The determinants of spatial location of creative industries start-ups: Evidence from Portugal using a discrete choice model approach*

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Abstract

This paper assesses the location determinants of the newly created firms in the creative sector within the framework of Discrete Choice Models. Estimations using a conditional logit model, which incorporate spatial effects of neighbouring regions in the location choices of firms, yield the following results: i) the concentration of creative and knowledge-based activities, due to agglomeration economies, play an important role in location decisions of new creative establishments; ii) in contrast, the concentration of service-business activities has a negative impact on location choices, which may be due to the fact that creative firms privilege interdependencies with other activity sectors, such as innovation/ knowledge-based activities; iii) creative firms tend to favour a diversified industrial tissue and related variety, in order to enjoy from inter-sectorial synergies; iv) higher education at a regional level has a highly significant, positive effect on location decisions, while lower educational levels of human capital negatively affect those decisions, explained by the specific requirements that creative firms usually have of a highly skilled labour force; v) tolerant/ open environments attract creative activities; vi) creative firms tend to favour municipalities where the stock of knowledge and conditions for innovative activity are higher.

Location decisions of creative firms also vary according to the creative sector they belong to and to their own characteristics, firm's educational level or technology-intensity. Finally, municipality attributes are more important in terms of firms' location decisions than the characteristics of nearby regions.

Keywords: Spatial economics; industrial location; econometric models; creative industries.

JEL codes: C01, R12, R30.

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1. Introduction

It is widely documented that firms tend to co-locate and that industrial agglomeration leads to localization economies (e.g., Marshall, 1890/1920; Hoover, 1937; Krugman, 1991; Fujita and Thisse, 2002; Devereux et al., 2004; Ellison et al., 2007; Arauzo-Carod and Viladecans-Marsal, 2009). For over a century, since the seminal study of Marshall (1890/1920) with the definition of spatial agglomeration economies (externalities deriving from the clustering of firms in space), researchers have studied the location behaviour of economic activities and the major reasons explaining geographical patterns of the industrial activity.

The empirical literature on the determinants of industrial location (e.g., agglomeration economies, human capital, taxes, wages) has increased in recent decades (e.g., Arauzo-Carod and Manjón-Antolín, 2004; Arauzo-Carod and Viladecans-Marsal, 2009; Alamá-Sabater et al., 2011; Guimarães et al., 2011; Arauzo-Carod, 2013). Two different approaches have been used in terms of modelling the location choices. One is focused on the choice behaviour of the firm/ agent (e.g., Arauzo-Carod and Manjón-Antolín, 2004; Alamá-Sabater et al., 2011). The other puts emphasis on the perspective of the territory where the firms are to be located (e.g., Arauzo-Carod and Viladecans-Marsal, 2009; Arauzo-Carod, 2013). Discrete Choice Models (DCM) are applied when the focus is on the firm and how the respective features of the firm (firm size, industrial sector, employment) or of the territory (infrastructures, inhabitants) have an impact on location choices. If the perspective is on the region and the determinants affecting location choices are studied in terms of firm entries on the region, then Count Data Models (CDM) are employed (Arauzo-Carod et al., 2010).

These modelling techniques have been mainly used for estimating the location patterns of manufacturing industries (e.g., Arauzo-Carod and Viladecans-Marsal, 2009; Manjón-Antolín and Arauzo-Carod, 2011; Alamá-Sabater et al., 2011; Liviano and Arauzo-Carod, 2012; Arauzo-Carod, 2013).

The study of location patterns of creative industries has mostly been comprised of exploratory analyses using the region as the unit of analysis (e.g., Lazzeretti et al., 2012; Miguel-Molina et al., 2012; Bertacchini and Borrione, 2013; Boix et al., 2013; Lazzeretti, 2013). Although such studies refer to the importance of studying the location determinants of creative activities, the modelling of their location behaviour using

micro-data at a firm level is still in an emerging stage of development (Boix et al., 2013). A micro-data analysis which focuses on firms/ establishments rather than on industries or regions permits capturing external economies in a detail where the effects of agglomeration economies have not yet been fully accounted for (Baldwin et al., 2010).

In this context, two contributions to the empirical literature on creative industries are made in this paper. First, it analyses the location behaviour of creative industries at a firm micro-level using highly detailed data on firms. Second, it assesses the role played by location determinants for the creative industries as a whole and for each creative sector in isolation, accounting for the potential heterogeneity of location behaviour across creative industries, using some of the most recent modelling approaches to location (e.g., Guimarães et al., 2004, 2011; Alamá-Sabater et al., 2011; Arauzo-Carod, 2013).

The next section reviews the determinants of industrial (and creative) activity locations, putting forward the main hypotheses of this study. In Section 3, the methodology is presented, namely the econometric specification of location of creative firms to test for those hypotheses and the description of the data used in the estimations. The estimation results are presented and discussed in Section 4. Section 5 concludes the paper, summarising this study's main contributions and limitations, and makes suggestions for future research.

2. Empirical literature on the determinants of industrial location

Existing empirical research has studied the effects of industrial location factors, such as the role of agglomeration economies (e.g., Arauzo-Carod and Viladecans-Marsal, 2009; Figueiredo et al., 2009; Baldwin et al., 2010), technology/ R&D (Autant-Bernard, 2006; Ellison et al., 2007), taxes/ regional grants (Devereux al., 2007), human capital/ skilled labour (Arauzo-Carod, 2013), etc., on firms' location choices.

Among the empirical studies on the geography of creative industries (e.g., Miguel-Molina et al., 2012; Lazzeretti et al., 2012; Bertacchini and Borrione, 2013; Boix et al., 2013; Lazzeretti, 2013), the most referred determinants of location have been associated with agglomeration economies, including localization/ location economies (firm size, industrial concentration) and urbanization economies (industrial diversity, social capital,

market size, population density), as well as with the three *T*'s of Florida (2002), namely *Tolerance/ Openness* (cultural amenities, foreign-born population/ rate of acceptance of foreign people/ share of foreign population), *Talent/ Human capital* (share of population with university degree, highly skilled/ qualified jobs), and *Technology* (R&D investments, patents created/ registered, employment density/ location quotient of high-tech manufacturing firms).

Agglomeration Economies

Agglomeration economies, primarily comprised of localization economies - industrial concentration externalities, lower transportation costs, increasing returns to scale, benefits from labour market pooling and the sharing of local knowledge - as earlier described by Marshall (1890/1920), represent crucial factors in industrial location modelling (see Table 1).

The geographical clustering of firms/ industries allows for industrial specialization as well as accessibility and sharing of specialized intermediate goods and services, networks of supplier-customer relationships and skilled labour resources, which explains the reduction of transportation/ trade costs and leads to increasing internal economies of scale of clustered firms. In turn, the sharing of knowledge predominantly arises from tacit, local, industry-specific technological sources, disseminated through spatial proximity (Harris, 2011).

Urbanization economies represent another source of agglomeration economies (cf. Table 1) in regard to product diversification, industrial diversity, access to skilled labour, to a varied range of suppliers and to large consumer markets. The co-location of diverse and interdependent economic activities/ employment in urban agglomerations promotes inter-sector synergies and leads to better access to public utilities (cultural, institutional, political) and information centres, thereby facilitating the diffusion and the sharing of knowledge and innovation (Jacobs, 1969).

