them becoming well consolidated urban structures connected to the rest of Europe. Finally, note that this last imbalance is consistent with the already stated minor relative development of the southern regions comprised by the SMA.

In this context, the data set comprises 1,092,864 plants located in 316 municipalities during the period 1998-2008.Since services now occupy a large proportion of jobs in the SMA, they are worth of attention and, departing from other studies on activity location, traditionally focused on the manufacturing sector, we include both, services and manufacturing firms in our analysis. Moreover, we assume that the relevance of the different determinants of the location choice may vary according to the own characteristics of the industry the firm belongs to. Consequently, we split our whole sample into four sub-samples, and estimate an individual model for manufacturing and services firms, also considering the existence of high and low technological activities inside every raw sector. The classification scheme for sectors of activities is shown in **Table 1**.

Finally, the spatial distribution of the firms among the SMA municipalities is depicted in **Figure 1**, where it is clearly showed that a large proportion of firms are established in the urban metropolitan areas of Barcelona and Valencia, together with those municipalities located in the coastal corridor (it should be added that, in general, administrative centres tend to be located in this area).

3.2 Model estimates

This paper is not intended to elaborate a comprehensive model of location choices of firms in the SMA, but to quantify the role played by spatial spillovers in such empirical issue, building in the econometric specification of equations (1)–(3). Subsequently, drawing on prior studies we include a list of explanatory variables that have become standard in the literature on industrial location (see for example the survey by Arauzo et al., 2010).[10] Their exact definition and data sources are summarized in **Table 2**.[11]

The set of explanatory variables employed when analysing the location pattern of new firms starts by including regional dummies (RCAT, RMUR, RAND) to capture differences in their cultural and institutional frameworks.[12] The design of the Spanish infrastructure networks clearly favours urban centres, so locations close to administrative centres would benefit from better accessibility,[13] expecting this variable (DISTHEAD) to be, ceteris paribus, negatively related to the firms' expected profits, as in traditional geography studies. The human capital index (HC3) is expected to act as an attractor of new firms, provided that availability of qualified workforce eases the adoption of advanced production technologies and promote information and knowledge diffusion through spillovers. The existence of a large enough local market may also act as an

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[10] Even though some explanatory variables may be still omitted, we are confident this does not pose a significant problem because of the inclusion of a random effects term in the model specification and regional dummies. Employed covariates are taken from previous studies for Spain and the SMA (see Arauzo, 2011).

[11] All continuous explanatory variables are expressed in logs.

[12] Spanish regions are to a large extent responsible for taxes, subsidies, and other policies which may potentially influence the attractiveness of municipalities for new firms.

[13] Note that administrative centres tend to coincide with largest municipalities which concentrate the supply of specialized services, etc.

important factor, so in order to capture such dimension we use the municipality population as a proxy (POPULAT). Urban population density (POPDEN) proxies land prices since industrial and residential users compete for available land. Finally, potential agglomeration economies are accounted for by the firm density per squared kilometre (FIRMDEN) and an index of economic diversity (DIVERS), both accounted for reflecting the existence of important urbanization economies. We also include the location quotient for each industry s in each municipality (FESPSECT) in order to capture specialisation or traditional localization externalities (MARS-type economies). In this way, all types of explanatory variables in location models are accounted for, including institutional and infrastructure variables, agglomeration forces, and supply and demand factors.

Additionally, the model includes cross-regressive spatial terms (WX_j, WZ_{sj}) that capture the characteristics of the neighbours for each municipality j which may act as important forces underlying location choices. To compute these terms, the spatial weight matrix W is defined in terms of the inverse Euclidean distances among municipalities with a representative term:

$$w_{jl} = \begin{cases} d_{jl}^{-1} \Big/ \sum_{l \neq j} d_{jl}^{-1} & \text{if } d_{jl} \leq R \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

where d_{jl} is the Euclidean distance between municipality j and municipality l, and R represents a critical distance determining the range of action of spatial effects,[14] if present. Note that, by construction, w_{jl} satisfies $w_{jl} = w_{lj}$, $w_{jj} = 0$ and $\sum_j w_{jl} = 1$. Finally, this definition of the W matrix implicitly assumes that spatial effects tend to dissipate as the physical distance between locations increases, and eventually disappears beyond a critical radius. This implies that the value of the explanatory variables in more distant places will contribute less than values close by in the computation of the spatially lagged terms.

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[14] In order to determining the most appropriate value for the parameter R, we adopt the approach proposed by Ferstl (2007). This implies computing the Moran's I statistic for spatial correlation for different values of R and selecting a value R_{opt} such that:

$$R_{opt} = \arg\min_R \mid z_{\mathcal{I}}(y^*) \mid, \quad 0 < R < +\infty \,,$$

where $z_{\mathcal{I}}(y^*)$ is the standardized Moran's I statistic for the spatially filtered data.

Table 3 presents the estimation results obtained for different sectors of activity, from which it can be drawn some general conclusions about the role played by every explanatory variable included in the econometric specification. In general, the estimated parameters show the expected sign and their magnitudes match with those found by the comparable literature employing logit models in location choice analysis.

Potential interaction effects among different municipalities in the firms' location choices are captured by the δ parameter. We find that spatial effects are significant albeit they exhibit a rather wide range of values, from 0.06 to 0.62 for industry and from 0.25 to 0.36 for services. Spatial effects are more pronounced for high-tech industry firms, while for low-tech industrial firms we find that neighbourhood seems to be not so relevant (the estimated coefficient is 0.06). According to this result, firms in the high-tech manufactures exhibit a more pronounced tendency to look for sources of positive externalities (via knowledge sharing, labour market pooling, etc.), beyond the municipality where they are localized as compared to other firms in the low-tech industries. This result is widely consistent with the fact that access to knowledge should be particularly relevant as a search strategy for high-tech industries, and consequently, there are evident potential benefits from co-location in municipalities' networks. This is also consistent with one of our empirical findings concerning the relevance of localization economies emerging from the very own municipality were the firm is located (we obtained a lower coefficient for the corresponding explanatory variable, the location quotients, in the case of high-tech manufactures).Turning to the services activities, the local neighbourhood seems to exert a rather moderate effect in the location decisions of services firms, especially when compared with high-tech manufacturing firms. For these services firms it seems to emerge a sort of *home market effect*, that is, services firms could potentially obtain enough local demand to exploit economies of scale, thus lessening the importance of the neighbourhood. Moreover, this effect seems to be of a comparable magnitude in both high-tech and low-tech services.

The conditional logit model also includes a random term (η_j), that is, a factor that looks for capture the effects of unobserved exogenous variables at the municipality level, such as physical or geographical characteristics. As suggested by Guimarães et al. (2004), if we interpret the independence from irrelevant alternatives as an omitted explanatory variables problem, then the random effect would contribute to mitigate this drawback of the conditional logit model.

3.3 Spatial spillovers

The conditional logit model allows us to investigate the spillover effects generated by changes in the characteristics of each municipality through its impacts in the surrounding environment of other municipalities in the SMA. As noted above, these effects come from two sources: the first one is induced by the model specification (that is, this effect would be also present in a not spatially augmented conditional logit model), while the second is due to the explicit recognition of the possibility of spatial effects in the firm location choice (this effect would only appear if the conditional logit model is augmented to include spatially weighted explanatory variables). Regarding the former source, a marginal change in one of the explanatory variables in the municipality j would improve the expected profits from choosing that location, thus decreasing the attractiveness of the other potential destinations for firms. The spatial indirect effects then arise, given a marginal change in a covariate characterising the municipality j, from an improvement of the expected profits of locating in neighbouring municipalities, which in turn will increase their attractiveness for the localization of firms.

Figure 2 depicts the distribution of the estimated spatial spillovers emanated from municipalities of the SMA.[15] To interpret correctly these results it must be underlined that the magnitude of the spatial spillovers emanated from a given municipality are a function of two basic factors. First, it depends on how much relevance firms assign to the neighbourhood area characteristics when computing their expected profits of locating in a particular destination; and this is controlled by the parameter δ. In this sense, for the case of the high-tech manufactures we obtained the highest estimated value for this parameter and, accordingly, overall spatial spillovers are more relevant for this type of

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[15] Note that from the model estimates it is possible to construct a measure of spatial spillovers from a municipality j for every sector of activity s (among those included in each sub-sample), that is, we can compute $SSE_{j|s}$ and $DE_{j|s}$. However, to simplify the discussion of the results, in **Figure 2** we computed aggregated measures of spatial effects from a municipality as a weighted average of the form:

$$SSE_j = \sum_s \frac{n_s}{n} SSE_{j|s}$$

where n_s represent the number of firms in the sector s, and n is the total number of firms in the corresponding sub-sample.

economic activities as compared with low-tech industries and services. Secondly, the magnitude of the spatial spillovers emanating from a given location is determined by the average distance to other municipalities as they contribute to shape the characteristics of the neighbouring area, thus increasing the expected profits from locating in that municipality. Subsequently, we expect municipalities integrated in dense urban networks to exhibit the greatest capability to generate spatial spillovers, being this effect particularly evident for the municipalities included in the metropolitan areas of Barcelona and Valencia.

In the case of high-tech manufactures, from **Figure 2(a)** it is clear that the main focus of spatial spillovers is defined by Barcelona and municipalities located in its vicinity. This result is explained by both, the high concentration of firms operating in this sector of activity in these locations, and the geographical proximity among them. Furthermore, municipalities in the metropolitan area of Valencia also display a noticeable ability to generate spatial spillovers, together with some locations in the South which concentrate firms operating in the manufacture of transport equipment. For the case of low-tech manufactures, apart from the metropolitan areas of Valencia and Barcelona, a group of municipalities in the *provincia* of Alicante reveal themselves as relevant sources of spatial spillovers. These municipalities exhibit a high specialization (and concentration) of light industry firms (mainly footwear and leather manufactures).

Regarding the services sector, some interesting remarks arise from **Figure 2(b)**. For high-tech services, in general, we find that municipalities' showing the highest capability of generating spillovers coincide with administrative heads (which barely match the largest municipalities in the SMA). It may be explained because that administrative heads tend to constitute the centre of the urban networks, in contrast with other municipalities of the SMA, which appear rather geographically isolated. With respect to the low-tech services, given the relevance of tourism related activities in the SMA, we find that those municipalities with the greatest potential to generate spatial spillovers are clearly related to the main touristic destination in the SMA, including Barcelona, and the coastal areas of Alicante, Málaga and Cádiz, given the relevance that sun and sand products still detent in the whole tourism market.

These results, considered as a whole, are consistent with the centre-periphery model of agglomeration for the SMA, given that coastal located municipalities reinforce their spatial effects each other, while inland localities are losing attractiveness for new firms progressively, given the behaviour underlying our model specification. That is really what we have been observing historically in the geography of the SMA. Because of that reason, in this particular case Cohesion and Regional European funds appear to be of great relevance in order to offset centrifugal forces, thus making a decisive contribution to balance the location of economic agents, such as firms and population, in the territory. The same could be applied to the rest of EU regions, especially for Southern region, so the results of our exercise appear to contribute to the territorial debate always opened regarding directives of the EU regional policy.

4 Conclusions

Introducing space in location analyses is of major interest for regional and urban studies. In this paper we have analysed the quantitative relevance of spatial spillovers for firms' location choices at the municipality level, defining such type of effects and proposing a method of measuring them. In contrast with previous empirical studies, our focus has been in capturing how changes in one characteristic of a given municipality spills over the surrounding area, then increasing its attractiveness for potential new firms. With this objective, we have estimated a spatial conditional logit, in order to identify the role of such inter-municipal externalities in the location search process. Seeking to improve the measurement of such spatial effects, we have included in our model regional dummies and random effects that controls for unobservable characteristics of municipalities and omitted covariates, this being an important issue not addressed by previous contributions.

We have also included information for both manufacturing and service industries in the analysis, employing a municipal focus in our exercise and providing a rich data set in comparison with the previous scarce literature on the topic. It has helped us to better identify the role of spatial effects in driving companies' decisions. Moreover, we have analysed the relationship between pure spatial effects and the technological content of the sector of activity analysed, obtaining that the net spatial effects may vary considerably among sectors, as has been corroborated for the empirical analysis.

As a summary, main findings support the hypothesis that inter-territorial spatial effects matter for the location decisions of firms in manufacturing and service industries. Moreover, we have found evidence that, beyond the characteristics of each potential location, firms also take into account the features of the neighbouring locations in order to decide where to locate. However, the empirical relevance of space in the firms' decision process is found to vary according to sectors of activity. In this regard, we have found that the neighbouring area characteristics are much more relevant for the high-tech manufacturing industries than for the services ones, with the latter being more focused on the own municipality characteristics and effective demand.

Finally, from the policy oriented view, our results point to the major effectiveness of defining differentiated policies for industry and services activities, also including a focus on their technological content. In this way, policies aimed to enhance the attractiveness of municipalities, as potential destinations for the establishment of new companies, must be aware of the characteristics and specialisation of the surrounding area, having in account that the success of such policies could at least partially rely on those specific issues.

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Tables

Table 1 Classification of economic activities

	Economic activities	ISIC codes
High-tech manufactures	Manufacture of chemical industry	24
	N.E.C. machinery and equipment	29
	Office machinery, computing machinery	30
	N.E.C. electrical machinery apparatus	31
	Radio, TV and Communication equipment	32
	Medical, precise, optical instruments	33
	Manufacture of motor vehicles and trailers	34
	Other transport equipment	35
Low-tech manufactures	Food products and beverages. Tobacco products	15,16
	Textile products	17
	Wearing apparel	18
	Dressing of leather	19
	Wood products (except furniture)	20
	Manufacture of paper and paper product	21
	Publishing and printing	22
	Other manufactures	36
High-tech services	Post and telecommunications	64
	Computer and related activities	72
	Commercial R&D services	73
Low-tech services	Wholesale and retail trades. Hotels and restau-	50,51,52,55
	Land, water, air transport and supporting ser-	60,61,62,63
	Finance & insurance	65,66,67
	Real estate activities. Business support activities	70,71,74

Table 2 Independent variables: definition and data sources

Variable	Definition	Source
RCAT, RMUR, RAND	Dummies for NUTS 2 regions (Catalonia, Region of Murcia, Andalusia). The reference category is the Valencian Community.	Own elaboration
DISTHEAD	Distance to administrative head in km.	Own elaboration
HC3	Ratio of labour force having attained a higher education degree to total labour force, 1998.	INE
POPULAT	Number of inhabitants in the municipality, 1998.	Censo (INE)
POPDEN	Urban population per squared km, 1998.	Censo (INE)
FIRMDEN	Number of firms per squared km, 1998.	DIRCE
DIVERS	Index of diversification computed as the inverse of the Herfindahl index for the share of the number of firms in each industry over total firms established in each municipality, 1998.	Own elaboration from DIRCE
FESPSECT	Location quotient for each economic activity (disaggregation at 2-digit level), 1998.	Own elaboration from DIRCE

Table 3 Location choice of firms in the Spanish Mediterranean Arc: conditional logit model

	Manufactures		Services	
Parameters	High-tech	Low-tech	High-tech	Low-tech
RCAT	–0.0157	0.0873	0.0821	0.0635
RMUR	0.2676 ***	0.2815 ***	0.3226 ***	0.3389 ***
RAND	–0.0152	0.0578	0.0320	–0.0293
DISTHEAD	–0.0706 **	–0.0130	–0.0423	–0.0366
HC3	0.5805 ***	0.6002 ***	0.7545 ***	0.6073 ***
POPULAT	0.1987 ***	0.2669 ***	0.3986 ***	0.2391 ***
POPDEN	–0.2853 ***	–0.2264 ***	–0.4318 ***	–0.3167 ***
FIRMDEN	0.1348 ***	0.1919 ***	0.2791 ***	0.2327 ***
DIVERS	–0.1954	–0.7482 ***	–0.3899 **	–0.8715 ***
FESPSECT	0.4329 ***	0.8934 ***	0.1997 ***	0.7613 ***
δ	0.6217 ***	0.0655 ***	0.2583 **	0.3616 ***
$\ln(\eta)$	1.4453 ***	1.4699 ***	1.4869 ***	1.4902 ***

The dependent variable is location choice. The model specification includes sectoral dummies (disaggregation at 2-digit level).
(***), (**), and (*) indicates significance at the 1%, 5% and 10% level.