A vast array of literature dedicated to the analysis of different types and effects of agglomeration externalities emerged in the last decade (Harris, 2011). This topic has been widely explored and the studies appear to be primarily related with the effects of

traditional factors such as transportation costs, increasing returns to scale, and industrial specialization as determinants of firms' location choices.[1]

Recent empirical research on the location of manufacturing/ industrial establishments generally report significant and positive effects of the different sources of agglomeration economies as determinants of firms' location choices (see Table 1). Specifically, localization economies (e.g., industrial concentration, local employment density, industrial employment share, firm size, transportation and trade costs) and urbanization externalities (e.g., population density, industrial mix, industrial employment share/ services share, industrial diversity) stand as relevant location determinants with a statistically significant positive impact on firms' location decisions. In their location analysis of 17,719 new manufacturing establishments in medium- and low-technology activity sectors (Natural Resources and Manufacturing industry sectors) across Catalan municipalities (1987-1996), Arauzo-Carod and Manjón-Antolín (2004) find that agglomeration economies - employment concentration in each industrial sector and the industrial diversity index - exert positive, significant effects on the entrants' decisions, due to the externalities (e.g., local knowledge, sharing of common resources) arising from industrial concentration and inter-sectorial linkages. Localization and urbanization economies also play an important role in the location decisions of new manufacturing plants (manufacturing industry sectors) in counties of 48 U.S. states (1989-1997), with Guimarães et al. (2004) reporting a statistically significant impact of the number of establishments/km^2 and of the county density of manufacturing/ service establishments/km^2 on firms' location decisions. With a focus on the intra-metropolitan level in 13 big metropolitan areas of Spain, for 5,569 new high, intermediate and low-technology manufacturing establishments (high-tech sectors: high-technology equipment manufacturing; intermediate-tech sectors: machinery/ equipment manufacturing and chemical products; low-tech sectors: food and beverages, textiles and leather), in 1992-1996, the role of agglomeration economies was analyzed by Arauzo-Carod and Viladecans-Marsal (2009), who conclude for the significant, positive impact of localization economies (industrial concentration, measured by the previous

[1] Comprehensive reviews of literature have been carried out by Rosenthal and Strange (2004: 2119) on the "nature and sources of agglomeration economies"; by Duranton and Puga (2004: 2063) on "the theoretical micro-foundations of urban agglomeration economies"; by Melo et al. (2009: 332) on a "meta-analysis of estimates of urban agglomeration economies"; by Puga (2010: 203) on the "magnitude and causes of agglomeration economies".

entries) on entrants' location choices. Urbanization economies, proxied by population density, show a mixed effect: positive for new entrants of low and high-technology sectors and no impact on intermediate-technology firms. This is due to the particular needs of high and low-technology firms, namely diversity economies/ innovation flows mostly found in populous cities for the high-technology entrants, and labour supply for the low-technology firms. Focusing on all the manufacturing industries, the study of Manjón-Antolín and Arauzo-Carod (2011) on new and relocated industrial establishments in 946 Catalan municipalities (2001-2004), concludes for the positive effects of either localization economies (industry employment share) or urbanization externalities (workers by km^2, industrial diversity) on firms' location decisions. Also analyzing all manufacturing industry sectors, similar results are reported by Alamá-Sabater et al. (2011) on the location of 8,429 manufacturing establishments in the 45 municipalities of Murcia, Spain in 2006. The authors obtained a significant, positive impact of localization (industrial specialization, industry employment share) and urbanization economies (population density, industrial diversification index) on the establishments' location choices. Likewise, Liviano and Arauzo-Carod (2012) obtain positive, significant effects of localization and urbanization economies (employment density, industrial mix) in the location decisions of manufacturing establishments in all Natural-Resource and Manufacturing sectors across 941 Catalonian municipalities (2002-2004). In the same activity sectors, Arauzo-Carod (2013) analyses 4,282 manufacturing firms in all Catalonian municipalities, from 2001 to 2005, and finds that their location choices are positively affected by the agglomeration economies (percentage of manufacturing jobs/ population density).

The positive effects observed are mainly due to the so-called Marshallian externalities from industry agglomeration (e.g., information spillovers/ local networking/ input sharing/ local labour market), and to the diversity economies arising from the proximity to urban/ innovative environments and to a varied range of industries and amenities (industrial mix, labour supply, supplier variety, transportation infrastructures, large consumer markets) (Harris, 2011).

According to the empirical literature on creative industries, localization economies, and particularly urbanization economies, are expected to have an important effect on the location behaviour of creative industries/ firms (Florida, 2002; Lazzeretti et al., 2012).

Indeed, innovation and creative processes are deeply intertwined with the urban environment (Florida, 2002, 2005), and creative industries tend to concentrate in cities and metropolitan areas in order to take advantage of the urbanization economies, provided by the development of new ideas, product differentiation and technological diversity, the geographic concentration of people, cultural diversity and the diffusion of new trends (Jacobs, 1969).

In this context, we put forward the following hypothesis:

H1. Agglomeration economies - localization and urbanization economies - are positively related to creative firms' location choices.

Table 1: Location determinants and respective effects in empirical literature: agglomeration economies

Location Factors	Statistical Effect	Authors/ Study
Localization Economies	✓ Municipality's employment density: positive effect on the location of new manufacturing plants.	Liviano and Arauzo-Carod (2012)
	✓ Establishment Size: positive effect of small sized-firms on the location of new plants (e.g., networks).	
	✓ Agglomeration economies (Industrial Specialization // Industrial employment Share): significant, positive effects.	Alamá-Sabater et al. (2011)
	✓ Industrial Surface: positive, significant effect.	
	✓ Localization economies (industry employment share): significant, positive effects on the location of start-ups/ new firms.	Manjón-Antolín and Arauzo-Carod (2011)
	✓ Localization economies (previous entries): significant, positive effect for all industries.	Arauzo-Carod and Viladecans-Marsal (2009)
	✓ Localization economies (number of establishments per km2): statistically significant, positive effect.	Guimarães et al. (2004)
	✓ Localization Economies (comarca level): employment/ industrial concentration (number of workers per km^2 in each industrial sector) have positive, significant effects in the location of manufacturing entrants.	Arauzo-Carod and Manjón-Antolín (2004)
Urbanization Economies/ Industrial Diversity	✓ Population density: statistically significant/ positive effect.	Arauzo-Carod (2013)
	✓ Industrial Mix/ Percentage of manufacturing jobs: statistically significant, positive effect.	
	✓ Higher percentage of small firms: statistically significant, negative effect (congestion effects).	
	✗ Concentration Index: not significant.	
	✓ Industrial Mix/ Percentage of manufacturing jobs: statistically significant, positive effect.	Liviano and Arauzo-Carod (2012)
	✓ Population (total by municipality): positive, statistically significant.	Alamá-Sabater et al. (2011)
	✓ Industrial diversity: positive, statistically significant effect.	
	✗ Services employment Share: not statistically significant.	
	✓ Urbanization economies (workers per km^2): statistically robust, positive sign.	Manjón-Antolín and Arauzo-Carod (2011)