Figures

Figure 1 Geographical distribution of firms in the Spanish Mediterranean Arc

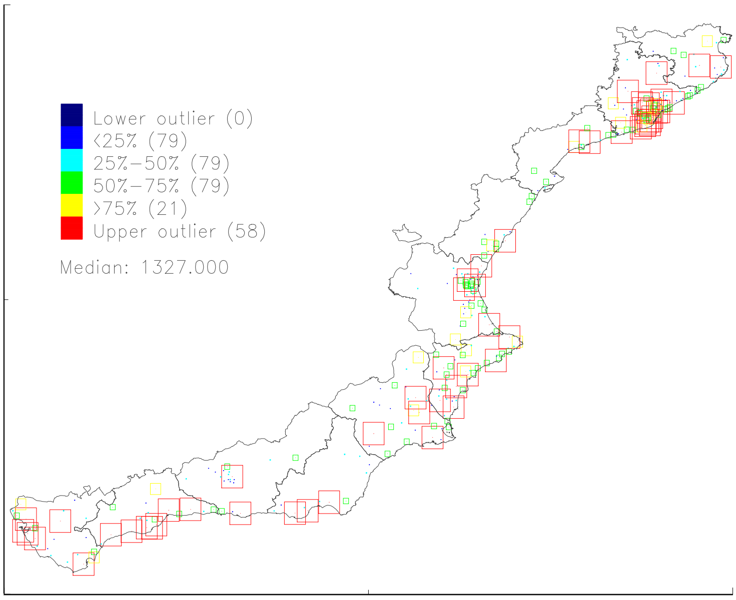
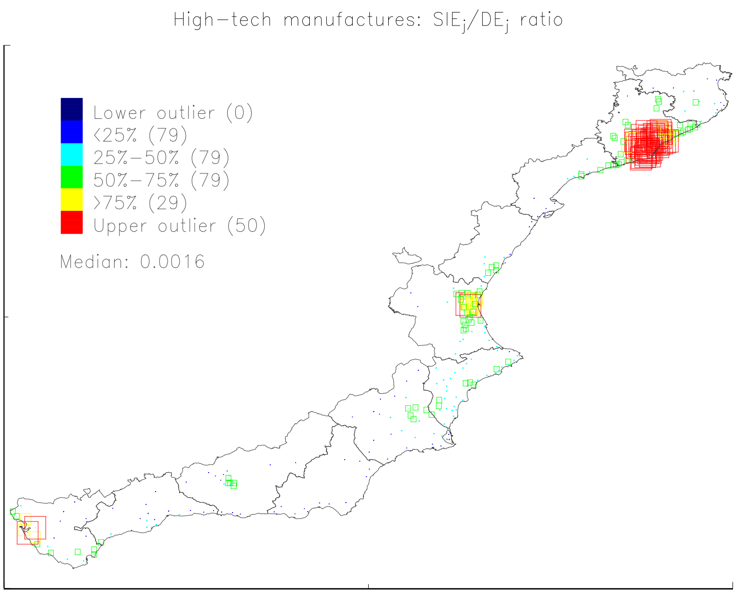
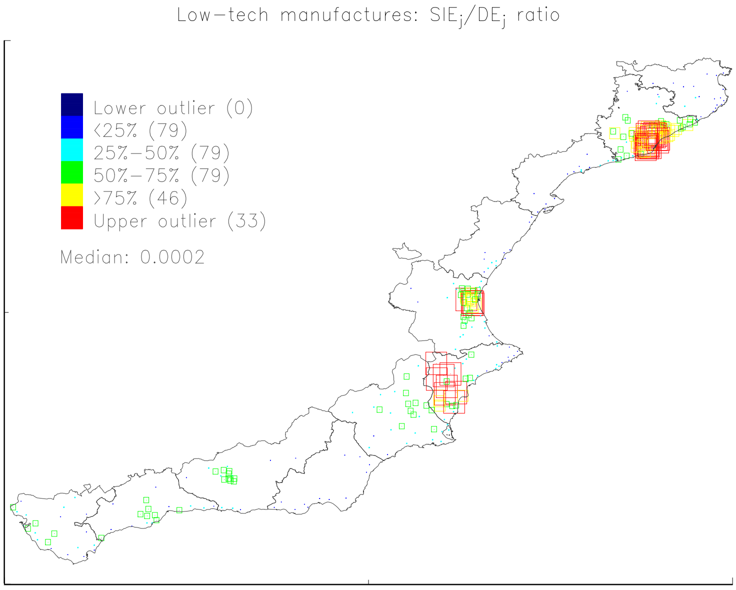
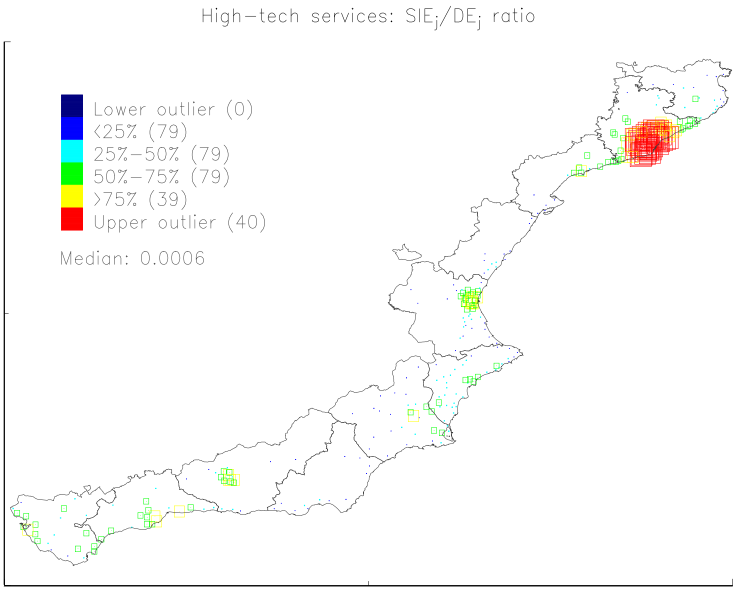
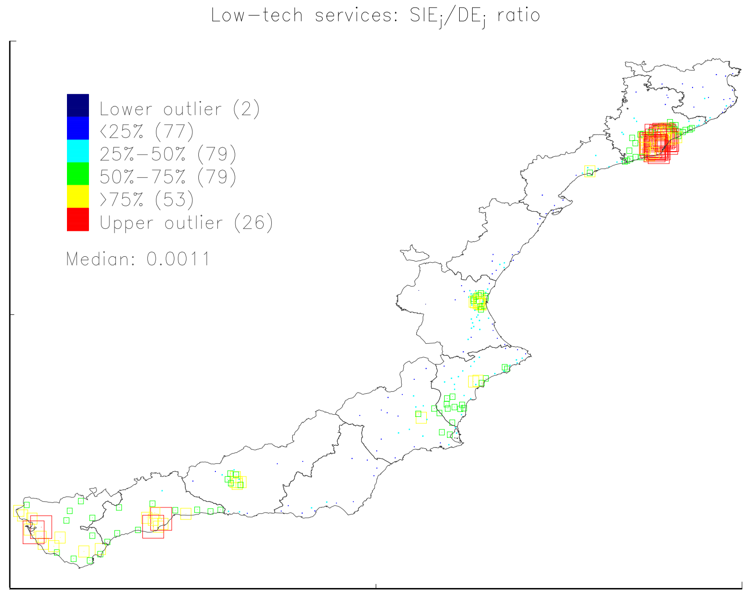


Figure 2 Geographical distribution of spatial spillovers from each municipality




Low−tech manufactures: SIE$_j$/DE$_j$ ratio
Lower outlier (0)
<25% (79)
25%−50% (79)
50%−75% (79)
>75% (46)
Upper outlier (33)
Median: 0.0002


High−tech services: SIE$_j$/DE$_j$ ratio
Lower outlier (0)
<25% (79)
25%−50% (79)
50%−75% (79)
>75% (39)
Upper outlier (40)
Median: 0.0006


Low−tech services: SIEj/DEj ratio
Lower outlier (2)
<25% (77)
25%−50% (79)
50%−75% (79)
>75% (53)
Upper outlier (26)
Median: 0.0011

Chapter 3

Spatial effects in industrial location choices: industry characteristics and urban accessibility

Abstract: In this paper we study how neighbourhood-related spillovers affect location choices of manufacturing firms at a local level. A Spatial Dirichlet-Multinomial regression model is applied to 90,000 new establishments of the Spanish Mediterranean Arc. Empirical findings show that spatial spillovers play an important role, together with traditional explanatory factors, in driving decisions of companies. Their size and scope depends on two main issues, the specific characteristics of the manufacturing industry the firm belongs to, and the accessibility of the urban environment where the firm is located.
Keywords: location, spatial spillovers, industry characteristics, urban accessibility

1 Introduction

External economies play a central role in economic theory since the works of Alfred Marshall. Today, the study of how spatial effects determine location decisions of people and firms constitutes one of the most interesting branches of research in regional studies (Glaeser, 2007). However, and despite the generalization of the theoretical concept of spillovers in economics, the empirical measurement of such variable is still an open issue (Burger et al., 2010). Departing from traditional location models, recent contributions building on spatial econometrics methods have introduced the role of neighbourhood-related effects in shaping firm's decisions (LeSage and Pace, 2009). In the industrial location field, and following the pioneer work of Rosenthal and Strange (2003), some papers have start dealing with this type of spatial effects. In doing so, they focus on extending the conditional logit model relying on random utility maximization problems (Autant-Bernard, 2006; Woodward et al., 2006; Jofre-Monseny, 2009; Alamá et al., 2010). Autant-Bernard (2006) studies how spatial spillovers influence the location of R&D laboratories in NUTS 2 regions of France. Woodward et al. (2006) analyse the choices of high-technology firms in US counties by employing spatially weighted explanatory variables. Jofre-Monseny (2009) focuses on the spatial scope of agglomeration economies along the Spanish region of Catalonia. Finally, Alamá et al. (2010) also build on such spatial framework for explaining location decisions of manufacturing firms in the Spanish region of Murcia. All four contributions are seminal in this literature, and propose ways of progressively improving the way we cope with spatial spillovers in location choices.

The present paper continues developing such an approach, with a deeper insight on the factors determining location choices of firms in the presence of neighbourhood-related spatial effects. As main novelties, we first provide a quantitative measure of the spatial effects spilling over local boundaries. We define this measure in relative terms to the magnitude of traditional externalities arising at a local level. In this way, we can show the relevance of spatial effects in the process of location of firms. Second, we identify the main factors driving spatial effects in the presence of local shocks. In this sense, they appear to be related to the type of industry the firm belongs to, as well as to accessibility issues characterising the municipality where the firm is expected to locate. After this introduction, in Section 2 we present the analytic framework employed in the study. In Section 3 we discuss the choice of the set of explanatory variables, run out our empirical routines and discuss main results. Finally, Section 4 concludes.

2 Model setting

This section introduces a location model based on the standard that the firm will choose the municipality with the highest expected profit among several alternatives.[1] From the point of view of a firm i which operates in a particular industry s, each municipality j in the set of J possible locations offers an expected profit of π_{ij} such that:

[1] The theoretical model builds on the original contribution for location analysis of Guimarães et al. (2004) and Woodward et al. (2006).

$$\pi_{ij} = X_j\beta + \delta WX_j\beta + \eta_j + \varepsilon_{ij} \ , \tag{1}$$

where the variables in X_j include characteristics of the municipality affecting the location decisions of firms in *all industries* (population, accessibility, availability of skilled labour force, etc.), and *in a particular industry s* (i.e., the specialization index of the municipality in that industry); WX_j represents the spatially weighted average of the characteristics of neighbouring municipalities also affecting the probability of a firm to be located in *j*;[2] η_j is a random variable capturing unobserved factors specific to each location;[3] and finally, ε_{ij} is a random term for other unobservable factors which determine the expected profits of firm *i* from locating in municipality *j*.

The specification in equation (1) implies that the expected profit from establishing in a given location *j* not only depends on the advantages offered by this own location, but on those ones spilling over from its neighbourhood. The spatially lagged term in equation (1) is composed by two parts: the first one reflects the existing stock of endowments at nearby municipalities (pool of qualified workers, institutions, etc.), captured by the term $WX_j\beta$; the second one represents the truly spatial effects spilling over from the neighbourhood to municipality *j*, captured by parameter δ. Following this specification, the higher the value of δ, the more important the spatial effects, while the closer the neighbouring localities, as defined in W matrix, the bigger these effects too.

As it is common in a discrete choice framework, the firm will choose to locate the plant in the (expected) most profitable location, the municipality *j* in this case. Hence, the probability of choosing location *j* accomplishes:

$$\Pr(\pi_{ij} > \pi_{ik}), \text{ for } j \neq k, \text{ and } j,k = 1,2,\ldots,J \ , \tag{2}$$

---

[2] Defined as $WX_j = \sum_{k\neq j} w_{jk} X_k$, with weights w_{jk} inversely related to geographical distances among location *j* and neighbouring *k* locations, specified by using a spatial weight matrix (see Section 3 for details).

[3] It is assumed that the η_j's are gamma distributed with parameters $(\alpha^{-1}\lambda_j, \alpha^{-1}\lambda_j)$ where $\lambda_j \equiv exp\left\{X_j\beta + \delta WX_j\beta\right\}$, and $\alpha > 0$.

and it can be shown that if the error term ε_{ij} is *i.i.d.* according to a type I extreme value distribution, the probability that a firm chooses municipality j conditional on the η random effects is:

$$P_j = \frac{\exp\left\{X_j\beta + \delta WX_j\beta\right\}}{\sum_{k=1}^{J}\exp\left\{X_k\beta + \delta WX_k\beta\right\}} \ . \tag{3}$$

The main focus of the paper would be then twofold. First, we will wonder if spatial effects play a role for location choices of companies. And second, this being the case, we will concentrate in analysing the main factors influencing such spatial effects. Pursuing these objectives, and to define an operational definition of the spatial spillover measure, we consider the derivative:

$$\frac{dP_k}{dX_j} = \frac{\partial P_k}{\partial X_j} + \sum_{r\neq j}\frac{dWX_r}{dX_j}\frac{\partial P_k}{\partial WX_r}, \quad k \neq j\,, \tag{4}$$

which shows how a marginal change in any covariate of the municipality j affects the expected probability of the nearby municipality k in attracting new firms of a particular industry (P_k). From equation (4) it can be distinguished two types of impacts on P_k: the first term is the direct impact of one shock in X_j on that probability; the second one summarises the indirect impact of the shock driven by changes in the neighbourhood characteristics (captured by WX_r). In this way, the second term in equation (4) allows us to define the appropriate measure of the spatial spillovers we want to identify, denoted as $SSE_{j\to k}$. From equations (1) and (3), it follows that:

$$SSE_{j\to k} = \delta P_k\left(w_{kj} - \sum_{r\neq j} w_{rj}P_r\right)\beta, \quad k \neq j \tag{5}$$

As shown in equation (5), the intensity of the spatial spillover between municipalities j and k depends on four key elements. First, on the value of parameter δ that measures the relevance of the spatial spillovers in firms' profits. Second, on the strength of the neighbouring relationship between both municipalities, as defined by the elements of the spatial weight matrix W. Closer neighbours to location k would be characterized by higher values of the corresponding element of the k-th row of W and, consequently, the term in parenthesis in equation (5) would be also higher.[4] Third, the magnitude of the spatial spillover is proportional to the probability P_k. In this sense, the industrial structure of municipality k is also determining how it can benefit, or absorb, the emerging spatial effects. If the shock is industry-neutral this is not a matter of fact, but if the shock is industry-specific, the degree of specialisation of municipality k in that particular industry will contribute to determine the magnitude of the spatial effect. If we generalise this fact to the whole neighbourhood of municipality j benefiting from spatial spillovers, we can understand how the existence of clusters, highly specialised in particular industries, reinforce the magnitude of spatial spillovers. Both concepts of "degree of specialisation of a neighbourhood", and the previous one of a "closer neighbourhood", would allow us to define our concept of accessibility of a municipality, that will be a centre piece of the paper. Fourth, β parameter captures the role of endowments in producing spatial spillovers. For computing our spatial effects, and in order of not introducing more complexity in the model, we assume that such parameter shows the same value in the case of municipality j, than for its nearby municipalities. That is, endowments share the same coefficients in locality j (X_j) and for the (average) nearby municipalities (WX_j). In theoretical terms this is a plausible assumption in this type of models, as shown in Anselin (2003), and from an empirical point of view it facilitates quantitative estimation of spatial effects for every industry in the study.[5]

Finally, since equation (5) is just measuring spatial spillovers arising to location k from a shock in municipality j, it is interesting to define summary measures of total spatial spillovers emerging from the model. Accordingly, we will integrate the terms $SSE_{j \to k}$ over locations $k \neq j$, for a nearby threshold area. In

[4] Given the definition of SSE we employ, we can observe both positive and negative effects. The term w_{kj} is inversely related to geographical distance between locations k and j, while $\sum_{r \neq j} w_{rj} P_r$ is a weighted average of elements of the terms in the j-th column of the W matrix. Thus, if the term w_{kj} is greater than the weighted average, the spatial spillover would be positive, and negative otherwise.

[5] The final measure employed for spatial effects is defined in relative terms to direct effects in the following sections, and do not rely on the value of the parameters in β, so this is not a pivotal assumption of the paper as we will see.

doing so, we rely on the evidence showing that spatial effects dissipate after a certain distance (Arauzo, 2008).[6]

3 Estimation results

This section is devoted to quantify the spatial spillover effects affecting firms' location choices in the geographical area of analysis. To this end, we start by introducing the data set and the explanatory variables employed in the empirical exercise. Further, estimates of the spatially extended location framework are used to compute the summary indices of spatial spillovers generated by each municipality, then discussing their magnitude and scope.

3.1 Geographical scope of data set: The Spanish Mediterranean Axis

Our analysis draws on a database for the population of industrial firms newly established in the Spanish Mediterranean Axis (SMA, henceforth) provided by the Central Directory of Enterprises (DIRCE) of INE (National Statistics Institute). The SMA is defined as the territory of the Spanish Mediterranean seaboard stretching from the French frontier to the Straits of Gibraltar, that is, between the regions of Catalonia and Andalusia. The geographical area making up the SMA accumulates 40% (approximately 19 million inhabitants) of the population of Spain (3.8% of EU-27) in 20% of the country surface (2.2% of EU-27), accounting for 40% of the national GDP (3.7% of EU-27). It makes the area bigger in geographic surface, population and economic activity than many of the EU countries. The data set is defined at the geographical level of municipalities, this being the optimal framework for studying spatial effects (Arauzo et al., 2009). Besides, the SMA is chosen as our area of analysis for two main reasons: First, the familiarity with municipal data sources in Spain allows us to compile all necessary covariates at the local level, a pivotal issue

[6] Note that our model integrates characteristics of all previous spatially extended location models in the literature, including spatially weighted explanatory variables (Woodward et al., 2006; Autant-Bernard, 2006; Alamá et al., 2010) and a threshold distance for spillovers (Jofre-Monseny, 2009). Additionally, we account for random effects in the specification of the model (Guimarães et al., 2004; Woodward et al., 2006). Beyond, we propose a statistical definition of the spatial spillover measure (in relative terms to locally bounded effects), and discuss the size and geographical scope of the spatial effects arising in the model.

of the study. And second, this territory shows important economic agglomerations, accumulating 50% of the industrial employment of the country, with a remarkable growth of the number of firms (45%) and employment (50%) along the past ten years (IVIE, 2010). In this way, it becomes an optimal field of study for our purposes. SMA is mainly characterised by a remarkable contrast between the active and densely populated seaboard and the rather inhabited inland, with some discontinuities in the urban network. Two cities, Barcelona and Valencia, make the difference in terms of global connectivity, becoming well consolidated urban structures connected to the rest of Europe.

The data set comprises around 90,000 new firms (start-ups) located in 314 municipalities between 1998 and 2008. We assume that the role played by the factors determining the location choice of the firm may vary according to the own characteristics of the industry that it belongs to. Consequently, we decide to split out the data set into five sub-samples, corresponding to five broadly defined sectors on the basis of the factors affecting the location process (OECD, 1987). The five categories reached are those of natural resource-based NR (e.g. food industry), labour intensive LI (e.g. textiles), product differentiated PD (e.g. publishing and printing), scale-based industries SE (e.g. motor vehicles and trailers), and science-based industries R&D (e.g. computing machinery; medical and precision instruments). The classification scheme for industries is shown in **Table 1**. The spatial distribution of firms in the SMA at a municipal level is depicted in **Figure 1**, showing big concentrations in the urban metropolitan areas of Barcelona and Valencia, and along the coastal corridor.

3.2 Model estimates

The present investigation is not another location exercise for industrial establishments, just being addressed to quantify the role of spatial spillovers in such processes. Subsequently, the empirical model builds on a set of explanatory variables that have become standard in this type of studies (see, e.g., Arauzo et al., 2010), not getting deeper into this issue. Basically we move to ensure correct behaviour for the covariates, resulting in robust estimates of the spatial effects of the model. The definition and data sources of the covariates are summarized in **Table 2**.

Our dependent variable is defined as the location of new firms (start-ups) in a given municipality for the years 1998 to 2008. The set of explanatory variables starts by including a size control variable as the municipality area (AREA), and the altitude of each locality over the sea level (ELEVATION) to tackle with some accessibility issues. Infrastructures are accounted for by distances between municipalities to the nearest ports (PORTS) and airports (AIRPORTS), together with new km of roads and highways built since the accession to the European Union (ROADS). Workers per squared kilometre in the urban core of the municipality act as a measure of urbanization economies (URBANIZATION), while local population measure is expected to capture demand potential (POPULATION). We approach the human capital variable (EDUCATION) by employing the share of labour force with higher education (secondary and tertiary studies finished). The design of the Spanish infrastructure networks clearly favours urban centres at the provincial level, so locations close to administrative centres would benefit from better accessibility, what is approached by the variable DISTANCE TO CENTRE. A set of knowledge-related variables in the model includes PATENTS, ICT INFRASTRUCTURES and R&D EXPENDITURES, all of them at the level of province, this being the more disaggregated geographical level we have access to in Spain. Finally, we also apply two traditional agglomeration economies of location models. First, we employ the inverse of the Herfindahl index for capturing the effects of a richer environment in the supply of economic activities (DIVERSITY INDEX). And second, we employ a specialization index at a local level (MAR-type economies) for each industry s in the investigation (LOCATION QUOTIENT). In this way, all types of standard explanatory variables in location models are accounted for in our exercise, including geographical measures, infrastructures, agglomeration forces, technological factors, and other supply and demand variables. We expect all these variables to show a positive coefficient in the regression, except for ELEVATION and infrastructure (distance-based) variables, where we expect negative signs. We also expect obtaining different estimates for every industrial subsample in the study.

Further, the model includes a cross-regressive spatial term (WX_j) capturing the (spatially weighted average) covariates of the neighbourhood for a given municipality j. In order to compute this term, we need to define the spatial weight matrix W. It is done in terms of the inverse of the Euclidean distances among municipalities, with a representative term:

$$w_{jk} = \begin{cases} d_{jk}^{-1} \,/\, \sum_{k \neq j} d_{jk}^{-1} & \text{if } d_{jk} \leq R \\ 0 & \text{otherwise} \end{cases} \tag{6}$$

where d_{jk} is the Euclidean distance between municipality j and municipality k, and R represents a threshold distance determining the range of action of spatial effects,[7] if present. Note that this definition of the W matrix implicitly assumes that spatial effects tend to dissipate as the physical distance between locations increases, eventually disappearing beyond a threshold distance. It must be highlighted that the definition we consider for the W matrix constitutes a particular choice, ultimately determining the estimates of the δ parameter of the empirical model. In the Appendix we include some additional results for alternative W matrices just for comparison purposes. In general, we show no greater impact of such an issue on the resulting estimates of the spatial effects.

Table 3 presents the results for the five subsets of industries in the study. Evidence of the presence of overdispersion in data is assessed by means of a likelihood ratio test, shown at the bottom of the table. These statistics provide strong empirical support to the Dirichlet-Multinomial specification against the conditional logit model, so we follow such a modelling strategy.[8] In general, the estimated parameters show the expected signs, with their magnitudes (marginal effects) being in line with those of the literature.[9] Despite employing the spatial lag model specification, it could be possible to find some correlation in the residual term. By relying on a substantive approach, we assume that the spatial effects basically apply to immediate neighbours, and so *"the proper spatial range of the explanatory variables is constrained to the location and its immediate neighbours (but not beyond)"* (Anselin, 2003). In the same line of reasoning, a recent work of Robertson et al. (2009) applying Monte Carlo simulation conclude that the inclusion of spatially lagged explanatory variables is the most effective procedure to capture spatial effects on discrete choice models. Moreover, we have checked for remaining spatial correlation problems in the residuals of the model, and following Pinkse and Slade (1998), we have applied Moran's I tests to the Pearson generalized residuals of the Dirichlet-

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[7] In determining the value of R, we select the value that maximizes the log-likelihood of the model through a grid search procedure.

[8] We acknowledge the referees for calling our attention at this point.

[9] We do not extend so much in the results of the location model, because our main focus is on the spatial terms of the extended model. However, following Arauzo et al. (2010) as a comprehensive review of the location literature, we find comparable results in terms of the employed explanatory factors, as well as for the magnitude of coefficients (marginal effects) obtained in previous studies. We elaborate some more on this issue in the text, deserving a greater attention to some interesting variables of the model.

Multinomial regressions. Our results show that estimated coefficients are not biased by the presence of spatial correlation in residuals. Remaining details regarding this procedure are included in the Appendix.

Geographical variables such as AREA and ELEVATION appear to be more relevant for Natural Resources (NR) activities. Total surface of the municipality is also an important factor for Scale Economies (SE). Accessibility to transport infrastructures seems to be important for location of NR, PD and SE industries for PORTS (goods transport), SE and RD for AIRPORTS (people transport), and all industries for ROADS (people and goods transport). In general, coefficients for infrastructural factors appear in average higher than those of geographical measures. DISTANCE TO CENTRE, as a connectivity measure, appear to be important for NR and LI industries, both activities with remarkable content of logistics in their production and distribution activities.

URBANIZATION economies, measured by total (density of) workers in urban surface at the municipal level appear to be a driving factor of firm's choices for all subsectors, with special emphasis for LI, PD and RD, emphasizing the importance of labour pooling effects in the location of new firms. EDUCATION is also relevant, with major emphasis for RD, PD and SE industries. Despite the good behaviour of the human capital variable, we are aware of the relevance of counting on data about occupational tasks of workers in order to improve our focus on this issue (Florida, 2002).

Technology and knowledge-related factors, measured by PATENTS, ICT INFRAST, and R&D EXPEND, show interesting results, particularly for RD, SE and PD industries. Curiously, R&D expenditures show higher estimated values for coefficients of PD and SE industries, although also appearing significant in the case of RD as one would expect. Looking at the results for RD industries, ICT infrastructures appear to be the most important factor pursued by this type of companies in our sample, followed by Patents, and R&D expenditures. Such results are in line with other existing studies for EU countries, where capital inputs (R&D expenditures) are in second place of relevance in fostering knowledge economies in comparison to labour inputs (knowledge workers and creativity) (Raspe and van Oort, 2008). In the case of the SMA, development of infrastructures for knowledge is still an important task to be pursued, because of the imbalances shown in this regard between some leading urban areas, as Barcelona and Valencia cities, and less populated provinces located in the south.

Traditional localization (LOCATION QUOTIENT) and diversity (DIVERSITY INDEX) economies seem to play a salient role in attracting new firms too. Diversity of industrial activities appears very important for location of any type of industry, showing the highest coefficients of all covariates in the model. LI and PD industries, those with higher content of inter-industry linkages in their final output show the highest coefficients, a result that is confirming similar findings on well renamed contributions in the (co-)location literature (Ellison et al., 2010). Moreover, localization economies (LOCATION QUOTIENT) show robust significance for all industries, and important sizes of coefficients too. NR companies seem to be the less affected by these two agglomeration forces, although still playing a role.

At the end of the table we include results for the δ parameter, showing them to be significant in the five groups of industries for the SMA area. Higher values of the parameter are shown for SE industries, and for RD industries, although all industries present relevant and very significant estimates for this variable. Such results appear to confirm our first working hypothesis, that spatial spillovers enter the profit functions of companies, and they account for neighbourhood-related external economies when choosing where to locate their establishments. In the following subsection we get deeper evidence on the issue.

3.3 Analysing "spatial spillovers" arising in the location model

In this section we concentrate in measuring and describing spatial effects arising in the model. As a measure of the ability of every municipality j to generate spatial spillovers we compute the following relative index:

$$SSE_j^{\bar{D}} = \frac{1}{DE_j} \sum_{k \neq j : d_{jk} < \bar{D}} SSE_{j \to k} \qquad (7)$$

Note that by normalizing for the direct (locally bounded) effects of the shock ($DE_j = \frac{dP_j}{dX_j}$), the index is a standardised (scale free) measure not depending on β parameter. The optimal threshold distance $\bar{D}$ employed to compute the index is 35 km, which coincides approximately with the minimum distance such that every municipality in the sample has at least one neighbour (Arauzo, 2008; Burger et al., 2010).[10]

[10] Arauzo and Manjón (2009) point to 40-60 km as the optimal threshold for analysing location choices in Catalonia region.

Figure 2 shows the distribution of the ratio of spatial spillovers to direct effects ($SSE_j^{\bar{D}}$) for all 314 municipalities in the sample. The ratio indicates by how much a shock in the municipality j changes the probability of a firm to locate in the surrounding area, relative to that of the own locality j, in the presence of spatial effects. We must note again that, first, the magnitude of the ratio $SSE_j^{\bar{D}}$ relies on the relevance that a firm confers to neighbourhood characteristics in their expected profit function, captured by the parameter δ. C*eteris paribus*, spatial spillovers will be more relevant for those industries with the highest δ. And second, given that δ parameter remains by definition constant for all municipalities in every industry, the size of the ratio also depends on the accessibility features defining every location. As previously discussed, the concept of accessibility relies on the degree of specialisation of the nearby locations in the particular industry s, as well as on the degree of closeness existing between location j and its neighbourhood.

Some conclusions emerge from results in **Figure 2**. In first place, we observe that the ratios exhibit the highest median values for scale economies-based industries (SE), followed by labour-intensive (LI) and product differentiation (PD) ones, although, in general, all industries rely on those externalities in their location choices. In average, spatial effects increase 10%-30% the probability of firms to choose nearby locations, relative to locally bounded traditional effects. In this way, they appear to be important determinants of location choices of firms, at least as important as other traditional explanatory variables shown in Table 3. In second place, **Figure 3** shows the distribution of the geographical scope where those spillovers arrive, now for the single measure of *SSE* effects introduced in equation (5). We define the mean scope of spatial spillovers as the average distance in which a given municipality exerts positive spatial effects over other locations. As shown, the scope of spatial spillovers varies among sectors, from a mean of 28 km in the case of LI sectors to 81 km of SE industries, with higher values on the upper tail of the distribution.

Despite these general findings for the area of analysis, we present detailed results in **Table 4** for some selected localities, in order to gain better insights on the role of spatial externalities in driving location processes. The table includes the results for accessibility indexes, the ratio $SSE_j^{\bar{D}}$, and geographical scope of

SSE for two central localities, namely Valencia and Barcelona cities.[11] We also include data for two typical intermediate municipalities, with some degree of industrial specialisation and good connectivity with central cities in their provinces (15-25 km), namely Oropesa in the province of Castellón, and Torrent in the province of Valencia. Results for more isolated localities are not included because they do not show relevant values in terms of the variables analysed. As main trends in the table, we see that urban centres show the highest accessibility values, and the highest *SSE* spilling over their neighbourhoods.[12] As expected, accessibility of locations becomes an issue in terms of generation of (absolute) spatial effects, as well as the industry of reference chosen. However, central and more accessible localities present more limited values for $SSE_j^{\bar{D}}$, and shorter scopes of their *SSE* in km; that is, the spatial effects do not show higher values in comparison with the volume of locally bounded traditional externalities, and they dissipate more rapidly in space, perhaps because they do not need to reach longer distances given higher concentration of specialised clusters in their neighbourhood and good accessibility issues. For the set of intermediate municipalities, Oropesa and Torrent, spatial effects are shown to be lower in absolute value, but so relevant in relative terms to direct effects of traditional externalities (1.3 to 5 times). They also reach a longer scope in km compared to central places (up to 90-110 km).

In terms of policy, spatial effects appear to reinforce existing clusters in central locations, although at a small scale than locally bounded traditional effects. In the case of intermediate industrial locations, spatial spillovers appear to be a remarkable force for attracting new firms in comparison to direct effects. Given that intermediate locations present good connectivity with central places too, we observe all type of externalities, traditional and spatial ones, reinforcing each other in fostering growth of central urban agglomerations. On balance, it

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[11] Note that these two cities not occupy a median position inside our sample, given their central role as urban centres for SMA (see **Figure 2**). However, we report results for these two particular cases in order to gain broader insights in policy terms.

[12] Values in **Table 4** appear to be small for absolute SSE effects, a result explained by the specific characteristics of the sample we employ. The great number of municipalities included in the study (314), determines the small value of spatial weights in *W* matrix for every municipality, and then the single value of probabilities computed. In this way, we show them just for comparison purposes between central and intermediate localities. In what regards the ratio *SSE/DE*, it can offer a closer idea of how spatial effects behave empirically, given its relative nature.

leads to a typical centre-periphery pattern of regional development, with central places becoming greater, inland locations becoming more isolated, and intermediate developed cities reinforcing central places. Given this result, regional policies would have to continue focusing on balancing that pattern of development at a national and EU scale, to counteract market forces. However, regional policies would also need to be aware of the existing trade-off between the higher absolute value of spatial effects arising in central places, and the higher relative value of the *SSE/DE* ratio observed for intermediate locations, in order to obtain the higher returns to private and public investments at a regional scale.

4 Conclusions

In this paper we get deeper insight on the role played by spatial effects in shaping location choices of firms. To this end, we have proposed a definition of neighbourhood-related spillovers for this framework of analysis, obtaining empirical evidence on the issue. The main findings of the investigation support the hypothesis that those externalities matter for manufacturing firms. Beyond the characteristics of each potential location, companies also take into account the features of the neighbouring area when building their establishments. Spatial spillovers clearly enter the (expected) profit function of the firm when choosing a new place; they vary by type of industry, and are closely related to accessibility features of the municipality where the firm is expecting to locate. In general, spatial effects account for 10% to 30% of locally bounded (direct) traditional effects arising in our sample. This is a remarkable value for any local government wanting to attract new firms to their territory.

Further results also point out that central places in the sample generate the most important spatial effects in absolute terms, while for municipalities with an intermediate level of development greater values are estimated for relative spatial effects (in terms of direct ones). Given the good accessibility of central and intermediate places, and the lower capacity of attraction of distant inland places, externalities naturally lead to a centre-periphery pattern of development. In this way, regional policies should, at least in the medium run, apply some cohesion actions to balance these forces. However, our results also indicate that any new investment in central and intermediate cities generates the most important spatial spillovers, and consequently the highest returns of the investment.

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Tables

Table 1 Classification of economic activities

Sector	Economic activities	ISIC
Natural resources	Food products and beverages. Tobacco	15,16
	Manufacture of paper and paper product	21
Labour intensive	Textile products	17
	Wearing apparel	18
	Dressing of leather	19
	Wood products (except furniture)	20
Product differentiation	Publishing and printing	22
	Manufacture of other non-metallic mineral products	26
	Manufacture of basic metals	27
	Manufacture of fabricated metal products, except machinery and equipment	28
	N.E.C. machinery and equipment	29
	N.E.C. electrical machinery apparatus	31
Scale economies	Manufacture of chemical industry	24
	Manufacture of rubber and plastics products	25
	Manufacture of motor vehicles and trailers	34
	Other transport equipment	35
Science	Office machinery, computing machinery	30
	Radio, TV and Communication equipment	32
	Medical, precise, optical instruments	33

Table 2 Explanatory variables: definition and data sources

Variable	Definition	Source
AREA	Municipality area in squared km (log), 1998.	Yearbook of Statistics, INE.
ELEVATION	Height of the municipality over the sea level (log), 1998.	Yearbook of Statistics, INE.
POPULATION	Number of inhabitants in the municipality (log), 1998.	Yearbook of Statistics, INE.
URBANIZATION	Total workers per km^2 at the urban core of the municipality (log), 1998.	Own elaboration from Statistics Yearbook, La Caixa.
EDUCATION	Share of labour force with higher education in the municipality (log), 1998.	Own elaboration from Population Census data, 1991, and Labour Force Survey EPA1998, INE.
DISTANCE TO CENTRE	Distance of the municipality to administrative centre, in km (log), 1998.	Own elaboration from Statistics Yearbook, La Caixa.
PORTS	Distance of the municipality to nearest Port, in km. (log), 1998.	Own elaboration from Ministry of Fomento.
AIRPORTS	Distance of the municipality to nearest Airport, in km (log), 1998.	Own elaboration from Ministry of Fomento.
ROADS	Km. of new highways plus local roads in the municipality since 1986 (log), 1998.	Own elaboration from Ministry of Fomento.
PATENTS	Number of patents per province (log), 1998.	Statistics of Patents, INE.
ICT INFRASTRUCTURES	ICT stock in million €/person per province (log), 1998.	COTEC Foundation.
R&D EXPENDITURES	R&D expenditures per province in million € (log), 1998.	R&D survey, INE.
DIVERSITY INDEX	Index of diversification computed as the inverse of the Herfindahl Index, defined as $H = \sum_s c_s^2$ where c_s is the number of firms in industry s (s=*NR, LI,…,RD*) over total firms established in each municipality, 1998.	Own elaboration from DIRCE data, INE.
LOCATION QUOTIENT	Location quotient for defined industrial branches, 1998.	Own elaboration from DIRCE data, INE, and Statistics Yearbook, La Caixa.