	✓ Industrial Diversity: statistically robust; entrants prefer more diversity at the municipality level.	
	✓ Population density (urbanization economies): mixed effect - a positive impact on new entries for firms belonging to low- and high-technology groups// ✗ No impact on intermediate-technology firms.	Arauzo-Carod and Viladecans-Marsal (2009)
	✓ Urbanization economies (county density of manufacturing/ service establishments per km^2): statistically significant, positive effect.	Guimarães et al. (2004)
	✓ Urbanization economies (industrial diversity): significant, positive effect on the location decisions at municipality level.	Arauzo-Carod and Manjón-Antolín (2004)
Transports Infrastructures/ Costs	✓ Transport infrastructures variables - County capital// located near the coast line: positive effect; greater distance from the provincial capital: negative effect.	Arauzo-Carod (2013)
	✓ Altitude: negative effect on industrial location// Areas at sea level: positive sign.	Liviano and Arauzo-Carod (2012)
	✓ Transport time to Cities: Negative (expected) effect.	
	✗ Transport infrastructures: non-significant effects on the frequency of strictly new and relocated plants.	Manjón-Antolín and Arauzo-Carod (2011)
	✓ Distance from each municipality to the central city: statistically significant, negative effects for all high- and intermediate-technology sectors.	Arauzo-Carod and Viladecans-Marsal (2009)

Talent/ Human Capital

Several authors (e.g., Florida, 2002, 2005; Markusen, 2006; Scott, 2006; Florida et al., 2008; Lazzeretti et al., 2012) have documented the role of urban centres in attracting human capital and creative people as factors of regional growth. Although some contend that there is a causal relationship between the concentration of human capital and the location of creative industries (Florida, 2002, Lazzeretti et al., 2012), to the best of our knowledge this causality has not yet been addressed through the empirics of location of firms belonging to creative industries.

In recent literature, studies on the effects of human capital and skilled labour on industrial location choices have mostly been done on firms in the manufacturing industry sectors, using the regional/ territorial dimension of human capital (e.g., Arauzo-Carod and Manjón-Antolín, 2004; Arauzo-Carod and Viladecans-Marsal, 2009; Alamá-Sabater et al., 2011; Manjón-Antolín and Arauzo-Carod, 2011; Liviano and Arauzo-Carod, 2012).

Existing studies allow for a diversified range of effects according to the measure of human capital and the type of firms (e.g., high, medium and low-technology) that are considered in models (see Table 2). For instance, in a location study of new

manufacturing establishments in the medium and low-technology sectors (natural resources/ manufacturing industry sectors) across Catalan municipalities, Arauzo-Carod and Manjón-Antolín (2004) find a significant negative effect of human capital, measured by the number of people with medium and high levels of education per km^2, on firms' location choices. Using the percentage of population with a university degree as a proxy for higher education human capital, similar findings are obtained by Arauzo-Carod and Viladecans-Marsal (2009) from firms of intermediate and low-technology industry sectors in 13 big metropolitan areas of Spain where a significant negative effect is detected (e.g., 'Machinery and equipment', 'Chemical products' and 'Textiles'). Regarding lower levels of human capital, the authors obtain an overall significant positive effect of intermediate human capital (percentage of the population who completed secondary school) in almost all the activity sectors. Some potential explanations lie in the characteristics of firms under study, belonging to medium and low-technology sectors which do not require a highly skilled workforce, or to local job matching, where the highly skilled human capital may not reside in the same regions where the employing firms are located, but rather in neighbouring areas with a better quality of life (Arauzo-Carod and Manjón-Antolín, 2004; Arauzo-Carod and Viladecans-Marsal, 2009). In contrast, on the location determinants of industrial establishments in all manufacturing industry sectors, across all the municipalities of Murcia, Spain, a significant positive effect of human capital - measured by the percentage of labour force that has completed secondary and tertiary level education - is described by Alamá-Sabater et al. (2011), who conclude that the role of highly skilled workers on firms' location decisions is important. Also Manjón-Antolín and Arauzo-Carod (2011), on their analysis of new and relocated establishments in all manufacturing industry sectors (from high- to low-technology sectors) in Catalan municipalities, find a significant positive effect of human capital (percentage of population working in science and technology/ percentage of graduates with a university degree in population over 25-years old) on start-ups' location choices. In turn, Liviano and Arauzo-Carod (2012), using a database comprising medium-to-low technology firms of the natural-resource and manufacturing industry sectors across Catalonian municipalities, find a negative effect of human capital (measured by the average years of schooling of the population over twenty-five years of age) on firms'

decisions, which arguably might be explained by lower requirements for highly-skilled human capital, as in Arauzo-Carod and Manjón-Antolín (2004) and Arauzo-Carod and Viladecans-Marsal (2009).

Addressing the issue of sector/ industry characteristics more explicitly, suggested to some extent in Arauzo-Carod and Viladecans-Marsal (2009), in his location study of manufacturing firms in Catalonian municipalities, Arauzo-Carod (2013) demonstrates that the requirements of human capital are industry-specific, and only in the case of high-tech firms, the human capital in the region - measured by the number of individuals with higher education relative to the number of jobs - has a significant positive effect on firms' location choices.

Table 2: Location determinants and respective effects in empirical literature: human capital

Human capital	Statistical Effect	Authors/ Study
Territorial perspective	✖ Average years of schooling of the population over twenty-five years of age: negative effect on the entry of new firms.	Liviano and Arauzo-Carod (2012)
	✔ Percentage of labor force with secondary and tertiary education by municipality: positive, statistically significant, most important effect.	Alamá-Sabater et al. (2011)
	✔ Percentage of population working in science and technology// % of population with a university degree// average years of education of population over 25 years old: statistically significant, positive effects on the location of start-ups.	Manjón-Antolín and Arauzo-Carod (2011)
	✖ Human Capital (number of people with medium and high levels of education per km^2): negative coefficient.	Arauzo-Carod and Manjón-Antolín (2004)
Industry/ sectorial perspective	✖ Human-capital variables (Nº individuals in each degree of educational attainment relative to nº jobs (illiterate // incomplete primary// primary education// middle school// technical high school// high school// intermediate university degree// advanced university degree): non-significant effects. ✔ Human-capital/ Highly skilled labour: Only for high-tech firms, there is a positive effect (human capital is an industry-specific factor). ✔ Spatially lagged human-capital variables: some significant and positive effects.	Arauzo-Carod (2013)
	✔ Human-capital Intermediate level (percentage of the population with complete secondary school): significant, positive effect on firms in all industries. ✖ Human-capital University level (percentage of the population with a university degree): significant negative impact for firms in intermediate and low-technology industries.	Arauzo-Carod and Viladecans-Marsal (2009)

Also, the residence region of the highly-skilled workers/ human capital may not coincide with the place where the firms are located. This mismatch is explained by the

preference of the workforce to live neighbouring regions, which leads to spatial lags of human capital (Alamá-Sabater et al., 2011; Arauzo-Carod, 2013).

Thus, empirical studies show negative, positive, mixed or non-significant effects of human capital on firms' location decisions, largely depending on the database or on the measure of human capital that is used. It is also suggested that, besides considering the role of human capital as an attribute of regions, it is important to take into account the industry-specific and firm-level characteristics - in terms of knowledge-base, employees' skills and educational level of the labour force - when analysing the impact of human capital on firms' location choices.

Given these considerations, we present a second hypothesis as follows:

H2a. The region's human capital is positively related to creative firms' location choices.

H2b. Human capital existent in each creative firm is related to its location choices.

Tolerance

Tolerance can be also considered as a key location determinant, since higher receptivity to newcomers, new influences and lifestyles are likely to attract creative firms to a particular region (Florida, 2002, 2005; Florida et al., 2008). Although this factor is not usually considered in location models, recent research on the geography of creative industries acknowledges the importance of institutional and tolerance-related variables on the analysis of these firms' location behaviour (e.g., Hansen, 2007; Florida et al., 2008; Lazzeretti et al., 2012; Mellander et al., 2013). Specifically, it is found that large urban centres are more likely to have a tolerant atmosphere, characterized by their openness to racial and sexual minorities as well as to other nationality groups/ foreigner people/ immigrants. This openness promotes a diversified local social network, where trust and social capital increase the effectiveness of relationships (Florida, 2002, 2005). On a study on location determinants for the creative class and regional development across all U.S. metropolitan areas, Florida et al. (2008) proved that tolerance (proxied by gay and bohemian indexes) allows for a higher accumulation of human capital and creative workers, complementary skills embodied in the immigrants, and artistic networks as channels of information among firms/ industries in the region. Thus, the more tolerant a region is the more favourable it will be to an open business climate

characterized by urbanization economies, positively affecting the location decisions of creative firms and creative workers (Jacobs, 1969; Florida et al., 2008).

Given these arguments, the third hypothesis is established as:

H3. The region's tolerance is positively related to creative firms' location choices.

Technology

Technological endowments (facilities, provisions, firms, products, networks) represent an important factor of firms' location patterns, particularly for knowledge-intensive and creative firms (Florida, 2002, 2005), given the role of localized, shared knowledge in the development of innovative and creative activities. As innovations and the outcomes of technological/ R&D facilities tend to spread locally, mainly due to aspects such as trust and reciprocity characterizing the networks where local knowledge is transferred (Feldman, 2000), technology provisions are a critical asset in promoting an environment where externalities arise in the form of tacit knowledge and encourage the creation of further knowledge/ innovative activities (Audretsch et al., 2007).

There is a wide corpus of empirical literature corroborating the relation between technology, knowledge and the spatial clustering of firms and industries (e.g., Jaffe et al., 1993; Audretsch and Feldman, 1996; Tödtling et al., 2004; Autant-Bernard, 2006; Audretsch et al., 2007). The mechanisms behind the relationship between technological endowments and the geographical clustering of firms are related to the ways through which local knowledge is diffused (Tödtling et al., 2004). Knowledge spillovers arise from labour mobility, local buzz, social networks, regular firms' inter-relations, face-to-face contacts, spinoffs or innovation joint projects, among others (Feldman, 2000; Audretsch et al., 2007). These spillovers explain the findings of Jaffe et al. (1993) on their study on the geographic location of patent citations and their spatial flows across the metropolitan areas of U.S. states, where the authors conclude that knowledge created at a regional level tends to be highly localized and stimulates the accumulation of additional knowledge in the same territorial unit. Likewise, on the geography of innovative activities across all U.S. states, Audretsch and Feldman (1996) discover that industries where knowledge spillovers (through industry innovations/ university research/ skilled labour) are more important show a higher tendency for the spatial

clustering of innovative activities than other industries for which knowledge externalities are less significant. Allowing a deeper understanding of the mechanisms through which local knowledge is transferred, Tödtling et al. (2004) undertake a firm survey in Austria, comprising the manufacturing medium-tech sectors, high-tech industries, knowledge and innovation-based services and research firms, among others. The authors conclude that in the case of manufacturing and knowledge and innovation-based services, knowledge is mainly transferred through supplier-buyer relationships/ markets, informal interactions and expert/ labour mobility. In high-tech firms, there is a particular relevance for research projects, formal networks, R&D joint collaboration and consultancy as mechanisms of knowledge exchange. Research firms make more use of explicit/codified knowledge such as scientific patents, formal contracts and research collaboration. Also proving the spatial clustering of knowledge activities is the study of Autant-Bernard (2006) on the location determinants of research and development firms/ labs across all regions of France, where the stock of knowledge available in the region (proxied by private R&D expenditures of the other labs located in the region), as well as the presence of knowledge spillovers (spatial lag of those expenditures) have significant positive effects on research labs' location decisions. These findings are also described in the study of Audretsch et al. (2007) on the location determinants of 75 German planning regions, where it is concluded that R&D facilities/ headquarters tend to concentrate in urban centres characterized by knowledge diversity, creativity and a business climate receptive to the creative innovation.

As shown in the empirical studies, the presence of a network of interdependent high-tech/ knowledge-based firms promotes the development of local innovation processes and encourages the transmission of knowledge, new ideas and patents (Tödtling et al., 2004). This ultimately leads to growth of the region, which attracts even more knowledge-based and creative capital, given that the industries that most rely upon this asset tend to locate where their potential might be reinforced (Florida, 2002, 2005; Audretsch et al., 2007).

Besides the role played as a territorial determinant (reflected, for instance, by a region's research and development investments/ number of patents created/ density of high-tech firms), technology can be also considered as an industry-specific factor (high, medium

and low-technology industries), which affects creative firms' location choices. In this line of reasoning, the fourth hypothesis is set as follows:

H4a. The region's technological endowments are positively related to creative firms' location choices.

H4b. Industry technological intensity is related to creative firms' location choices.

Inter-territorial spillovers

The benefits for firms locating in a particular region may be affected by the characteristics of surrounding locations. Inter-territorial spillovers are the effects that territory-specific (economic, social, cultural, geographic) attributes of neighbouring regions may have on a particular location. They have been recently studied and appear to be relevant in industrial location choices (e.g., Autant-Bernard, 2006; Arauzo-Carod, 2007; Alamá-Sabater et al., 2011; Guimarães et al., 2011). Indeed, there are flows characterized by supplier-buyer linkages, company interactions, industry interdependencies, labour/ human capital mobility, intellectual/ knowledge spillovers, which not only explain the (co)agglomeration patterns within each region, but also occur beyond the established frontiers of each territorial unit, with an influential effect on firms' location choices (Autant-Bernard, 2006; Ellison et al., 2007; Alamá-Sabater et al., 2011). For instance, firms may get benefits from locating near regions (e.g., large urban centres) with large consumer markets, intensive production linkages, high population density, human capital, supplier and distribution chains, but may choose to avoid those territorial areas because of congestion effects. In these cases, the attributes of nearby regions have a significant positive effect in firms' location choices (Arauzo-Carod, 2007).

Despite the importance of neighbouring effects, to the best of our knowledge this issue has not yet been specifically addressed in the empirical literature on the location of creative industries.

Inter-territorial spillovers are reflected in spatial autocorrelation, which occurs when the observations of a variable at a particular region are partially correlated with the variables of neighbouring locations (Arauzo-Carod, 2007). From this perspective, location choices are not only affected by the attributes of the chosen territory but may also depend on the characteristics of nearby areas. This is analysed by Autant-Bernard

(2006), on the study of regional determinants of R&D labs/ firms across the French NUTS 2 regions, where it is proved that spatial knowledge spillovers, proxied by the spatially-lagged term of private R&D expenditures, exert a significant positive effect in R&D labs/ firms' location decisions. The author concludes that the selection of a particular region is not only influenced by the relative stock of knowledge present in the region but also by that of nearby regions.