Table 3 Location choice of firms in the Spanish Mediterranean Arc: spatial Dirichlet-Multinomial regression

	NR	LI	PD	SE	RD
CONSTANT	10.1099 **	13.9743 ***	12.1672 ***	12.7159 ***	9.9535 ***
	(1.2647)	(0.6792)	(0.8690)	(1.1568)	(0.8299)
AREA	0.1422 **	0.0069	0.0936 ***	0.1048 ***	0.0111 **
	(0.0214)	(0.0187)	(0.0177)	(0.0266)	(0.0057)
ELEVATION	0.0544 **	0.0029	0.0018	0.0647 **	0.0152 **
	(0.0174)	(0.0159)	(0.0131)	(0.0190)	(0.0082)
POPULATION	0.7707 **	1.0066 ***	0.8805 ***	0.8220 ***	0.9847 ***
	(0.0269)	(0.0236)	(0.0209)	(0.0324)	(0.0343)
URBANIZA-	0.1936 *	0.3210 ***	0.3205 ***	0.2613 **	0.3932 ***
	(0.0996)	(0.0812)	(0.0695)	(0.1335)	(0.1217)
EDUCATION	0.0080	0.1856 ***	0.3317 ***	0.2508 ***	0.3787 ***
	(0.0576)	(0.0504)	(0.0469)	(0.0684)	(0.0774)
DISTANCE	0.0383 **	0.0498 ***	0.0168	0.0048	0.0011
	(0.0198)	(0.0186)	(0.0162)	(0.0260)	(0.0255)
PORTS	0.0922 **	0.0256	0.1022 **	0.1339 **	0.1003
	(0.0474)	(0.0260)	(0.0526)	(0.0681)	(0.1315)
AIRPORTS	0.0256	0.0024	0.0023	0.0589 *	0.0052 *
	(0.0210)	(0.0026)	(0.0018)	(0.0328)	(0.0028)
ROADS	0.1282 **	0.0752 *	0.1420 **	0.1121 ***	0.1225 *
	(0.0398)	(0.0397)	(0.0727)	(0.0343)	(0.0647)
PATENTS	0.0238	0.0263	0.0941 **	0.1439 ***	0.1722 **
	(0.0433)	(0.0336)	(0.0497)	(0.0538)	(0.0889)
ICT INFRA-	0.1224 **	0.0631 *	0.1302	0.1937 **	0.2115 **
	(0.0626)	(0.0335)	(0.2723)	(0.0996)	(0.1095)
R&D EXPEND.	0.0223 *	0.0752 *	0.1424 **	0.1107 ***	0.0921 *
	(0.0119)	(0.0396)	(0.0731)	(0.0333)	(0.0490)
DIVERSITY	0.8437 **	1.6636 ***	1.3723 ***	0.9843 ***	0.9822 ***
	(0.1372)	(0.1440)	(0.1425)	(0.1754)	(0.1947)
LOCATION	0.2065 **	0.3338 ***	0.3762 ***	0.3114 ***	0.3695 ***
	(0.0111)	(0.0098)	(0.0281)	(0.0160)	(0.0629)
δ	0.2171 **	0.1675 ***	0.2441 ***	0.4214 ***	0.2972 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Overdispersion	786.2 **	3180.8 ***	3634.6 ***	576.7 ***	121.8 ***
Overall signifi-	542.0 **	679.0 ***	739.7 ***	562.2 ***	719.8 ***
Log likelihood	1076.06	1397.21	1464.43	1015.64	733.496

The dependent variable is location choice by new firms for 1998 2008 in every industrial branch defined. Standard errors in parenthesis.
(***), (**), and (*) indicates significance at the 1%, 5% and 10% level.

Table 4 Results of the model for some selected municipalities in the sample

SE industries

Municipality	Accessibility	*SSE* (35 km)	*SSE/DE* (35 km)	Scope (in km)
Oropesa	0.0015	0.0003	1.5771	117.51
Torrent	0.0015	0.0001	5.1535	93.44
Valencia	0.0030	0.0007	0.0187	48.15
Barcelona	0.0058	0.0014	0.0163	39.11

RD industries

Municipality	Accessibility	*SSE* (35 km)	*SSE/DE* (35 km)	Scope (in km)
Oropesa	0.0015	0.0001	1.3032	60.58
Torrent	0.0008	0.0000	3.7572	52.32
Valencia	0.0039	0.0001	0.0017	33.46
Barcelona	0.0049	0.0003	0.0020	31.59

Figures

Figure 1 Geographical distribution of firms in the dataset

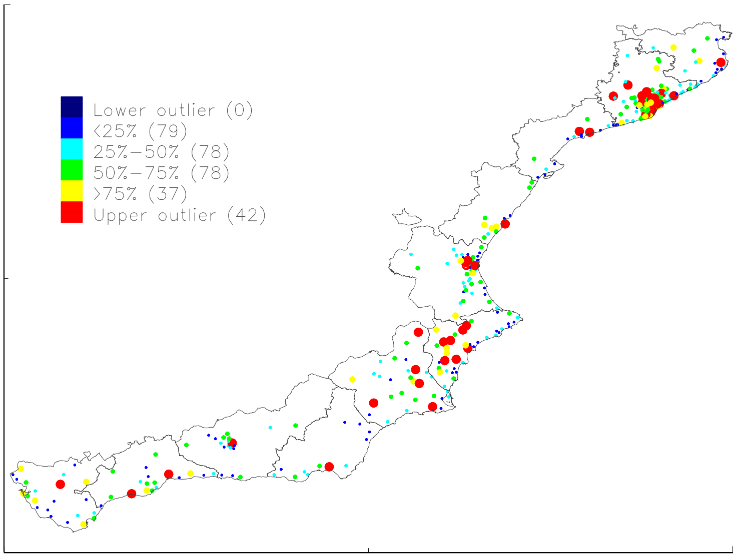


Figure 2 Distribution of spatial spillovers from each municipality

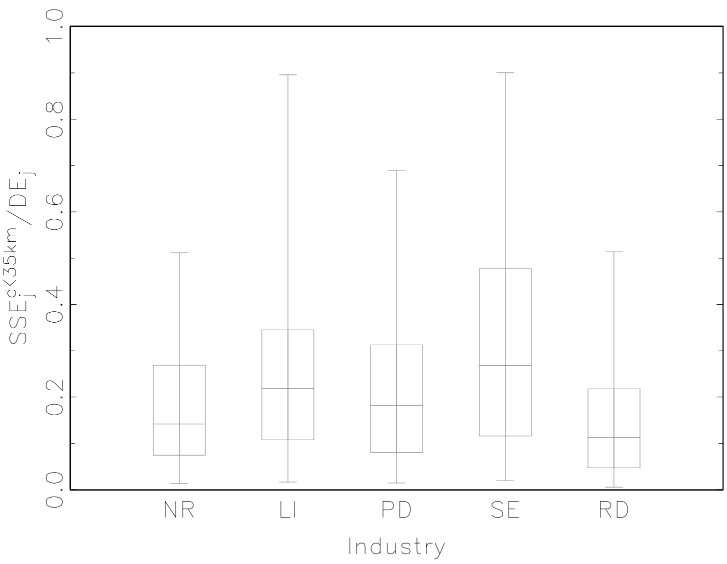
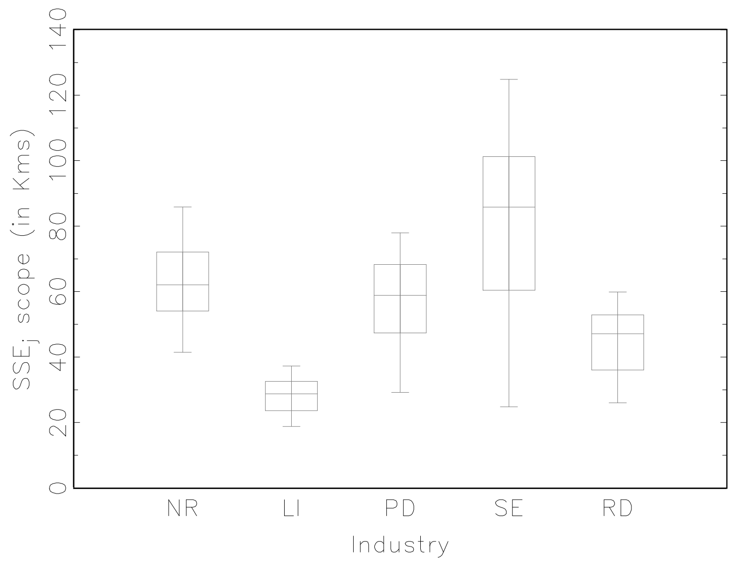


Figure 3 Distribution of the scope of spatial spillovers from each municipality

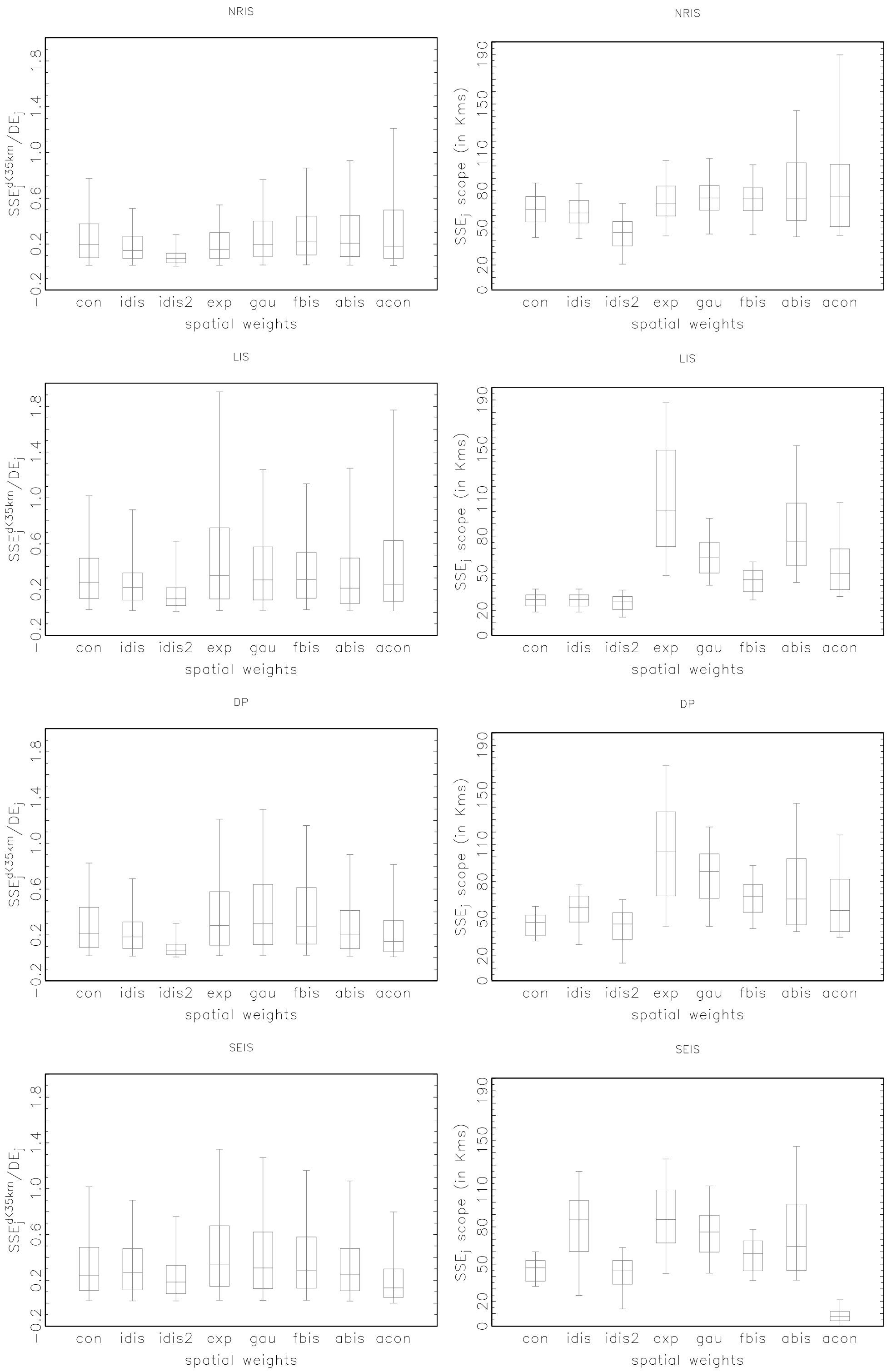


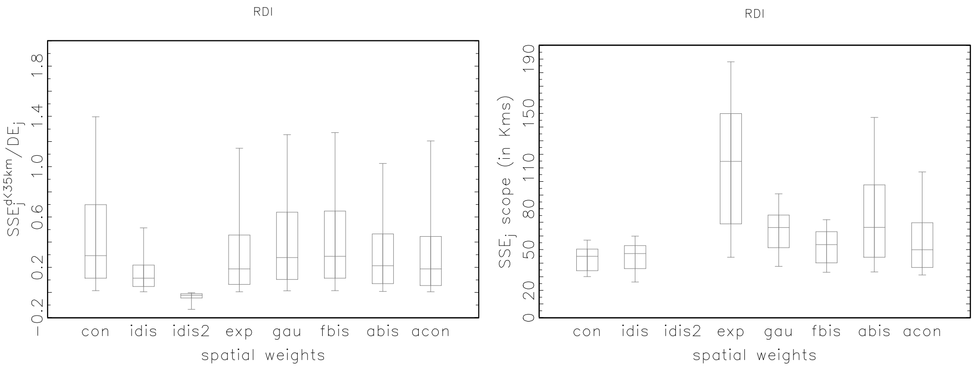
Appendix A: Sensitivity of spatial spillovers measure to the definition of spatial weight matrix

As argued in the paper, the choice of appropriate spatial weights (W matrix) is a key issue of spatial models as it assumes a priori a structure of spatial dependence, which may or may not correspond closely to the reality one wants to explore. In general, there are multiple possible choices, and the literature tells us little about adequate foundations for them. Typically, the spatial weights are defined as functions of economic or geographic distances, as the (inverse) distance decay functions (see, e.g., Arauzo et al., 2009). Accordingly, we follow such an approach in specifying our W matrix in order to not introduce more complexity in the analysis, and concentrate on measurement issues of spatial spillovers in the model.

Yet, it was not the aim of the paper to present a thoroughly research on the issue, it appears of interest, as some reviewers well pointed out, to note that our estimates should be interpreted as conditioned on the particular choice of the spatial weights we have made. In order to illustrate the influence of the definition of the spatial weights in the estimates of the spatial spillovers, **Figure A.1** included below shows the distribution of such effects (and their geographical scope) for a collection of eight alternative spatial weights definitions (contiguity, inverse distance, inverse square distance, exponential decay, Gaussian, fixed bisquare, adaptive bisquare, and adaptive contiguity). The analysis suggests that our choice of the inverse distance based W matrix does not affect the size and scope of spatial spillover measures in a sharp way. Moreover, it seems that our results tend to underestimate the spatial effects regarding other W definitions as, for example, those of exponential decay, Gaussian, and bisquare. It is possible to employ a likelihood or information criteria (AIC, BIC) approach in choosing the more appropriate W matrix, but when it was attempted we obtained a different W definition for every industry, what not makes so much sense as a full methodology for treating our entire data set, so we decide to follow the mainstream literature in driving our approach on the issue. Anyway, all these estimates show the relevance of accounting for such spillovers in the location models, what was the main aim of the paper.

Figure A.1. Distribution of spatial spillovers and geographical scope for alternative definitions of the spatial weight matrix.




RDI
$SSE_j^{d<35km}/DE_j$
-0.2
0.2
0.6
1.0
1.4
1.8
con idis idis2 exp gau fbis abis acon
spatial weights
RDI
SSE_j scope (in Kms)
0
20
50
80
110
150
190
con idis idis2 exp gau fbis abis acon
spatial weights

Appendix B: Computation of Moran's I test for spatial correlation problems in the residuals of the model

We have checked for remaining spatial correlation problems in the residuals of the estimated models. To this end, in the spirit of Pinkse and Slade (1998), we have applied a Moran's *I* test to the Pearson generalized residuals of the Dirichlet-Multinomial regressions. Given that the asymptotic distribution of the test statistic is unknown, we take a numerical approach, which can be summarized as follows:

i. By using the Dirichlet-Multinomial parameter estimates $\hat{\theta} \equiv (\hat{\beta}, \hat{\delta})$, we construct the generalized residuals $\hat{u}_j = \frac{n_j - \hat{P}_j \sum_j n_j}{\sqrt{\gamma \hat{P}_j (1-\hat{P}_j) \sum_j n_j}}$ where n_j represents the number of new firms established in municipality *j*, and $\gamma = \frac{\alpha^{-1} \sum_j \exp\{X_j\beta + \delta W X_j \beta\} + \sum_j n_j}{\alpha^{-1} \sum_j \exp\{X_j\beta + \delta W X_j \beta\} + 1}$. After that, we compute the Moran's *I* statistics.

ii. We draw a new random sample such that the probability of a new firm to localize in municipality *j* equals $\hat{P}_j$ (for $j = 1, 2, \ldots, J$).

iii. On the basis of the new data, we re-estimate the model to obtain new estimates of $\hat{\theta}_r$.

iv. We repeat *R*-times steps (i) to (iii) with $\hat{\theta}$ replaced by $\hat{\theta}_r$.

After completing *R* replications, the p-value of the test is estimated as the fraction of the *R* simulated statistic greater than the statistics computed for the original model's estimates. In our case, the estimated Moran's *I* statistic values (see **Table B.1** below) seem to be not significant, that is, the null hypothesis of not remaining spatial correlation in the residuals of the model cannot be rejected (we use *R*=200). Subsequently, we are confident that findings reported in the paper are not biased by the presence of spatial correlation in residuals. We include a footnote on the paper for not adding more complexity to modelling issues.

Table B.1 Moran's *I* statistic for the generalized residuals of the spatial Dirichlet-Multinomial

	NR	LI	PD	SE	RD
Moran's I	0.0046	0.0116	0.0022	0.0011	0.0035
p value	0.9950	0.9950	0.9950	0.9950	0.9950

Chapter 4

A two-stage modelling approach to internal migration in Spain

Abstract: This paper investigates the determinants of migratory decisions of people for inter-municipal flows. The migration decision-making process is divided in two stages: first, the decision of departure and, second, the choice of a destination. Accordingly, we estimate a model for the propensity to migrate and a model for the selection of destination, each depending on attributes of either the origin or destination places. Empirical findings for the case of internal migratory movements in Spain imply that the characteristics of the municipalities play a different role in each stage. Main results are consistent with: first, a general trend to suburbanization where central cities play a key role by redistributing population to the suburbs; and second, a relative lack of mobility of the labour force strengthened by the prevalence of higher rates of home-ownership.
Keywords: intra-regional migration, spatial interaction model, urban environment.