The significance of inter-territorial spillovers is also observed in Alamá-Sabater et al. (2011) on the location factors of 8,429 industrial establishments in the 45 municipalities of Murcia, Spain. Their findings show that spatial spillovers have a significant impact on firms' location decisions, with a declining effect as municipalities become more distant. In fact, the authors find that the attributes of neighbouring regions have a similar impact as those of the chosen municipality in firms' location decisions. This is due to the presence of spatial dependence effects, which become more important when the analysis is undertaken at a more disaggregated level (e.g., municipalities, local metropolitan areas) and there is a sharing of economic, socio-cultural, infrastructural/ connectivity and other territorial aspects among neighbouring regions (Arauzo-Carod, 2007; Alamá-Sabater et al., 2011).

Applying to employment data by industry/ establishment of manufacturing industry sectors across U.S. states/ counties, Guimarães et al. (2011) incorporate spatial neighbouring effects in measures of industrial concentration,[2] and conclude in support of the improvements obtained in the spatially-weighted index when compared to the original corresponding measure.

In this line of argumentation, we hypothesise that:

H5. Inter-territorial spillovers of neighbouring regions explain creative firms' location choices.

[2] The authors develop a spatially weighted Ellison-Glaeser index accounting for the spatial neighbouring effects, which offers more detailed information in measuring spatial economic concentration than popular measures of localization such as Gini, Herfindhal and common Ellison-Glaeser indexes that only consider the information inside each pre-defined territorial unit. Besides all the information within the limits of each geographical unit, these authors' index includes the spillovers that lie outside the boundaries of each territory.

3. Methodology

3.1. Data considerations

The data comprises all (369) creative start-ups or new establishments created in 2009,[3] in all the creative industries, distributed across all 308 Portuguese municipalities. The source of the data is the Linked Employer-Employee Databases of GEE/ ME, Portugal. It covers all employment in industries and establishments operating in the national territory with at least one employee, excluding Public Administration and self-employment.[4] According to the latest data available (2009), national employment in the private, structured sector totalled 3,128,126 workers, operating in a total of 407,235 establishments in all the activity sectors.

Although in 2009 a total of 12,246 creative establishments ran businesses in Portugal, we had to restrict our analysis to the newly created establishments in order to avoid any endogeneity effects between firms' location choices and the determinants of such choices.

Nine major creative industries were considered for the analysis - Advertising and Marketing; Architecture; Design; Film, Video and Photography; TV and Radio; Music/ Entertainment and the Performing Arts; Publishing; Software and Digital Media; and Research (cf. Table 3).

Table 3: Creative industry sectors - mapping the creative startups/ new establishments (n=369)

Core Creative sectors	**Industries**	**Portuguese CAE - Rev. 3 Industry codes (**compatible with ISIC - Rev. 4 codes)
1. Advertising and Marketing	Advertising; Market research/ public opinion polling	**7311; 7312; 7320**
2. Architecture	Architectural activities	**7111**
3. Design	Design activities	**7410**
4. Film, Video and Photography	Motion picture, video and television production, post-production, distribution and projection activities; Photographic activities	**5911; 5912; 5913; 5914; 7420**
5. TV and Radio	Radio activities; Television activities	**6010; 6020**

[3] This is the latest data available at the time of this study (June 2014). Courtesy of GEE/ ME, Gabinete de Estratégia e Estudos, Ministry of Economy, Portugal (*Quadros de Pessoal*, Linked Employer-Employee Databases).

[4] Further implications on the aspects of this database are discussed in Cruz and Teixeira (2013).

6. Music/ Entertainment and the Performing Arts	Sound recording/music publishing activities; Performing arts; Support activities to performing arts; Artistic and literary creation; Operation of arts facilities; Amusement/ recreation activities	**5920; 9001; 9002; 9003; 9004; 9321; 9329**
7. Publishing	Publishing of books, periodicals/ others; Translation/interpretation activities; Libraries/archives/ museum activities; Information service activities (news agencies)	**5811; 5812; 5813; 5814; 5819; 7430; 9101; 9102; 9103; 9104; 6391; 6399**
8. Software and Digital Media	Software publishing; Computer programming/ consultancy; Data processing/hosting/Web portals	**5821; 5829; 6201; 6202; 6203; 6209; 6311; 6312**
9. Research	Research on natural sciences, engineering, social sciences and humanities	**7211; 7219; 7220**

Note: For a detailed account of the relevant creative industries see Cruz and Teixeira (2014).

Given that our purpose includes the testing for neighbourhood effects on creative firms' location behaviour, through the use of spatially-lagged explanatory variables, in order to account for the spatial dependence among regions, the most suitable territorial unit of analysis is the municipality - as is shown in most recent empirical literature (e.g., Alamá-Sabater et al., 2011; Liviano and Arauzo-Carod, 2012; Arauzo-Carod, 2013).

3.2. Location determinants: variables selected and respective indicators

In order to account for the location economies and to capture the benefits from the co-location of creative firms with interdependent activities/ knowledge-based firms, we used a standard measure, which is usually applied in the empirical literature for its analytical tractability (e.g., Alamá-Sabater et al., 2011; Miguel-Molina et al., 2012; Lazzeretti et al., 2012) - the location quotient (LQ)[5] (see Table 4). Based on the employment by industry sector in each region, we calculated the LQ in all the municipalities for: i) creative firms (*LQ Creative firms*), service-based firms (*LQ Service firms*); iii) knowledge-based activities (*LQ Knowledge firms*).

Regarding urbanization economies, we used a traditional proxy describing the effects of urban agglomeration, *Population Density* (e.g., Arauzo-Carod and Viladecans-Marsal, 2009; Arauzo-Carod, 2013), which is robust to differences in land surface sizes and allows control for urban scale economies deriving from populated regions (Melo et al., 2009). To account for the industrial mix and the external economies transversal to all firms/ industries, we computed indexes based on the Herfindahl-Hirschman Index, usually adopted by the extant empirical research on industrial location (e.g., Arauzo-

[5] The LQ captures the degree of specialization in a given industry, for each region, in comparison with the national average in that industry.

Carod and Manjón-Antolín, 2004; Alamá-Sabater et al., 2011; Manjón-Antolín and Arauzo-Carod, 2011; Liviano and Arauzo-Carod, 2012): Index of industrial diversity (*Industrial Diversity*) and Index of creative industries' diversity (*Creative Diversity*), for all 308 municipalities (cf. Table 4).

Then, the variables *LQ Creative firms*, *LQ Service firms*, *LQ Knowledge firms*, *Population Density*, *Industrial Diversity* and *Creative Diversity* were included in our model to test *Hypothesis 1* ("*Agglomeration economies are positively related to creative firms' location choices*").

To examine the implications of *Hypothesis 2a.* ("*The region's human capital is positively related to creative firms' location choices*"), human capital variables at the municipality level - graduates of higher education human capital, measured by the percentage of population with a completed degree (*Higher Education*) and intermediate human capital, proxied by the gross enrolment rate in upper secondary education (*Secondary Education*) - were incorporated in the model. Since human capital is also a firm-level asset, we also considered the average educational attainment of the workers in each of the firms in our database, to test for the *Hypothesis 2b.* ("*Human capital existent in each creative firm is related to its location choices.*").