1 Introduction

The decision to move is among the most relevant decisions made by households. On a personal level migration has important and obvious influences on the life course of migrants and at the aggregate level, migration flows contribute decisively to conform the demographical pattern of sending and receiving places, and mirrors labour mobility widely understood as one of the basis for sustained economic growth.

This study focuses on the migratory movements between localities belonging to the same country (internal migration) and their key determinants. We want to shed more light on the characteristics of this type of migrations by adopting a behavioural approach that distinguishes the overall decision to leave the previous place of residence from the motivations for moving to a particular destination. Even though it is useful to consider the migration decisions as a two stage process, this separation is not without its difficulties. First, too often the decision might be characterised as an event without any kind of search process involved, or it is simply not a rational or conscious decision. Second, the process might not be necessarily sequential: sometimes, a strong preference for a particular destination could be developed previous to the decision upon whether or not to move (via vacation experience, presence of friends or relatives, etc.), in which case destination selection may actually precede the decision to move. However, decoupling the two stages of the migration decision still constitutes a valuable analytical tool to achieve a better understanding of the very role played by the potential driving factors of the migration decision-making process.

As far as Spain is concerned, internal migrations have been the subject of a number of previous studies. A general picture from the early 1990's onwards shows some interesting findings. First, internal flows have accelerated mainly due to an intensification of intra-regional movements, departing from previous significant inter-regional flows. Original exodus from rural places to main urban centres in the country, taking place in the 1960's and 1970's, has turned into a new model where short-range flows dominate the scene (García-Coll and Stillwell, 1999; Ródenas and Martí, 2002). Second, intra-regional flows account for two main trends. The first one is the emerging preference of people for living in intermediate towns in good communication with big cities, avoiding negative externalities arising therein. The other reflects the movement of people towards the residential suburbs of main metropolitan areas in the country (Hierro, 2009).

A closer look at the determinants of internal migration flows in Spain show the low profile role played by traditional economic variables, such as real wage differentials or unemployment gaps between locations (Bentolila, 1997, 2000; Bentolila and Jimeno, 1998; Maza and Moral, 2006; Maza and Villaverde, 2004). Indeed, some of these studies detected a negative correlation between rates of unemployment and migration flows for the regions of the country, so that high unemployment rates appear to act as a deterrent factor of people's movements in times of crisis (Antolín and Bover, 1997). Mulhern and Watson (2009, 2010) find that wage and unemployment differentials are relevant explanatory factors for internal migrations in Spain during the boom period 1998–2006. These authors argue that such a result could reflect the changes occurring in the Spanish economy along these years, particularly the highest level of labour market flexibility reached.

In this context, the present paper makes two main contributions. First, we examine migratory decisions at the municipality level rather than between regions (NUTS 2) or provinces (NUTS 3). This is important because intra-regional movements represent now the bulk of internal migration flows in Spain, so by employing the local level of analysis we will be able of more accurately capturing their main characteristics and determinants. It would also help us to shed more light on current controversies existing between previous studies about the relevance of economic factors in influencing internal flows of people, all of them employing an (inter)-regional approach. Second, we follow a modeling approach that considers the migration choice as a two-stage process, where migrant first decide to leave a place of origin, and then select a destination where establishing her/his new residence. This modelling strategy thus implies estimating an equation of out-migration rates in which the characteristics of the sending municipalities act as push factors, and a destination choice equation for migration flows to evaluate the role played by pull factors associated to the destination.

After this introduction, the remainder of the paper is organised as follows. Section 2 introduces the modelling framework. Section 3 describes the data, and Section 4 presents the main results of the investigation. Finally, Section 5 concludes.

2 Modelling migration decisions in a two-stage framework

The main focus of this study is on the migration decision-making process and its determinants. To this aim we adopt an empirical modelling strategy that divides the migration division into two phases: the decision to move and the search for a new place of residence. Although the migration decision is made at the personal level the model we employ attempts to explain migrations without the explicit introduction of an individual decision function. Instead, migratory flows are related to a set of potential explanatory aggregate variables, so that we can evaluate the contribution of the characteristics of a locality to encourage the departure of its residents on the one hand, and their role enhancing the attractiveness for potential in-migrants on the other. At this point it is worth noting that by considering two stages in the decision-making, the model allows that the same variable that generates an intolerable level of discomfort with the current place of residence for out-migrants might be at the same time an irrelevant factor for potential in-migrants in their selection of a destination, that is, it would not affect at all the overall attractiveness of the locality.

In statistical terms, the two-stage modelling approach implies the following decomposition of the probability for a particular individual to choose destination j given that the individual resides in locality i, denoted as p_{ij}:

$$p_{ij} = p_i \times p_{j|i}, \qquad j \neq i;\ i, j = 1, \ldots, n\,, \tag{1}$$

where p_i is the probability of departure from municipality i, and $p_{j|i}$ is the conditional probability of choosing destination j once the individual has made the decision of departing from locality i. Our main interest centres on the evaluation of the determinants of the probabilities in the right hand side of the equation (1), thus we will separately specify an empirical model for the departure probability p_i and the destination choice probabilities $p_{j|i}$.

Regarding the probability of departure, the first decision potential migrants residing in locality i face is to decide whether to move or stay at the same locality. We assume that individuals are continuously evaluating the suitability of their current place of residence: most are apparently satisfied with it and have not motivation to move; some, however, are not satisfied and consider a move. The migration decision-making is primarily a decision at the individual or household level, wherein personal circumstances such as age, satisfaction with the current housing and community, or specific events in the life-course (childbirth, retirement, etc.) act as the main triggering factor. However, in this study we hypothesise that local or regional conditions at the place of origin might also occupy a prominent position among the factors that shape the decision to move. Consequently, our main concern here is on how the movement/non-movement decision relates to a set of aggregate characteristics of the municipality of origin of the potential migrants. The latter is achieved by considering a binomial logit model that specifies the probability that a given inhabitant of municipality i chooses to leave-out this origin as

$$p_i = \frac{\exp(X_i \alpha)}{1 + \exp(X_i \alpha)}, \qquad i = 1, \ldots, n\,, \tag{2}$$

where X_i a vector of observed attributes of the municipality i, and α is a vector of coefficients to be estimated.

For the second stage in our modelling approach we consider a migration destination choice model that distributes the total number of emigrants from municipality i into each of the alternative locations according to their characteristics. Individuals face a multiplicity of choices in their search for a new residence, so that this is basically a process of acquisition and processing of information regarding alternative destinations. The *competing destinations model* (Fotheringham, 1986) assumes that there is a limit to individuals' ability to process large amounts of information and suggests a simplifying decision scheme whereby a cluster of destinations is first selected, and then the final destination is chosen among those belonging to that cluster.[1] Under this hierarchical setting, destinations inside the same cluster are perceived by migrants as close substitutes. As a result, single alternatives within the cluster would lose visibility by themselves, resulting in smaller choice probabilities than those located in more isolated but visible destinations, *ceteris paribus*. The competing destinations model takes into account both, the hierarchical nature of the choice process and the effect of spatial competition arising among alternatives, by specifying the expected probability of moving to destination j departing from location i as

$$p_{j|i} = \frac{\exp(Z_j\beta)\,L_j}{\sum_{r\neq i}\exp(Z_r\beta)\,L_r}, \qquad j \neq i;\ j,r = 1,\ldots,n\,, \tag{3}$$

where Z_j is the set of observed characteristics of destination j, β is a vector of coefficients, and L_j accounts for the effect of spatial competition on the choice probability of each individual alternative. The term L_j is defined as

$$L_j = ACCESS_j^{\theta}\,, \tag{4}$$

where θ is a parameter to be estimated, and $ACCESS_j$ represents the accessibility (or centrality) of destination j relative to all other alternative destinations. Following the common practice, this measure of accessibility is computed

[1] The model also assumes implicitly that the identification of the spatial clusters made by individuals is unknown *a priori* for the researcher, so that employing a *nested logit model* in this framework would be inappropriate. Indeed, the specification of the nested logit requires the researcher to know in advance the composition of each nest (cluster).

in this study as the population weighted average of the *inverse* distances between location j and the rest of potential destinations (d_{jr}),

$$ACCESS_j = \frac{1}{n-1}\sum_{r\neq j}\frac{POP_r}{d_{jr}}, \qquad j,r = 1,\ldots,n\,. \tag{5}$$

For a given destination j, larger values of the accessibility index reflect this to be located in a central position, that is, to be so close to other potential locations candidates to conform a joint spatial cluster. Correspondingly, lower values of the accessibility index are associated with a greater degree of spatial isolation of the destination. In the framework of the competing destinations model, if $\theta < 0$, then more spatially isolated localizations are more likely to be selected by migrants and competition forces are said to exist. In the opposite case, if $\theta > 0$, potential destinations in close proximity to other alternatives will have a higher probability of being selected and agglomeration forces are said to exist. Finally, $\theta = 0$ corresponds to a situation wherein individuals evaluate all alternatives simultaneously, and the competing destination model is equivalent to a standard conditional logit specification.[2]

3 Empirical results – The internal migratory flows in Spain

3.1 Data

This study uses data on inter-municipal migratory movements in Spain from the Residence Variation Statistics (*INE*).[3] During the period 2011–2013 there

[2] Fotheringham et al. (2001) remark that the competing destination variable might account for hierarchical destination choice and competing effects between places within the same cluster but, alternatively, it might also reflect migrants' preferences regarding the spatial agglomeration of destinations. In either case, the authors conclude that we must be confident that if hierarchical destination choice is present, then the inclusion of the competing variable will capture it appropriately.

[3] The Residence Variation Statistics (*Estadística de Variaciones Residenciales, EVR*) elaborated by the Spanish National Statistics Institute (*Instituto Nacional de Estadística, INE*) is based on the official Municipal Population Registers (*Padrón Municipal de Habitantes*) and comprises all residential movements declared by citizens. The Spanish local authorities are required to make entries in these registers for all individuals usually living in the municipality, whether they are Spaniards or foreigners and whether they have residence permits or not.

were registered more than 1.5 million movements per year (**Table 1**), that implies that on average 3.05 per cent of the resident population change of locality every year, a number big enough to influence the local housing and labour market conditions.[4] Internal migratory processes do not affect homogenously to each municipality but the potentiality of internal migrations as a mechanism to redistribute population across the territory is rather low given the high (positive) correlation between inward and outward migratory flows. The latter implies that those municipality exhibiting the most intense migratory activity tend to display simultaneously both the highest in-migration and out-migration rates. It is equally remarkable the short-distance nature of the internal migration movements in Spain (for example, 25% of the migrants travelled a distance lower than 10 km, and 60% of them did not surpass the 100 km boundary). The bulk of internal movements are flows inside the same metropolitan area of a major urban centre. Hence, inter-regional flows have lost relevance in the whole migratory picture, which should be analysed from a more spatially disaggregate point of view (at the municipality or, even, zip code level).

3.2 The departure model

The first stage focuses on the decision of out-migration according to a set of characteristics of the municipality that is left away. In doing so, we specify a model where the out-migration probability for a given municipality i is a function of a set of covariates capturing the local economic conditions, housing market features, availability of amenities, climate, etc. that might act as push factors.

The econometric specification for the departure decision is then written as

$$p_i = \frac{\exp(V_i)}{1 + \exp(V_i)}, \tag{6}$$

with

[4] As stated by Ródenas and Martí (2009), a fraction of the movements recorded by the EVR are associated with repeated migrations by the same individual. These authors report a ratio of approximately 1.12 movements per migrant during the period 2003–2005, and this is the ratio we use to approximate the percentage of resident population involved in internal migratory flows.

$$\begin{aligned} \mathrm{V}_i = {} & \alpha_0 + \alpha_1 POP_i + \alpha_2 URBAN_i + \alpha_3 UNEMP_i + \alpha_4 HOWNER_i \\ & + \alpha_5 SERV_i + \alpha_6 CLIMATE_i + \alpha_7 EDUC_i + \alpha_8 AGE_i \\ & + \alpha_9 ALLOC_i + \alpha_R REG_i \end{aligned} \tag{7}$$

A detailed definition of the explanatory variables employed in the model can be found in **Table 2**, and the estimates of the model are reported in **Table 3**.[5]

Local population size (*POP*) accounts for the degree of urbanisation of the municipality and the related potential agglomeration economies (or diseconomies) that affect the quality of life of inhabitants. Most populated municipalities offer higher opportunities of personal interaction and increase the attractiveness for current residents but, on the hand, large municipalities might be associated with congestion problems that worsen quality of life, higher house prices, etc. The estimated effect of this variable on the probability of departure is positive and statistically significant and, as we also find that belonging to an urban area (*URBAN*) contributes to make less desirable residing in a given municipality, these results together suggest the existence of negative externalities steaming from locations within highly urbanised environments.

The general availability of employment opportunities at the municipality of current residence is captured by the unemployment rate (*UNEMP*). As a striking outcome, this variable is found to exert no significant effect in encouraging the departure decision of people. Nevertheless, the latter is consistent with the empirical findings obtained by previous studies, such as, for example, Antolín and Bover (1997), who shows that Spanish unemployed workers are particularly unwilling to move. In this respect, the prevalence of a high level of national unemployment implies a lower probability of finding a job in the destination. Migration becomes riskier and, as a result, workers would be less willing to try their luck by moving to a destination with a lower unemployment rate. Moreover, during a recession, tightening of credit market conditions may make it difficult for perspective migrants to finance their mobility costs. Finally, other factors such as unemployment benefits or the availability of family support may also play a role in explaining the low mobility of unemployed workers

[5] Regional dummies (defined at NUTS 2 level) are included in the model to reflect the effects of region-specific attributes such a language, cultural heritage, legislation, etc.

by allowing them to stay on and to avoid migration[6] (see Braunerhjelm et al., 2000, for a detailed discussion of these issues).

Housing tenure conditions is a critical factor in explaining the decision of departure. Owning a house may discourage people from moving: homeowners face additional costs associated with moving to a new locality, including preparing their existing house for sale, the selling commission on it, and mortgage origination costs if they purchase a new house. We estimate the highest (negative) elasticity for the home-ownership rate ($HOWNER$), so that high housing ownership rates clearly constitutes a barrier to the decision to move, aggravated by the fact that home-ownership is much more common in Spain than in the average European countries (for example, in 2011 the home-ownership rate in Spain was 79.8%, well above the 66.4% for the countries in the Euro Area).

The influence of local amenities[7] on the moving/non-moving decision is captured by including a proxy for the availability of services at the local level ($SERV$) and an indicator of climate harshness ($CLIMATE$).[8] Both variables are found to be significant determinants of migration intentions although they make a rather modest contribution to out-migration flows.

A number of personal characteristics are likely to exert important influences on the individuals' decision to move. Among these characteristics are level of education and age. In general, education is correlated with non-observable ability and employability at the individual level, therefore highly educated individuals will be more likely to move as a way to improve their employment

[6] The relevance of family support in discouraging migration is particularly clear for the youngest unemployed workers. In Spain, young adults tend to live with their parents longer than in many European countries so they are relatively unwilling to move to another place to escape high local unemployment rates.

[7] Even though the "*jobs versus amenities*" debate has been the focus of a large body of the literature, the idea of amenities is still a not well-defined concept. Thus, the list of amenity/dis-amenity variables is diverse and could be made very long, and it is not immediately apparent to discern which one reflects this type of local attributes the best.

[8] The index of climate harshness is defined as the product of the origin's latitude and elevation. The underlying hypothesis is that climate conditions tend to worsen as latitude and elevation of a location increases, thus making it a less desirable place to live in.

prospects and high rates of out-migration will be more common for municipalities with the highest proportion of well-educated residents. The latter assumption is confirmed by our results and a higher average education level of the population in a given municipality (*EDUC*) is found to be significantly linked to a higher propensity to migrate. For the average age of the local population (*AGE*) we estimate a positive effect on the probability of moving. This is a rather surprising result, as we expected a higher out-migration propensity for municipalities where young people were more prevalent (indeed, population aged 25-34 years represents about 27% of internal migrants in Spain).

Finally, to capture the existence of some inertia in the migratory decisions made by the residents in a municipality or, alternatively, to reflect a particularly favourable attitude to migration (areas that experience much immigration possess substantial segments of their population that are migration prone), we have considered the degree of allochthony of the local population (*ALLOC*) for which we estimated a significant positive effect for this variable.

3.3 The destination choice model

The second stage of our modelling approach explains the destination choices of migrants. Fotheringham (1991) suggests that equation (3) should be estimated separately for each locality of origin, because the magnitude of the effect that each factor might exert on the migrant's destination choice is origin-specific, that is, it depends on the relative value of the variable between origin and destination. Since the model is estimated for each origin i, we consider a specification where coefficients vary among origins[9]

$$p_{j|i} = \frac{\exp(V_{j|i})\, ACCESS_j^{\theta_i}}{\sum_{r \neq i} \exp(V_{r|i})\, ACCESS_r^{\theta_i}}, \quad j \neq i;\, j = 1, \ldots, n \tag{8}$$

with

[9] It is worth noting that according to well-known theoretical result the model will lead to identical coefficient estimates that those obtained by assuming that the migratory flows m_{ij} can be modelled as Poisson random variables with mean $\mu_{j|i} = \exp\left\{\omega_i + V_{j|i} + \theta_i \ln(ACCESS_j)\right\}$, where the ω_i s are origin-specific intercepts (see, for example, Baxter, 1984).

$$
\begin{aligned}
V_{j|i} = {} & \beta_{i1} DIST_{ij} + \beta_{i2} SAMEUA_{ij} + \beta_{i3} POP_j + \beta_{i4} URBAN_j \\
& + \beta_{i5} UNEMP_j + \beta_{i6} RENTAL_j + \beta_{i7} SERV_j + \beta_{i8} CLIMATE_j \\
& + \beta_{i9} YOUNG_j + \beta_{i10} ALLOC_j + \beta_{iR} REG_j
\end{aligned} \tag{9}
$$

The specification of the model includes as explanatory factors the traditional gravity variables, that is, the aerial distance between origin and destination, the destination population as the mass variable of the model, together with other destination characteristics that potentially contribute to conform its attractiveness for migrants. Estimates of the parameters in the model are obtained by maximum likelihood for each municipality of origin in the sample. The results are summarized by applying the DerSimonian–Laird method to the set of parameter estimates, so in **Table 4** we present the estimated overall effects for each explanatory variable.[10]

Firstly, our estimates point to the existence of a hierarchical strategy in the choice of destinations by migrants where competition effects prevail (we estimate a negative value of the parameter θ).