Following Florida (2002, 2005) and Lazzeretti et al. (2012), tolerance-related indicators include local cultural amenities (*Culture*) proxied by the number of museums and recreational facilities by municipality, immigrant legalization rate (*Foreigners*), and a social inequality ratio (*Social Inequality*) (cf. Table 4), with the aim of checking the *Hypothesis 3* ("*The region's tolerance positively affects creative firms' location choices*").

To test *Hypothesis 4a.* ("*The region's technological endowments are positively related to creative firms' location choices*"), technology endowments at a regional level are proxied by the proportion of business research and development expenditures in regional gross domestic product (*R&D Firms*), in line with Autant-Bernard (2006). In each region, technology is usually proxied in terms of R&D expenditures (in total turnover), R&D workers (in total workers), or patents owned (e.g., Jaffe et al., 1993; Audretsch et al., 2007). We opted for not including patents ('codified' knowledge), as R&D private investments more properly capture all the localized knowledge, 'tacit' and

'codified' (Autant-Bernard, 2006), that is likely to be incorporated in the innovation process of creative firms (Florida et al., 2008).

At the industry level, and in order to test for the *Hypothesis 4b.* ("*Industry technological intensity is related to creative firms' location choices*"), we categorize industries/ firms in terms of their technology intensity: high, medium and low-technology.

The neighbouring effects in firms' location decisions are analyzed by introducing spatially-lagged explanatory variables in the model, calculated on the basis of spatial-weights matrices (e.g., Alamá-Sabater et al., 2011). We carry out this analysis by constructing a spatially-lagged model, composed of the explanatory variables and their respective spatial lags, for the purpose of testing *Hypothesis 5* ("*Inter-territorial spillovers of nearby regions explain creative firms' location choices*").

All the variables selected and respective indicators are presented in Table 4.

Table 4: Location determinants: variables and respective indicators/proxies

Location determinants	Variable	Proxy	Indicator computation	Source	Reference period
Localization economies (and co-location benefits)	*LQ Creative firms*	Location Quotient of Creative firms	Authors' own computations[1] for all the municipalities (n=308) based on the employment by industry sector: $\frac{E_j^s / \sum_{s'=1}^{S'} E_j^{s'}}{\sum_{j'=1}^{J} E_{j'}^s / \sum_{s'=1}^{S'} \sum_{j'=1}^{J} E_{j'}^{s'}}$, where E_j^s is sector *s* employment in the municipality *j*.	GEE/ ME, Portugal.	2009
	LQ Service firms	Location Quotient of Service-based firms			
	LQ Knowledge firms	Location Quotient of Knowledge-based activities			
Urbanization economies	*Population Density*	Population Density	Total number of persons/ Area (square kilometer), by each municipality.	INE, Statistics Portugal.	2008
	Industrial Diversity	Industrial Diversity Index	Authors' own computations[2] on the diversity index of all the industry sectors in each municipality (employment data by industry sector): $1 - \sum_r (E_j^r / \sum_{r'} E_j^{r'})^2$ where E_j^r describes industrial employment in sector *r* and municipality *j*.	GEE/ ME, Portugal.	2009
	Creative Diversity	Creative Industries' Diversity Index	Authors' own computations[3] on the diversity index of all creative sectors in each municipality (employment data by creative industry sector): $1 - \sum_t (E_j^t / \sum_{t'} E_j^{t'})^2$ where E_j^t describes industrial employment in creative sector *t* and municipality *j*.	GEE/ ME, Portugal.	2009
Human capital	Region's human capital *Higher Education*	Proportion of resident population with higher education completed (%)	Proportion of the resident population with 21 and more years old with higher education completed in total resident population with 21 and more years old (percentage) by each municipality.	INE, Statistics Portugal.	Census 2001
	Secondary Education	Gross enrolment rate in upper secondary education (%)	Proportion of pupils enrolled on upper secondary education in resident population aged between 15 and 17 years old (percentage) by municipality.	INE, Statistics Portugal.	2008/ 2009
	Firm's human capital	Firms' classification according to high, intermediate and basic educational attainments (based in the average education of all the workers in each establishment); Authors' own computations.		GEE/ ME, Portugal.	2009

Tolerance	*Culture*	Cultural amenities and museums (No.)	Number of museums, zoological, botanic gardens and aquariums by municipality.	INE, Statistics Portugal.	2009
	Foreigners	Foreign population (total number) who have applied for resident status per 100 inhabitants (%)	Proportion of foreign population who have applied for resident status in total resident population (percentage) by municipality.	INE, Statistics Portugal.	2007
	Social Inequality	Social inequality ratio	INE's calculation based on the weight of each socioeconomic group in the municipality's population, by municipality. The ratio varies between 0 (minimum inequality) and 1 (maximum inequality).	INE, Statistics Portugal.	Census 2001
Technology	Region's technology endowments *R&D Firms*	Region's Private R&D investment	Proportion of total expenditures in R&D of Private firms in regional gross domestic product at market prices (percentage) by region.	INE, Statistics Portugal.	2008
		Industry's technology intensity	Industry taxonomy by technological intensity (high, medium, low).[4]		2009
Inter-territorial Spillovers			Spatial lags (*_spl*) of the explanatory variables considered above.		2009

Notes:

[1] Based on the Linked Employer-Employee Databases of GEE/ ME, Portuguese Government; year 2009. The industry codes have been classified into Services, Knowledge and Creative segments, after their thorough interpretation using the Portuguese CAE - Rev.3 industrial classification (INE, 2007), compatible with ISIC - Rev. 4: *Services* activity sectors (CAE - Rev. 3): 41, 42, 43, 45, 46, 47, 49, 50, 51, 52, 53, 55, 56, 61, 64, 65, 66, 68, 69, 70, 7112, 7120, 7490, 75, 77, 78, 79, 80, 81, 82, 84, 86, 87, 88, 92, 931, 94, 95, 96, 97, 98, 99; *Knowledge* activity sectors (CAE - Rev. 3): 85; *Creative* activity sectors (CAE - Rev. 3): 58, 59, 60, 62, 63, 7111, 72, 73, 7410, 7420, 7430, 90, 91, 932.

[2] Based on the Linked Employer-Employee Databases of GEE/ ME, Portuguese Government; year 2009. The Industry Diversity index was calculated for each municipality according to the formula presented in Alamá-Sabater et al. (2011), taking into account all the activity sectors of the economy.

[3] Based on the Linked Employer-Employee Databases of GEE/ ME, Portuguese Government; year 2009. The Creative Industries' Diversity index was calculated for each municipality according to the formula presented in Alamá-Sabater et al. (2011), considering all the Creative activity sectors as described in Table 3.

[4] Authors' own computations based on the taxonomy in Silva and Teixeira (2011).

Given that the firm micro-data available comprises all the new creative establishments of the year 2009, each indicator computed for the analysis of regional location determinants refers to 2008 and 2009 or earlier periods, to best describe the existing conditions at the time that those establishments were created.