The distance variable (*DIST*) is a proxy for overall transaction costs of migrating whether financial or personal; moreover, it is assumed that these costs increase as the distance between the origin and destination does. Distance can also be related to the information costs of traveling, with higher distance hampering the migration process. As expected, estimates of the distance-decay parameter are negative, so that the probability of being selected as destination decreases as distance from the locality of origin increases. On the other hand, we find that destinations in the same urban area that the origin (*SAMEUA*) are clearly preferred by those who have decided to change their place of residence. This implies that a significant part of the migratory flows are short-distance movements, which can be labelled as residential mobility that simply redistribute population within urban agglomerations and are directly linked to the growth in commuting.

[10] In short, given a set of estimates of the effect of an explanatory variable it is assumed, first, that $\hat{\beta}_i = \beta_i + e_i$, where $\hat{\beta}_i$ is the effect estimate obtained from study *i* (by estimating the model for the origin municipality *i* in our case), β_i is the true effect, and e_i is a random error; and second, $\beta_i = \beta + \varepsilon_i$, where β is the true overall effect we wish to estimate and ε_i is an error term capturing variability across studies.

The population (*POP*) parameter estimates suggest that migrants prefer large municipalities as destination. The preference for larger municipalities as the destination of migratory flows is associated to both the better knowledge of such places (from the media, personal contacts, etc.) and the fact they offer more opportunities for employment, entertainment, etc. not captured by the corresponding covariates also included in the model specification. Despite this general preference for larger municipalities as destinations, integration within an urban area (*URBAN*) seems to deter potential in-migrants given the positive and significant estimate of the associated coefficient. In this case, diseconomies associated to urban agglomerations come into play so that dense and congested areas are left away for migrants in their mobility choices.

The availability of economic alternatives or, more precisely, better alternatives in the job market is captured by the unemployment rate at potential destinations (*UNEMP*). Our findings indicate that, as expected, unemployment rates at destination plays a statistically relevant role as a pull factor.

The possibility of finding home accommodation easily may also be of importance for the destination choice, therefore, in the specification of the model the percentage of rentals (*RENTAL*) accounts for this characteristic. The estimates suggest that immigrants are more likely to go to places with substantial fractions of rentals, that is, municipalities with an easier access to housing are more prone to receive migratory flows.

The destination choice model includes also includes the proxies for two types of local amenities: those related with the general availability of services (*SERV*), and climatic conditions (*CLIMATE*). Our findings suggest that the attractiveness of a place as destination for potential migrants arise with the supply of services. Moreover, climate harshness represents a negative amenity, that is, migrants prefer destinations enjoying a mild climate. The attractiveness of a destination is also reinforced by a higher weight of young people in the total population (*YOUNG*); migrants clearly prefer youthful places, maybe associated with an environment socially more dynamic and attractive.

Lastly, the positive effect of the index of allochthony of the local population (*ALLOC*) might be associated with the existence of some inertia in the choice of destination by migrants, or maybe to some type of social networking effect (interpersonal ties linking previous immigrants in a destination with relatives, friends, etc. in their places of origin may help them to migrate, get jobs, or adjust to society in the destination in other ways).

3.4 Further discussion of the empirical results

Once discussed the empirical results obtained for each stage of the migratory process it is customary making some additional comments regarding the general picture of the Spanish migratory system they show.

The first point to highlight is related to the geographical pattern followed by the internal migratory flows. By combining the estimates from the departure and the destination choice models we conclude that in the case of Spain, migrants are attracted to large cities but, at the same time, those yet settled in large cities are more likely to move, probably to another destination within the same urban area. Urban areas do not attract migrants, but large cities do so. Consequently, large cities play a key role as ports of entry and redistribution of migrants to their urban/metropolitan areas. This redistribution process only implies short-distance movements, by far the most common, and mainly reflect residential mobility within the limits of the urban area of origin. In sum, internal migratory flows reinforce suburbanization trends by spanning the metropolitan areas into peripheral areas.

The role of unemployment levels in shaping the pattern of the internal migration flows also deserves some special consideration. The conventional approach to migrations assumes that unemployment differentials between territories are among the main drivers of migrations, so that we should observe people moving from regions with high rates of unemployment towards regions with low ones. However, our empirical findings indicate that internal migration patterns in Spain are only partly consistent with this theoretical framework. Indeed, while destinations with higher rates of unemployment are avoided by migrants, higher rates of unemployment also discourage people from moving. Thus, internal migrations in Spain can be characterized as flows directed towards the more prosperous places (those with lower unemployment) and, to some extent, originated from places where the level of unemployment is relatively low as well.

Finally, it remains certainly true that housing market conditions are today one of the most important variables determining the mobility options of people across the countries. Dynamics of the sell and buy options for real estate assets inside a country or continental market, and rotation of such type of assets, as well as flexibility conditions for financing these options, also play a major role in defining the capacity of people of moving abroad to improve their life conditions when business cycle changes. This appears to be a key result for the current Spanish economy, mainly if we take into account the disproportionate rate of unemployment characterizing the country, and this hitting the young population in particular. In such a tough context, the friendly management of the housing market appears to be an essential tool for the recovery of the national economy for the case of Spain.

4 Conclusions

In this paper we have analysed the determinants of the inter-municipal migratory flows in Spain during the period 2011–2013. We evaluated the effect of labour market, housing and other local characteristics on the two parts of the migratory process: the decision to leave-out a municipality and the choice of a particular new destination. Both issues conform the main contribution of the paper, say the local approach to migratory decisions, and the splitting of the two main choices making up them.

Key findings of the study have shown the relevant role of pivotal variables of the urban studies in explaining both the departure and the destination choices, such as agglomeration and congestion economies, diversification of the amenities supplies, housing market conditions, and demographics at the city level. Development of professional careers of migrants also plays a prominent role in internal movements, as they are mainly of the intra-regional, intra-urban type. Main urban destinations are receiving the bulk of arrivals and exits in this process, which has clearly turned into a search for better life quality standards in personal and professional terms. Moreover, these flows seem to be no more responding to the shift of traditional economic variables, mainly to unemployment differentials between locations.

Finally, and regarding policy recommendations, our findings suggest that serious steps should be taken in improving housing market flexibility at the country level, and particularly those options related to facilitate the migratory options of collectives more affected by the ongoing crisis. Amenities are both of relevance for in-and-out flows of people at the local level, while congestion problems of big cities should be addressed by employing policy guidelines such as the promotion of public transport networks and related actions, that help to revitalise these increasingly abandoned urban areas of the main cities of Spain.

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Tables

Table 1 Internal migratory movements in Spain 2011–2013

Year	Population	Internal movements	Ratio (%)
2011	46667175	1650298	3.54
2012	46818216	1586075	3.39
2013	46727890	1551940	3.32

Table 2 Variables definition and sources of information

Variable	Definition	Data source
DIST	Euclidean distance between municipalities centroids (km).	IGN
SAMEUA	Dummy variable (1 whenever origin and destination municipalities belong to the same urban area).	Ministerio de Fomento, 2011
POP	Total municipality population.	Censo 2011
URBAN	Dummy variable (1 for municipalities in urban areas; 0 otherwise).	Ministerio de Fomento, 2011
UNEMP	Unemployment rate.	Censo 2011
HOWNER	Home-ownership rate computed as the proportion of owner-occupied housing units over the number of housing units.	Censo 2011
RENTAL	Rental rate computed as the proportion of renter occupied housing units over the number of housing units.	Censo 2011
SERV	Percentage of the municipality area dedicated to service activities.	Censo 2011
CLIMATE	Index of climate harshness computed as the product of latitude and elevation above the sea	IGN
EDUC	Percentage of people who have achieved upper secondary levels of education at least.	Censo 2011
YOUTH	Index of population youth computed as the ratio of persons aged between 15 and 29 to the whole population.	Censo 2011
AGE	Average age of the population.	Censo 2011
ALLOC	Percentage of allochthonous population over total population in the municipality.	Censo 2011
ACCESS	Index of accessibility (details are given in the main text).	Censo 2011, IGN

Table 3 Departure model

	APE		s.e.	p-value
POP	0.0145	***	0.0006	0.0000
URBAN	-0.0412	***	0.0017	0.0000
UNEMP	-0.0300	***	0.0013	0.0000
HOWNER	-1.4192	***	0.0075	0.0000
SERV	-0.0079	***	0.0006	0.0000
CLIMATE	0.0016	***	0.0004	0.0000
EDUC	0.0527	***	0.0045	0.0000
AGE	0.0737	***	0.0107	0.0000
ALLOC	0.6805	***	0.0022	0.0000
Regional dummies included				
Pseudo-R^2	0.4579			
Observations	750			

Dependent variable is the probability that population from a municipality move to another Spanish municipality. APE stands for average probability elasticities. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 4 Destination choice model

	APE		s.e.	p-value
DIST	-1.4347	***	0.0096	0.0000
SAMEUA	0.3514	***	0.0363	0.0000
POP	1.0337	***	0.0049	0.0000
URBAN	-0.1340	***	0.0118	0.0000
UNEMPL	-0.0795	***	0.0075	0.0000
RENTAL	0.2973	***	0.0123	0.0000
SERV	0.0244	***	0.0038	0.8900
CLIMATE	-0.0329	***	0.0030	0.0000
YOUTH	0.4997	***	0.0464	0.0000
ALLOC	0.6718	***	0.0184	0.0000
ACCESS	-0.9428	***	0.0163	0.0000
Regional dummies included				
Pseudo-R^2	0.3902			
Observations	750			

Dependent variable is the probability of immigrants choosing to live in a particular destination given its characteristics. APE stands for average probability elasticities. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Chapter 5

Foot voting in Spain: what do internal migrations say about quality of life in the Spanish municipalities?

Abstract: In this paper we analyse the differences in well-being between Spanish municipalities reflected by people's migratory decisions. It is assumed that people move for improving their well-being conditions, and consequently migratory flows basically reflect perceived differences in the quality of life between potential destinations. Our empirical findings are: first, municipalities in the Mediterranean Axis are perceived as those with the highest quality of life; second, we detect a general process of convergence in quality of life conditions among the Spanish municipalities in the last fifteen years; third, estimated levels of quality of life are inversely related to urban size; and, fourth, people perceive nearby destinations as the most attractive places to move to.
Keywords: quality of life; migration; foot voting; Spain; municipal

1 Introduction

Quality of life has recently become a hot topic for interdisciplinary research. However, several conceptual and empirical problems have to be faced in this still-evolving research field. Most popular techniques in building quality of life indicators, either at the country, regional or municipal level, include the computation of composite measures of well-being. Along this process, there is a lack of consensus on which variables should be included in the analysis, and the relative weight that should be assigned to every one of them. Thus, some caution is needed when using and interpreting the aforementioned composite indexes (Faggian et al., 2012). Other relevant problem arising in this framework is the availability of comparable information on living conditions, and its evolution along time, mainly if we take into account the high level of geographical disaggregation that these type of studies use to employ.

In dealing with those important limiting factors, some authors have suggested to approach the quality of life concept by using information on migratory flows. These include contributions of Douglas (1997), Douglas and Wall (2000), or Wall (2001), among others. More recently Nakajima and Tabuchi (2011), and Faggian et al. (2012) have addressed this issue. The underlying hypothesis on these studies is that individuals migrate "*vote with their feet*" in order to improve their well-being. In making their migration decisions, utility maximizing people reveal their preferences for different locations and, consequently, it is possible to infer how individuals perceive differences in the quality of life between potential destinations by looking at migratory flows. As compared with synthetic indices of quality of life, the migration-based approach presents some evident advantages, demanding much less information in building indicators, and not facing arbitrary choices or weighting assumptions about their components, this being two outstanding limitations of this literature.

The main focus of this paper is then the measurement of quality of life based on observed migratory flows. In doing so, we estimate differences in well-being for Spanish municipalities as reflected by people's migratory decisions. Previous methods and results on quality of life indicators for Spanish municipalities are somehow mixed. González et al. (2011a,b) employ a refinement of data envelopment analysis (DEA) to construct a composite index of quality of life for the Spanish municipalities with population over 10,000 inhabitants in year 2001. Their main results suggest that local-based determinants account for more than a half of the variance of the index, while the remaining variability can be attributed to factors linked to higher geographic levels (regions and provinces). These authors also conclude that the highest levels of quality of life stand for the Northern and Central regions of Spain. Further, other authors have pursued to study the well-being of more restricted communities. For example, Martín and Mendoza (2013) apply DEA methods in search of a synthetic index for 87 municipalities of the Canary Islands in Spain in 2001. Among other things, this research concludes that the overall performance of the index is mainly driven by living conditions, commuting time, and educational and unemployment levels. Royuela et al. (2003) construct a composite index for the municipalities in the area of Barcelona by averaging a large number of variables describing individual characteristics of residents (wealth, education, etc.), social inequalities (gender inequality, commuting, etc.) and the community conditions of life (housing, transportation, environment, etc.). Unlike other studies, they analyse the time evolution of the indexes (from 1991 to

1998), finding a general improvement in the quality of life, while the city of Barcelona loses relative prominence in the area. A similar approach is found in Faggian and Royuela (2010), concluding that quality of life is a key determinant of migration flows between municipalities in the Barcelona metropolitan area. The common factor of all these studies is that they search for a set of factors determining the quality of life.

In this paper we opt for approaching the concept of quality of life by following an ex-post focus based on migratory flows at the municipal level. In doing so, we estimate indices of quality of life for Spanish municipalities with more than 10,000 inhabitants for the period 1997 2011 building on internal migration data. This exercise will allow us to employ a complementary approach in comparison with previous studies for Spain by relying on the migration-based methodology. Such an exercise will update results of previous studies on quality of life measurement for the whole country case, and of other group of studies more focused on the case of particular regions of Spain. Employing the local focus is also important for this literature, as it helps to capture the nature of the internal people's flows, most of them of a short-haul condition, while showing the interrelations between migration and the search of an improvement of the people's well-being. Moreover, the municipal approach seems to be the most appealing one in this type of studies, given that local factors appear to be accounting for more than half of the variance of the quality of life in Spain, as shown by González et al. (2011b). Providing additional evidence for the municipal approach will also extend this literature at the international level, given that the regional or counties-based approach is still the dominant in this type of studies.

In conducting the estimation of quality of life indexes, we rely on the approach of Nakajima and Tabuchi (2011). However, unlike them, we do not assume that fixed costs of migrating are arbitrarily large. Such an assumption appears to be inadequate in our case, given the intra-provincial and short-haul nature of these flows for the Spanish case, where more than 60% of intra-national movements of people do not reach more than 75 km from their origin point. Accordingly, our framework of analysis is slightly different in regards to the originally defined by these authors.

The period of analysis ranges between years 1997 2011, comprising two dissimilar phases in the recent economic history of Spain. The first years, 1997-2006, coincide with an economic boom period. Along these years, economic growth was more intense in the Mediterranean corridor, with construction industry generating huge employment opportunities that attracted an increasing number of migrants. In contrast, during the second part of the period, and particularly in years 2009 2011, the Spanish economy underwent a severe economic crisis where the collapse of the housing market constitutes the more striking aspect. As a result, seaside destinations have been hit the most by the economic crisis, largely losing their attractive for immigrants. In this context, as we will show, such a process has had a relevant influence on the evolution of quality of life differentials between municipalities along the Spanish geography.

After this brief introduction, the remainder of the paper is organised as follows. Section 2 describes the methodology employed in estimating quality of life at the local level as reflected by internal migration flows. Section 3 presents and discusses the empirical findings of the research, while section 4 concludes.

2 Methodology

This paper builds upon the recent contribution of Nakajima and Tabuchi (2011), which develop an analytical framework to estimate utility differentials among destinations starting from an individual utility maximizer's locational choice problem. The central idea in the Nakajima and Tabuchi (2011) model is that the primary factor influencing the probability of a person to move from one origin location to a new destination, is the expected change in the level of quality of life destination j (Douglas, 1997):

$$U_{ij} = u_j + \varepsilon_{ij} \,. \tag{1}$$

From equation (1), we will consider the consensus term as a proper measure of the quality of life in destination j along this research, as it captures the overall associated to that particular choice. In this sense, migration flows would provide reliable data on the relative attractiveness of different locations, and its evolution in time.

In short, it is assumed that an individual will move from location i to destination j if

$$U_{ij} - c_{ij} = \max_r \left\{ U_{ir} - c_{ir} \right\}, \quad r = 1,2,\ldots,n \tag{2}$$

In turn, the ex-ante utility from living in the municipality j (U_{ij}) is assumed to be the sum of a *consensus component* (u_j) and an idiosyncratic term (ε_{ij}) reflecting differences in preferences between individuals when evaluating the attributes of new attractiveness, including economic opportunity, of the location for a typical resident.

As previously shown by literature if the error terms are independent and identically distributed with the Weibull distribution, then the probability that an individual at location i chooses area j can be written as

$$p_{ij} = \frac{\exp(u_j - c_{ij})}{\sum_{k=1}^{n} \exp(u_k - c_{ik})}. \tag{3}$$

Nakajima and Tabuchi (2011) suggest that the costs of migration are independent of distance and that they are essentially a fixed cost, say $c_{ij} = c$ for every $j \neq i$ while $c_{ii} = 0$, so that the probability of moving from any location i to a specific area j can be rewritten as[1]

$$p_{ij} = \frac{\exp(u_j)}{\exp(u_i + \mathrm{c}) + \sum_{r \neq i}^{n} \exp(u_r)}. \tag{4}$$

At this point, let us now assume that the expected number of people moving from location i to location j, denoted by N_{ij}^{e}, is

$$N_{ij}^{e} = POP_i \times POP_j \times p_{ij}\,, \tag{5}$$

where POP_i represents the size of the population in municipality i and measures the number of potential migrants from municipality i, and POP_j is

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[1] Nakajima and Tabuchi (2011) assume that the fixed cost c is arbitrarily large, thus the following approximation to the probability in (3) applies

$$p_{ij} \approx \frac{\exp(u_j)}{\exp(u_i + c)},$$

and, subsequently, they consider:

$$\ln\left(\frac{N_{ij}}{N_{ji}}\right) \approx 2\left(u_j - u_i\right).$$

Such an assumption hardly simplifies the estimation of utility differentials, but making the approximation crucially dependent on it. In this way, we are not confident that this assumption could be applied in all situations.

the size of the population in destination j which acts as a proxy of the opportunities that an average migrant would receive by moving to that destination.[2] Then, equation (5) suggests a natural estimator for the probability of moving from location i to location j, which would correspond to the gross migration rate defined as

$$m_{ij} \equiv \frac{N_{ij}}{POP_i \times POP_j} \quad . \tag{6}$$

Finally, by combining equations (4) and (6) we obtain

$$m_{ij} \approx \frac{\exp(u_j)}{\exp(u_i + \mathrm{c}) + \sum_{r \neq i}^{n} \exp(u_r)} \quad . \tag{7}$$

Resulting in

$$\ln\left(\frac{m_{ij}}{m_{ik}}\right) \approx \left(u_j - u_k\right), \quad i \neq j \neq k \, , \tag{8}$$

so that the ratio between gross migration rates reveals information relative to the utility differential for migrants. Equation (8) is useful because even though the utility differentials $\left(u_j - u_k\right)$ may not be directly observed or estimated, the migration rates may be and, consequently, they can be used to construct indices of quality of life according to this theoretical framework. Thus, in the empirical section of this study we will compute measures of the quality of life (QoL henceforth) differentials between municipalities by estimating the following regression model for relative cross migration rates:

$$\ln\left(\frac{m_{ij}}{m_{ik}}\right) = \sum_{r=2}^{n} \beta_r D_r + e_{ijk} \, , \tag{9}$$

where D_r $(r = 2,\ldots,n)$ are dummy variables defined as

$$D_r = \begin{cases} 1 & \text{if } r = j \\ -1 & \text{if } r = k \\ 0 & \text{otherwise} \end{cases} \tag{10}$$

[2] See Douglas (1997, p. 417-419) for a detailed justification of the use of population to control for the number of locations or “opportunities” available at the destination.

and e_{ijk} is an error term. In the equation (9) the dummy variable for $r = 1$ is drop to avoid exact colinearity given that $\sum_{r=1}^{n} D_r = 0$; and the estimated coefficients thus corresponds to the expected consensus utility differentials, that is, $\hat{\beta}_r = u_r - u_1$. Furthermore, notice that the empirical model (9) identifies the utility differentials between every pair of locations *j* and *k* by comparing the relative strength of the migratory flows towards them departing from the same origin *i*. This feature of the approach may be used to compute indexes of well-being which reflect exclusively the perception of the natives of a particular localization, by simply estimating the model for a fixed *i*.[3]

3 Data and estimation results

3.1 Database

The empirical analysis employs yearly data of migration flows among Spanish municipalities taken from the Residence Variation Statistics (*Estadística de Variaciones Residenciales, EVR*) of the Spanish National Statistics Institute (*INE*). The period of analysis extends for the years 1997-2011. Data builds on information from the official Municipal Population Registers (*Padrón Municipal de Habitantes*) and comprises all residential movements declared by citizens.[4] To preserve the identity of reporter, the publicly available database contains detailed information for municipalities with a population of 10,000 inhabitants and more. Such an issue constitutes a limitation for the analysis, given that along the period considered 23% of the Spanish population on average was located in small municipalities (those with population under 10,000). However, we are able to study the state of quality of life for approximately 700 municipalities,[5] through the analysis of migration decisions of the remaining 77% of the population.

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[3] In fact, this approach assumes that the consensus utility level associated with a municipality may vary depending on the origin of the migratory flows, that is, equation (1) should be rewritten as $U_{ij} = u_{ij} + \varepsilon_{ij}$.

[4] The Spanish local authorities are required to make entries in these registers for all individuals who usually live in the municipality, whether they are Spaniards or foreign citizens, having or not residence permits.

[5] The number of municipalities over 10,000 inhabitants varies from 618 in 1997 to 759 in 2011.

Figure 1 plots the evolution of inter-municipal migration flows in Spain along the period of analysis,[6] showing an increase in volumes of that flows from 400,000 movements per year in 1997, up to around 1.1 million in 2007. Since that year until the end of the period the magnitude of internal migrations remains constant around 1 million per year.

The increasing level of internal migration shown in **Figure 1** not only reflects the existence of relevant changes in the standard of living among the Spanish municipalities, but an increasing mobility of people inside the intra-provincial space along the period of analysis. Major urban centres in the country are losing population because of congestion problems, while intermediate urban areas become preferred locations for people, because of the higher quality of life they permit. Development of infrastructures in these years in Spain provided the necessary connectivity with main urban centres, reducing commuting times, and allowing for a higher dispersion pattern of population around main urban attractors.

Simultaneously, we observe that almost every municipality in the sample has played both the role of source and destination of migrants in this period, with internal migrations in Spain progressively losing their ability to redistribute population.[7] In this context, we observe that according to our theoretical framework migratory flows reflect differences in expected utilities, plus preferences based on an idiosyncratic component of migrants. In controlling for that second factor, our empirical model aims to isolate the effects of the consensus component among total migration flows, by focusing on the analysis of cross migration rates.

3.2 Results

Map 1 depicts the results regarding estimated utility differentials between Spanish municipalities through the econometric specification given by equation (9).[8] The period under scrutiny covers both a first phase of economic expansion

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[6] Note that, given the limitation of the available data, gross and net migration numbers depicted in **Figure 1** refers solely to migrants from one location to another within municipalities in our sample.

[7] The migration effectiveness index (the ratio of net migration flows to gross migration) went down from 0.4184 in 1997 to 0.1236 in 2011.

[8] Detailed numerical tables of results are available on request to the authors. We decide to focus on figures in search of simplicity for the text.

(1997 2006), followed by a pronounced economic crisis (2007 2011). Furthermore, both the economic boom and the crisis affected unevenly to the Spanish regions (and municipalities), so it seems more appropriate to split the full time interval and estimate QoL indexes for every sub-period separately.

For the first years of the period under study, we find that municipalities with the highest estimated QoL are mainly localised in the continental Mediterranean coast and the Balearic and Canary Islands. However, as expected, this geographical distribution of the utility differentials has not remained stable during the final part of the period as it becomes clear when comparing the first and last figures in **Map 1**.

To elaborate a much clear picture of these changes, we analyse the trend followed by each municipality from the point of view of QoL differentials drawn by migration flows. To accomplish this task, the model (9) was estimated on a yearly basis and then we perform the Mann-Kendall test for extracting the trend in data of QoL differentials. The Mann-Kendall is a non-parametric test for identifying trends in time series data. The test proceeds by comparing the relative magnitudes of sample data rather than the data values themselves. There are two advantages of using this test. First, we do not need to make any particular assumption about the statistical distribution followed by data. And second, this test has low sensitivity to the presence of breaks in time series data. Both are important characteristics of the test, given the changes in QoL ranking we have seen in **Map 1** for the period of analysis. The null hypothesis of the Mann-Kendall test assumes that there is no trend in data, and this is tested against the existence of an upward/downward trend. For a series of T data points $\left\{x_1, x_2, \ldots, x_T\right\}$ the Mann-Kendall test statistic is defined as

$$S = \sum_{k=1}^{T-1} \sum_{j=k+1}^{T} \operatorname{sgn}(x_j - x_k), \tag{11}$$

where $\operatorname{sgn}(\cdot)$ represents the sign function.[9] Obtaining a huge positive value of S would indicate the presence of an increasing trend in data, while a very low

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[9] This is an index function such that

$$\operatorname{sgn}(z) = \begin{cases} -1 & \text{if } z < 0 \\ 0 & \text{if } z = 0 \\ 1 & \text{if } z > 0 \end{cases}$$

negative value would show a decreasing trend. Under the null of no trend in data, the test statistics is normally distributed for $T > 10$.

The **Map 2** presents the evolution of the estimates of the QoL differentials at the municipality level in Spain. A clear pattern emerges across the whole country's geography, showing statistically significant decreases in relative well-being indices for the Mediterranean Axis and the island regions, and an upward trend in the centre (Madrid) and northern regions (Basque Country, Navarra, Asturias, and Galicia). Some municipalities in the south of Spain (western part of Andalusia region) also improve their positions in the QoL ranking along these years.

As noted, the estimated measures of well-being do not give by themselves any relevant indication about the factors or causes underlying this process at the level of municipalities. However, as the evolution in the estimated QoL indexes roughly follows that of the regional economies in years 1997 2011, we can guess that the quality of life of a location is by large determined by its overall economic performance. In this sense, until 2007 the southern and Mediterranean regions exhibited a resilient economic growth both in GDP and employment, mainly boosted by the strength of the construction industry. However, from 2008 onwards, the economies of these regions were hit the most, widening the income gap with more industrialised northern regions that better confronted the recession period.

Additionally, results also show the existence of a process of convergence in the QoL index for Spanish municipalities along the period of analysis. In this regard, those cities located in the Mediterranean region that exhibited the highest values of the index in 1997, suffered a severe decrease of it at the end of the period. By contrast, the lagged territories in terms of well-being improved their positions along these years. Some statistical evidence of this convergence process occurring at the level of municipalities is depicted in **Figure 2,** showing the effective decrease in the variance of utility differentials taken place along these years.

3.3 Further results: quality of life, urban size and distance

Estimation of QoL indexes based on migratory movements relies in the assumption that people's migratory decisions are mainly guided by their perception of the quality of life in alternative destinations. Now, since we count on QoL estimates for each municipality, we are able to extend the analysis by exploring how the perceived quality of life of a new given municipality is conditioned by both its size and geographical proximity. Although there is a wide list of variables that may explain the migratory flows and hence the differences in the perceived quality of life, we focus here only on urban size and distance because they typically appear in the well-known gravity models used in the migration literature. The main reason is that, by relying on just these two single variables included in our modelling framework, we are able to obtain more information on the relationship between migration and QoL measures.

In this framework, we start with the analysis of the relationship between urban size and well-being conditions of people. Previous research by González et al. (2011a) yet found that none of the 10 biggest Spanish cities appears in the 50 top positions of the ranking of QoL indexes. This seems to reflect the existence of an underlying negative relationship between urban size and quality of life. In the present case, from the scatter diagram presented in **Figure 3**, we observe a clear negative slope between the size of the urban destination and the index of perceived QoL. This result appears to show that the potential benefits, pecuniary and non-pecuniary, associated with living in bigger cities appear to be offset by the perceived costs of urban features such as congestion, higher housing prices, pollution, insecurity issues, stress, etc. Preferred destinations appear to be those populations with around 10,000 to 35,000 inhabitants, defined as emerging centres located in the area of influence of bigger cities, but staying apart from highly dense areas. The surge of this type of urban centres match very well with the intra-provincial movements of people characterising migration flows in Spain for the period of analysis (Minondo et al., 2013).

Finally, as commented above, it is also interesting to evaluate how the perceived quality of life of a given municipality, as revealed by migratory flows, is affected by geographical distance to new destinations. A key feature of internal migratory flows in Spain is the prevalence of short-distance moves, so revealed perceptions of QoL for people seem to point to a preference for staying inside the regional (provincial) space, where components of well-being remain relatively constant. We have checked this hypothesis by estimating the model (9) for each municipality in the sample; in doing so, we estimate a type of QoL indexes reflecting solely the perceptions of the migrants departing from every single municipality.

The results summarised in **Figure 4** confirm the idea that the perceived QoL of a destination is inversely related with its distance from the individual's original residence. In this sense, we observe that the QoL level in a municipality located within 25 kilometres of an individual's residence would on average be perceived twice the QoL level of a municipality located 50 kilometres far away. Such a result provides evidence on the rationality of location choices of people in terms of preference for particular areas in the country. Familiarity with neighbouring locations seems to be leading migration choices, while preference for particular local conditions appear to be closely captured by our QoL index. Reasons for that behaviour surely include the higher information that migrants have on potential destinations' characteristics for closer locations, the capacity that low-distance movements offer in maintaining existing personal networks, or simply the preference for economic, cultural, and weather specificities of that particular area. In sum, migratory flows seem to be explained by a process of suburbanization, where short-haul movements of people are better explained by a process of leaving aside high density areas, after congestion levels reach some threshold, while longer-haul movements seem to be fuelled by economic conditions of the origin-destination pairs along the business cycle.

4 Conclusions

This paper exploits the relationship between migration and destination overall attractiveness to assess changes in the quality of life among Spanish municipalities during the last two decades. Following the international literature, we assume that people move for improving their well-being conditions as the main reason. In this way, people's migration choices reveal their assessment of the quality of life conditions of every potential destination. Under this theoretical framework, the quality of life is understood in a wide sense, being influenced both by pecuniary and non-pecuniary variables. Therefore, the estimated levels of municipal quality of life also include the opportunities to obtain a higher real income as one of its components.

The results of the investigation suggest that in the case of Spain, municipalities in the Mediterranean Axis are perceived as those with the highest quality of life, although relative levels of well-being in central and northern municipalities have exhibited an upward trend more clearly since the beginning if the crisis. This pattern has led to a general process of convergence in quality of life conditions among the Spanish municipalities in the last years. Moreover, we find that estimated levels of quality of life as revealed by the internal migratory flows are inversely related to urban size, and that people perceive nearby destinations as more attractive places to move to. Two main trends appear to emerge from the study regarding the relationship between migratory flows and quality of life conditions. The first trend is characterised as long-distance movements, where people preferred the seaside destinations of the country in the boom period, then opting for increasingly directing to industrial northern municipalities. In this regards it seems that migration flows, and hence related quality of life indices, are mainly driven by economic conditions of destinations.

The second trend is characterised as a short-distance movement, concentrating a great share of total internal movements in Spain in the last years. In this type of intra-provincial movements, migratory flows, and hence higher quality of life levels, are related to movements towards municipalities located closer from their origin places, mainly characterised by lower levels of congestion and density related problems, in a clear process of suburbanization from big-size to middle-size municipalities.

In sum, the migratory approach to the analysis of quality of life conditions has shown an acceptable performance for the Spanish case. The methodology has shown at least two outstanding aspects. First, it has allowed evaluating well-being levels by using an ex-post measure avoiding some of the measurements problems associated to synthetic indices. And second, it has reasonably captured the well-being conditions in every geographical area, both in a particular point of time (conjunctural analysis) and across time (structural analysis).

Notwithstanding their potential advantages, it is also important to highlight some of the limitations of this research. Indeed, the approach relies heavily on the general validity of the hypothesis that people make explicit how they perceive quality of life through migratory decisions. On the other hand, estimates obtained in the present study are clearly limited by the availability of data on migratory movements involving municipalities with population below a given threshold of 10,000 inhabitants. Above all, despite remaining limitations of this type of analysis, the findings from this study reinforce the role of the quality of life index based on migration flows as a useful tool in approaching the relevant socio-economic concept of well-being. Along these lines, a natural extension of this methodology would be the use of more detailed information regarding migration flows in order to obtain more refined descriptions of individual perceptions of quality of life conditions. This might be accomplished by directly exploiting the census microdata relative to the individual characteristics of migrants.