3.3. A description of the selected modelling approach: Discrete Choice Model

Discrete choice models in industrial location literature (McFadden, 1974) put an emphasis on each firm's selection process behaviour and permit the study of the effects of territorial features (e.g., population density, infrastructures, industrial mix) and firms' attributes (e.g., educational levels, size, activity sector) on location choices, within a set of territorial alternatives (Arauzo-Carod et al., 2010).

On studying the location behaviour of creative industries at the micro-level, our primary interest lies in understanding the effect of territorial and industry-specific determinants on those firms' location choices. For this we use the Discrete Choice Model (DCM) approach, which follows the theoretical setting based on the random utility maximization (RUM) framework (McFaden, 1974), described in the Appendix.

In this context, our model specification for the expected, non-observable, profit (π_{ij}) that each new creative establishment *i* obtains from locating in municipality *j* is given by:

$$\pi_{ij} = \beta_1 Population\ Density + \beta_2 LQ\ Creative\ Firms + \beta_3 LQ\ Service\ Firms + \beta_4 LQ\ Knowledge\ Firms + \beta_5 Industrial\ Diversity + \beta_6 Creative\ Diversity + \beta_7 Higher\ Education + \beta_8 Secondary\ Education + \beta_9 Culture + \beta_{10} Foreigners + \beta_{11} Social\ Inequality + \beta_{12} R\&D\ Firms \quad (1)$$

where the right hand side variables in (1) are measured by the indicators presented in Table 4.

To account for the spatial spillovers among neighbouring municipalities, we additionally introduce the spatial lags (*_spl*) of the explanatory variables. This results in the spatial discrete choice model, described as follows (2):

$$\pi_{ij} = \beta_1 Population\ Density + \beta_2 LQ\ Creative\ Firms + \beta_3 LQ\ Service\ Firms + \beta_4 LQ\ Knowledge\ Firms + \beta_5 Industrial\ Diversity + \beta_6 Creative\ Diversity + \beta_7 Higher\ Education + \beta_8 Secondary\ Education + \beta_9 Culture + \beta_{10} Foreigners + \beta_{11} Social\ Inequality + \beta_{12} R\&D\ Firms + \beta_{13} Population\ Density\_spl + \beta_{14} LQ\ Creative\ firms\_spl + \beta_{15} LQ\ Service\ firms\_spl + \beta_{16} LQ\ Knowledge\ firms\_spl + \beta_{17} Industrial\ Diversity\_spl + \beta_{18} Creative\ Diversity\_spl + \beta_{19} Higher\ Education\_spl + \beta_{20} Secondary\ Education\_spl + \beta_{21} Culture\_spl + \beta_{22} Foreigners\_spl + \beta_{23} Social\ Inequality\_spl + \beta_{24} R\&D\ Firms\_spl$$

The spatially lagged explanatory variables are obtained by the matrix product between a contiguity (row-standardized) spatial-weights matrix **W** with the vector **X** of explanatory variables, with the general specification: **X_spl = WX**.

W can be obtained using different approaches (distance-based/ inverse-distance-based, using Euclidean/ Haversine distance-based methods; *k*-nearest neighbours; contiguous neighbours) (see Drukker et al., 2013). In our case, a queen contiguity spatial-weighting matrix with row normalization was the preferred arrangement.[6] Contiguity matrices are commonly used for their suitability to describe what is considered as neighbour in a straightforward sense, only taking into account the spatial dependence among contiguous regions (Drukker et al., 2013). Neighbouring units are assigned weights of 1, and non-contiguous units are assigned weights of 0.[7] Since our purpose is to parameterize spatial spillover effects among nearby/ adjacent municipalities, we found the contiguity matrix the most appropriate one.

3.4. A description of the selected econometric estimation: Conditional Logit Model

In the estimation of the coefficients and other relevant parameters in our model, we use the Conditional Logit Model (CLM), which has been the most commonly used econometric setting in order to empirically estimate the parameters of discrete choice models. The CLM used is composed of variables that vary over alternatives (the generic specification is provided in the Appendix). It allows differentiating among the attributes of choices - *alternative-specific attributes* - and it also estimates taking into account the characteristics of the decision-makers/ firms - *case-specific attributes*. Despite the

[6] Queen contiguity assumes that any geo-referenced polygon (in our case, municipality) that shares even a point-length border, a corner or one vertex with the reference polygon is considered as adjacent, contiguous or a neighbour of the reference polygon.

[7] Using row-sum normalization (each row will have a sum equal to 1), each weight in the matrix will be given by: $w_{ij} = w_{ij}^* / \sum_{j=1}^{n} w_{ij}^*$.

computational burden when the set of choices is large (in our case, *j*=308), major advantages of the CLM are that the parameters, coefficients and marginal effects are easily calculated and interpreted.[8]

The coefficients and relevant parameters in our conditional logit model are estimated by maximizing the log-likelihood function:

$$log\ L_{Conditional\ Logit} = \sum_{i=1}^{N} \sum_{j=1}^{J} y_{ij}\ \ log\ P_j \tag{3}$$

where y_{ij} = 1 if individual *i* chooses alternative *j* and equals 0 otherwise. This leads to the following expression:[9]

$$log\ L_{CL} = \sum_{j=1}^{J} n_j\ \ log\ P_j \tag{4}$$

In order to test all the hypotheses mentioned in Section 2 on the analysis of the location determinants of creative firms, our primary interest is to observe the sign and effect of each explanatory variable (municipality characteristics) on creative establishments' location behaviour.[10]

The CLM estimates yield coefficients that cannot be directly interpreted because firms' profits are not observable and the location choice behaviour can only be analyzed in terms of probabilities. It is only possible to observe the characteristics of alternatives, of firms, and the outcomes of location choices, represented by a binary dependent variable *c*, which equals to 1 if firm *i* decides to locate in a particular region *j*, and 0 otherwise.

The estimation by maximizing the log-likelihood function of the probabilities for all the alternatives (*j*=308), and all the firms (*n*=369), expressed in (3) and (4) gives us a list of

[8] The main limitation of this method lies in the assumption of Independence of Irrelevant Alternatives (IIA). The strictness of the "independence of irrelevant alternatives" axiom is related with the fact that given two alternative choices, X and Y, if X is preferred to Y from the choice set {X,Y}, then inserting a third spatial alternative Z and extending the set to {X,Y,Z} must not make Y preferable to X. That is, preferences for X or Y are not altered by the insertion of the option Z. Guimarães et al. (2004) provide potential ways of dealing with the IIA violation by making use of the relation between CLM and Poisson regression models. Also the use of nested logit models relaxes the IIA assumption by allowing the unobserved factors, ε_{ij}, to be correlated.

[9] P_j is specified in the Appendix by (A4).

[10] Obtaining the marginal effects/ elasticities would allow verifying how, ceteris paribus, variations in the explanatory variables influenced the probability of selecting a specific location. Besides the computational burden, given the 308 alternatives/ regions available, the study of marginal effects is not of major relevance at this stage since our focus is on the overall effects/ sign of each location determinant on creative firms as a whole, and according to the attributes of creative firms in our database.

coefficients, specific to each explanatory independent variable (location determinant) in the model. Those coefficients establish the relation between the regressors in model (1) and the binary dependent variable of choice *c*.