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Figures and maps

Figure 1 Inter-municipal migration flows in Spain

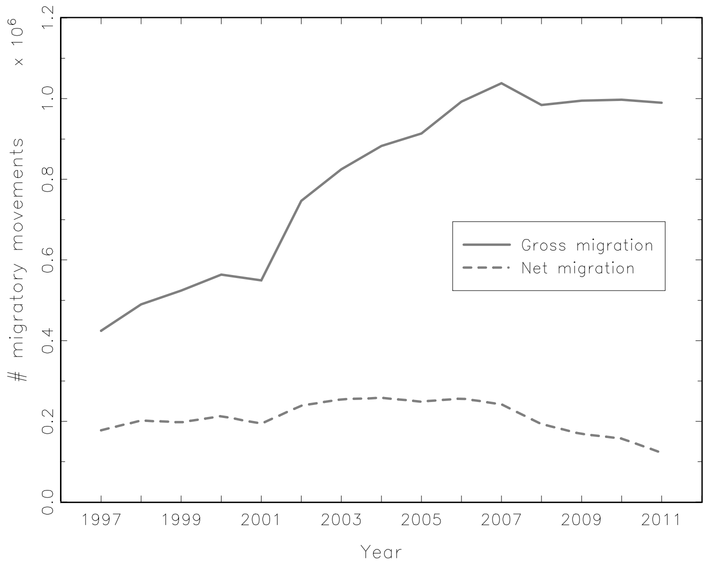


Figure 2 Convergence of levels of municipal quality of life

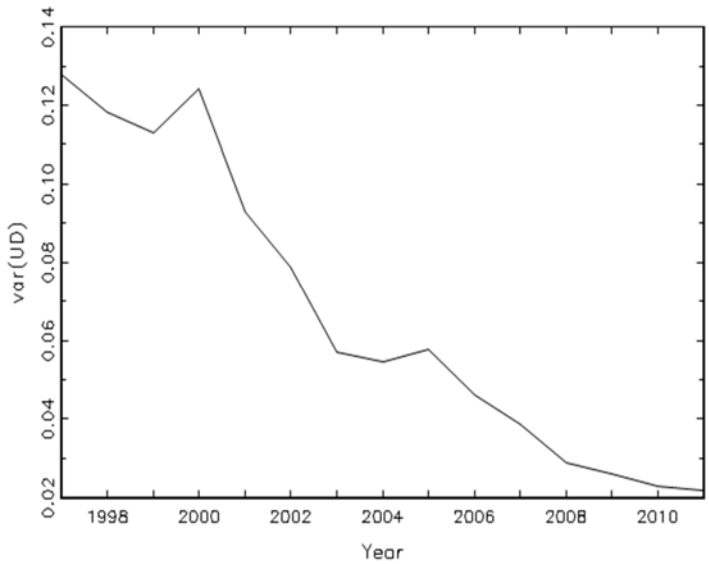


Figure 3 Urban size and perceived quality of life

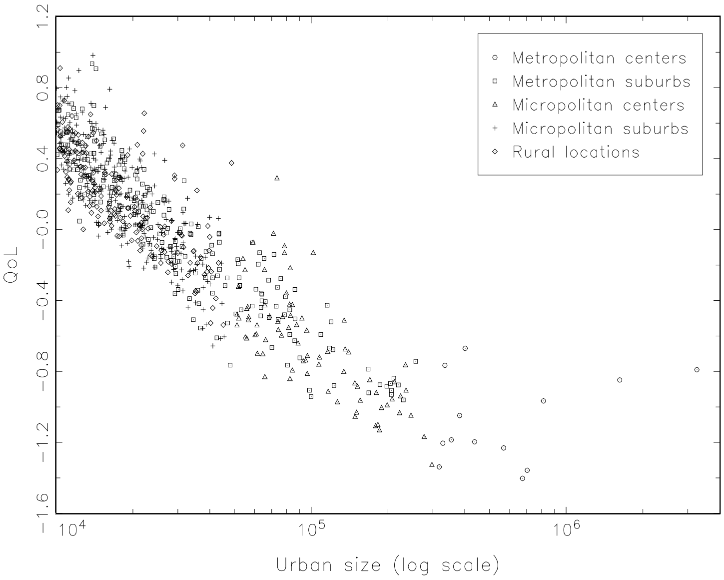
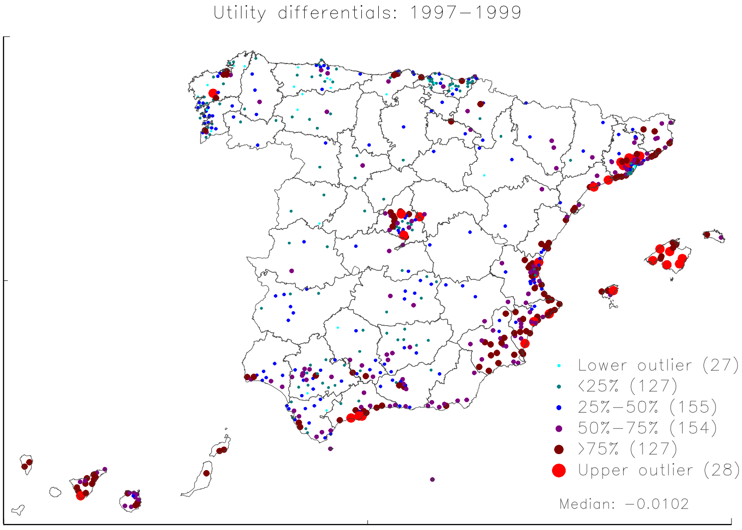
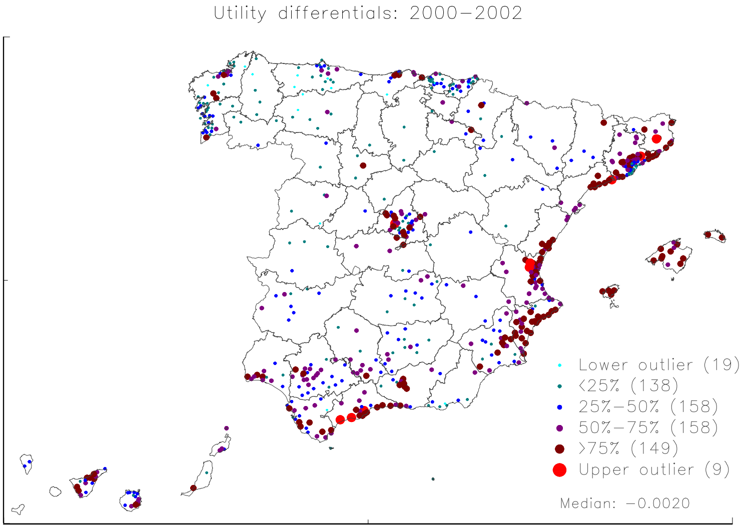
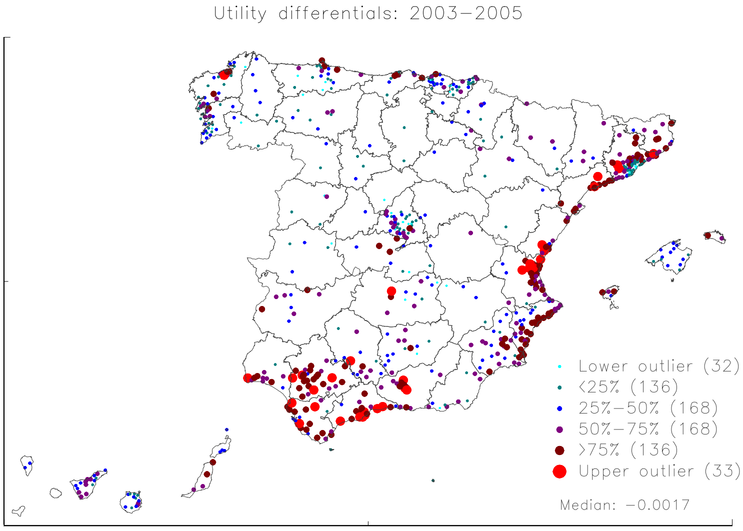


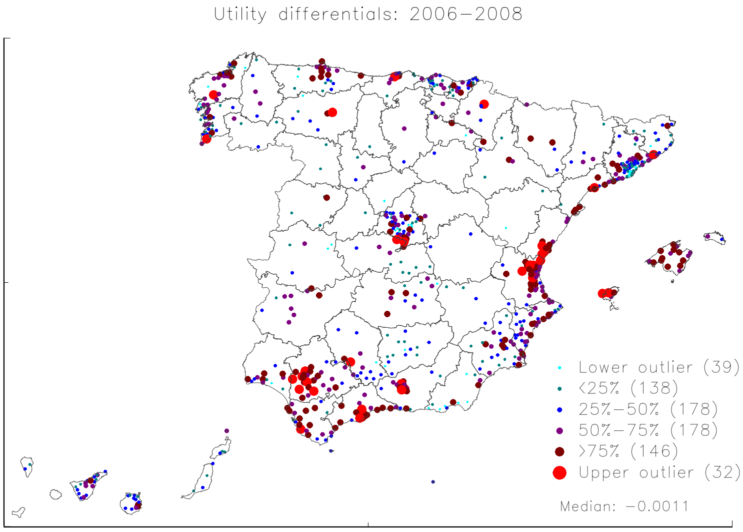
Figure 4 Distance and perceived quality of life

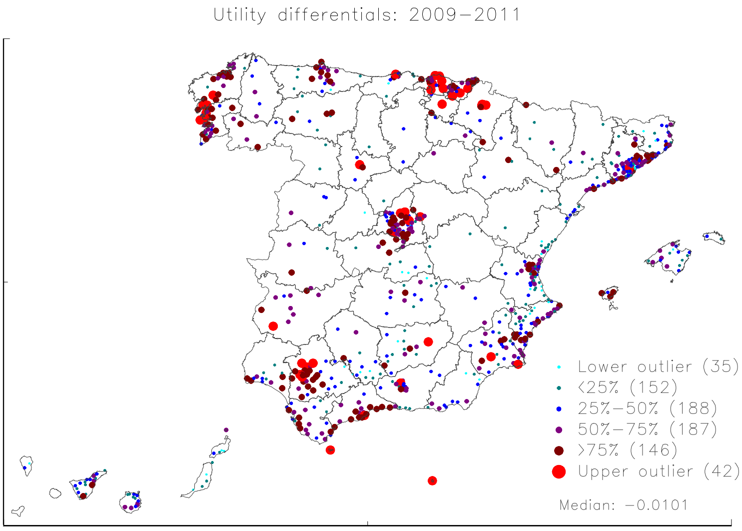
Map 1 Estimated quality of life in Spanish municipalities (1997-2011)



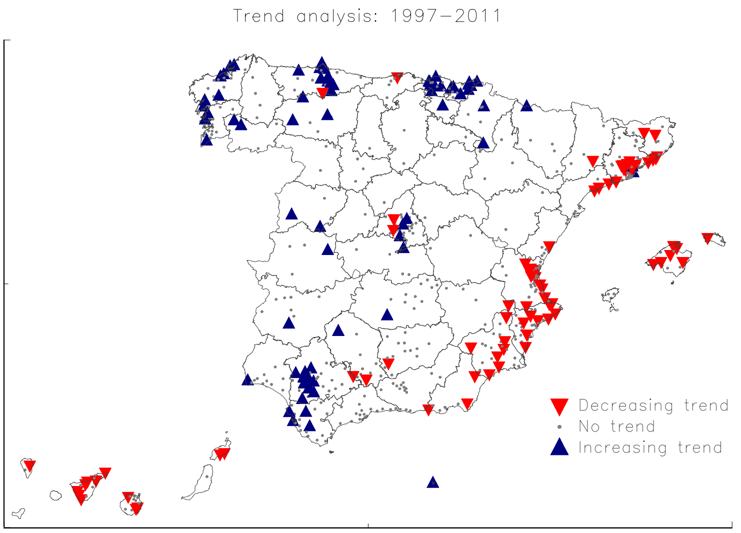



Utility differentials: 2003–2005
Lower outlier (32)
<25% (136)
25%–50% (168)
50%–75% (168)
>75% (136)
Upper outlier (33)
Median: −0.0017


Utility differentials: 2006–2008
Lower outlier (39)
<25% (138)
25%–50% (178)
50%–75% (178)
>75% (146)
Upper outlier (32)
Median: −0.0011



Map 2 Trends in quality of life (1997-2011)



Appendix: Regional utility differentials

This Appendix presents additional results regarding the estimation of utility differentials between the Spanish NUTS2 regions (autonomous communities). Estimates for the period 1997-2011 are shown in **Table A.1** together with those obtained by applying the approach of Nakajima and Tabuchi (2011). A few conclusions may be drawn from these aggregate results. First, judging by the statistical significance of the estimates, the regression we propose in this study define here a more contrasted pattern of utility differences than the pattern emerging from the Nakajima and Tabuchi approach. Secondly, the regression we propose in this study has a lower coefficient of determination than the corresponding regression in Nakajima and Tabuchi. However, we do not believe the latter should necessarily be interpreted as evidence against the approach we propose given that the dependent variable is not the same in both regressions. Finally, there remains obvious discrepancies between results from each method that encourage further research in this field in order to elaborate reliable indexes of quality of life from data on migratory decisions.

Table A.1 Estimates of regional utility differentials (1997-2011)

	This study		N&T (2011)	
Region	coeff.	p-value	coeff.	p-value
Andalusia	0.0000	—	0.0000	—
Aragon	0.3118 ***	0.0000	–0.0350	0.3761
Asturias	–0.0077	0.9199	–0.1252 ***	0.0016
Balearic Islands	1.1906 ***	0.0000	0.1841 ***	0.0000
Canary Islands	0.5910 ***	0.0000	0.0307	0.4384
Cantabria	0.3060 ***	0.0001	–0.0116	0.7691
Castile–La Mancha	0.1131	0.1403	–0.0516	0.1923
Castile and León	0.3644 ***	0.0000	–0.2207 ***	0.0000
Catalonia	0.1296 *	0.0910	–0.0569	0.1505
Valencian Community	0.4808 ***	0.0000	0.1508 ***	0.0001
Extremadura	0.0868	0.2578	–0.1525 ***	0.0001
Galicia	–0.2946 ***	0.0001	–0.1017 ***	0.0102
Madrid	0.7122 ***	0.0000	–0.0866 **	0.0287
Murcia	0.4099 ***	0.0000	0.0511	0.1966
Navarre	0.6465 ***	0.0000	0.1386 ***	0.0005
Basque Country	–0.5274 ***	0.0000	–0.0044	0.9114
La Rioja	2.0174 ***	0.0000	0.0098	0.8039
S.E. of estimates	0.0767		0.0396	
Adjusted–R^2	0.4640		0.6232	
Observations	2040		136	

Conclusions

This dissertation has focused on extending our understanding of location choices made by firms and people. Central to this enquiry has been the notion of space, geographical concentration of economic activity and externalities driving the flows of people and companies. Relocation choices occur because firms can earn more and because individuals can access higher quality of life standards (including better job and recreational opportunities) by settling in a particular place and not in any other. In this basic framework, we have delivered a great part of the analysis to ascertain how place's attributes shape location decisions by two key economic agents.

A common problem arising in regional and local analysis is that the results use to be dependent of the scale and the spatial configuration of the units used to aggregate the set of information. This problem, known as the modifiable areal unit problem (MAUP), is minimized to an extent by using the municipality as the relevant geographical unit of analysis. The municipalities were selected because they are relatively homogeneous units with respect to population characteristics, economic status, living conditions, etc. Moreover, since those administrative units are the basis for census statistics and other socio-economic data, we conclude this geographical unit of analysis is appropriate enough for the assessment of driving forces behind location decision made by firms and people.

This concluding section collects the main findings emerging from the dissertation work. The entire research has been divided in two parts: the first part is devoted to the spatial location of firms; the second one address the relocation of people within the limits of the country, that is, internal migration.

Regarding firms' localisation, the main contributions and empirical results achieved in the first part to the dissertation can be summarized as follows:

1. On the methodological ground, we have extended the traditional modelling approach by incorporating explicitly potential inter-territorial externalities in the location model. Our main hypothesis regarding this issue says that the value achieved by the firm's expected profit from locating in particular place may also be affected by the characteristics of nearby locations because of the likely presence of spatial effects or spillovers. Consequently, in the framework of the discrete choice models we have introduced an additional

term which allows us the evaluation of the strength that neighbourhood effects may exert in firms' location choices.

2. Estimation of the resulting model including neighbouring effects for a sample of Spanish firms has shown how the attributes of nearby places clearly act as key determinant of the attractiveness of a particular municipality for new establishments. However, the empirical results have shown significant differences in the extent that spatial effects play in the location decision according to the type of activity the firm develops. In this sense, neighbouring area characteristics seem to be especially relevant in the case of high-tech manufacturing industries, as compared to other manufactures and to the service sector.

3. The econometric specification also allows us to compute measures of the geographical scope where spatial spillovers arrive, that is, the average distance in which a given municipality exerts spatial effects over other locations. The scope of spatial spillovers varies among sectors and are more relevant for high-tech manufactures. Detailed results for individual municipalities have shown that locations integrated in dense urban networks exhibit the greatest capability to generate spillovers, although these effects tend to dissipate more rapidly in space as compared to those arising from intermediate municipalities.

4. There are several policy implications emerging from the empirical findings obtained in the first part of this dissertation that deserve some consideration here. First, differences in the determinants of location decisions due to differences in the type of activity that firms specialise in, the technological content of their production processes, or the sources of competitive advantages of the corresponding sector clearly suggest that policy measures must be designed with an eye on the specificities of each sector. In this way, for the "*one size fits all*" principle should be definitely abandoned in industrial location policies. Second, the empirical relevance of spillovers effects provides a mean to palliate the traditional policy trade-off between efficiency and inequality through cluster promotion measures. In this regard, the efficiency of some measures of industrial policy commonly requires their spatial concentration on a delimited geographical area with a productive structure sufficiently developed. In this way, this type of policy measures has traditionally neglected areas wherein industry is under-developed and whose chances of improving their current status seemed to be further away. Nevertheless, with spatial spillovers into play those policy measures do not only concentrate their potential effects in the restricted

places wherein they are focused but also on the neighbouring area, so allowing the diffusion of their potential effects on local economic growth.

The second part of the dissertation shifts the focus of the analysis to issues relative to the spatial location choices of people reflected by migratory flows. The analysis in the two chapters that conform this part shares the same basic hypothesis that people move from one location to another in order to improve their welfare or quality of life. The main findings achieved are summarised as follows:

1. In chapter 4, we adopt a behavioural perspective in our approach to migration, and divide the migration decision-making process into two stages: the decision to leave the current location, and the search of a better location from alternative destinations. Decoupling the decisions at each stage provides important insights into the complexity of the overall process and is fully justified because the magnitude of the influence of certain variables on out-migration is likely to differ from the magnitude of the influence of these variables on in-migration, and certain variables that are relevant to explaining out-migration are not relevant to explaining in-migration. For each stage we have considered a discrete choice econometric specification, where both the probability of departure from a given municipality and its probability of being chosen as destination by migrants are represented as functions of the attributes of the municipality itself. Indeed, whilst there may be countless individual motivations and migrant attributes affecting migration decisions, the characteristics of the municipalities are also likely to affect the propensity to migrate as well as the choice of a new destination.

2. Agglomeration effects are also present here as a key driving factor of the migratory decisions. Estimates based on the inter-municipal migratory movements in Spain shows that in looking for a suitable destination to move, migrants prefer central cities. However, people yet living in a large city seem to be more likely to move, probably to another municipality within the same urban area, but further away from the city centre. This finding is consistent with a suburbanisation process that spans the metropolitan areas of cities and is driven by the movement of many households to the suburbs attracted by better housing market conditions.

3. Regarding traditional determinants of both the decision to migrate and the choice of a destination, we found that labour market conditions do not play the expected role: destinations with the highest unemployment rate are avoided by migrants but, at the same time, higher unemployment rates

also deter out-migration. This at first sight surprising result appears to be explained as a consequence of several factors such as the deterioration of the probability of finding a job elsewhere in a generalized context of high unemployment in Spain, the availability of family support at the current place of residence, or even the access to public unemployment benefits in more friendly, by better known, local environment. On the other hand, housing market characteristics are a very relevant factor shaping the migration decision-making process. Indeed, housing tenure and, more precisely, home-ownership clearly hampers the decision to migrate to another municipality. Moreover, the availability of home accommodation at the potential destinations contributes to enhance or deteriorate their attractiveness for migrants.

4. The spatial patterns described by the migrations flows can also be exploited as a source of information about how people perceive the quality of life associated with living in each destination. This hypothesis is explored finally in chapter 5. People react to socio-economic conditions and migration is just another form of reaction: people migrate when they perceive situations to be more beneficial elsewhere. This type of reaction is commonly known as "*foot voting*" in the literature. Accordingly, it is possible to compute a quantitative measure of the perceived quality of life at the municipality level from the observed migratory flows. In principle, the quality of life associated to residing in a municipality will be higher the more in-migrants is receiving. However, as two-way migratory flows typically represent a substantial part of internal migrations in developed economies some methodological refinement is necessary to estimate an acceptable index.

5. Interestingly, the former type of analysis is applied to the migratory flows between the Spanish municipalities reveals a process of convergence in terms of quality of life among them. An examination of the estimated indices of well-being suggests that people expect the highest quality of life conditions from living in medium sized municipalities located within a rather short-distance range from the current place of residence. Once more, the empirical findings can be linked to an underline tendency to suburbanisation, according to which relocating decisions of people reflect a particular liking for places characterised by lower urban density where congestion-related effects are less relevant in daily life.