Given the characteristics of the CLM we are using (see (A5)-(A7), in Appendix), the estimated coefficients of the alternative-specific regressors can be given an odds interpretation,[11] through the exponentiation of their values (Scott Long and Freese, 2006). Each exponential beta coefficient, *exp(β)*, obtained in the CLM estimates can be translated into the effect/ impact in the odds between locating in a target region versus locating in one of the other alternative locations, of a unit variation in the corresponding explanatory variable (location's attribute).[12]

Intuitively, a positive CLM coefficient (or *log-odds ratio*) means that if the explanatory variable has an increase of one unit, then the target alternative is more likely to be chosen and the other alternatives are less likely to be chosen, *i. e.*, increases the odds of choosing the target alternative; the opposite rationale for a negative coefficient. Thus *exp(β)* reflects the impact of a unit change in the alternative-specific regressor, in the odds of choosing a particular alternative versus one from all the other alternatives (Scott Long and Freese, 2006).

4. Empirical results

4.1. Results for creative firms as a whole

An exploratory analysis of our database of new creative establishments (n=369) infers that creative firms tend to cluster around a small number of large/ important urban centres (cf. Figure 1). Mainly, they locate in the most relevant North-Centre cities (Porto, Aveiro, Coimbra and Leiria), as well as in Lisbon and Oeiras (the capital city and a densely populated high-tech municipality near Lisbon, respectively).

Also, a heterogeneity of location patterns according to the creative industry sector has been previously detected: 'Advertising/ Marketing', 'Publishing' and 'Software/ Digital Media' mostly concentrated in large urban centres; 'Architecture' and 'Design/ Visual

[11] Coefficients of the alternative-specific regressors directly obtained in CLM estimations are commonly identified as *log-odds ratios*.

[12] Expressions (A5) to (A7) in Appendix allow explaining this effect in the *odds ratio* of a unit change in the explanatory variable.

Arts' distributed around intermediate urban centres in the North-Centre of the country; 'Research' quite dispersed throughout the territory with concentration around municipalities with higher-education institutions; 'Film/ Video/ Photography' dispersed throughout the territory with some clusterization around large urban centres; and 'Music/ Entertainment/ Performing arts' distributed across tourism/ coastal municipalities (Cruz and Teixeira, 2014).

Figure 1: Number of new creative establishments in Portugal by municipality (our database; *n*=369 establishments/ *j*=308 municipalities), in 2009

Source: Authors' computations based on STATA 13 ® and micro-data from the Linked Employer-Employee Databases, GEE/ ME, Portugal (year 2009).

Given this evidence, we seek to uncover the main location factors behind the irregular patterns found in creative firms' geographic distribution. In order to assess such determinants, we first estimated a standard Conditional Logit model (standard CLM) and then we added the spatial lags of each explanatory variable in the model (CLM with spatially-lagged variables).[13]

The parameter estimates of the standard CLM are presented in Table 5. Goodness-of-fit measures for the model specification (e.g., Wald qui-square test; Likelihood-ratio test; Wald test for the joint significance of variables in the model) infer that the unrestricted CLM, with all the explanatory variables, is suitably specified when compared to the alternative restricted model. All coefficients are statistically significant (at one, five and ten percent levels), most of them highly significant (at one percent level).

From Table 5, and similar to the results obtained by the bulk of research on the location of manufacturing industries (cf. Section 2), it is noticeable that (co)location economies play an important role in creative firms' location decisions. The concentration of creative firms (*LQ Creative Firms*) and the clustering of knowledge-based activities (*LQ Knowledge Firms*) are statistically significant and exert a positive effect on the decisions of creative establishments. There is enough evidence to maintain that creative firms tend to locate where other creative and knowledge-based activities are clustered, suggesting co-location among these sectors/ activities, due to potential interdependencies and local synergies.

In contrast, the concentration of service-business activities (*LQ Service Firms*) has a negative impact on choices. This is a similar result to that obtained in Alamá-Sabater et al. (2011) and may derive from the fact that in large urban centres, service-based activities are not so highly concentrated, or that creative firms privilege interdependencies with other activity sectors such as innovation/ knowledge-based activities. It is mostly in inland/ remote municipalities that services (e.g., health, accountancy or legal activities) usually have more relative importance at a local level.

Regarding urbanization economies, population density (*Population Density*), denoting externalities from urban agglomeration, has a significant, positive effect in firms' location decisions, suggesting the tendency of creative establishments to locate near

[13] Estimates were carried out using STATA 13 ® (alternative-specific conditional logit estimation and post-estimation tool packages). The sector of 'TV and Radio' registered no observations in our data.

large consumer markets. In terms of regional industrial mix, estimated coefficients for the diversity indexes of all the activity sectors (*Industrial Diversity*) and of creative industry sectors (*Creative Diversity*) have positive, significant impacts in location choices. This evidence suggests that creative firms tend to favour a diversified industrial matrix both in terms of all the industrial sectors and of the mix of creative industries, substantiating the argument in Lazzeretti et al. (2012) that creative firms privilege local related variety in order to benefit from inter-sectorial, transversal synergies.

Table 5: Standard CLM estimates (*n*=369 cases/ creative establishments; *j*=308 alternatives/ municipalities)

Hypotheses	Variable/ Location Determinant	Estimated Coefficient	Standard Error
H1. Agglomeration (location and urbanization) economies	Population Density	**0.0001***	0.0000541
	LQ Creative Firms	**1.053*****	0.3500657
	LQ Service Firms	**-0.769****	0.3957541
	LQ Knowledge Firms	**0.775*****	0.280637
	Industrial Diversity	**0.141*****	0.0377678
	Creative Diversity	**11.726*****	2.530715
H2. Human Capital	Higher Education	**0.206*****	0.0245704
	Secondary Education	**-0.005*****	0.0009556
H3. Tolerance/ Openness	Culture	**-0.033*****	0.0108462
	Foreigners	**0.268*****	0.0597044
	Social Inequality	**-0.125*****	0.0205913
H4. Technology	R&D Firms	**1.198***	0.6898952
Log-likelihood	-1566.4406		
Wald chi2(12) (joint significance of the variables in the model)	1228.17 [Prob > chi2 = 0.0000]		
Pseudo R^2	0.2592		
Nr. Observations	113,652		
Likelihood-ratio (LR)test – Unrestricted with all variables vs restricted (measure of fit for CLM specification)	$LR_{full/\ restricted}$ = 460.59 [Prob > chi2 = 0.0000]		

***, **, * one, five and ten percent significance levels, respectively.
Source: Authors' computations based on STATA 13 ® and micro-data from the Linked Employer-Employee Databases, GEE/ ME, Portugal (year 2009).

From this it is possible to conclude that the effects of traditional location factors - location and urbanization economies - support the empirical literature due to benefits arising from industry-specific (creative sectors) clustering, urban agglomeration and due to externalities transversal to all co-located firms/ industries, which validates our *Hypothesis 1* (*H1*) that agglomeration economies are positively related to creative firms' location choices.

Regarding human-capital estimates, it is noticeable that higher education at a regional level (*Higher Education*) plays a statistically highly significant and positive effect in creative firms' location decisions. A unit increase in this factor leads to a positive increment of 23% ($e^{0.206}$) on the odds of locating at a particular municipality versus all the other alternative locations. In turn, lower educational levels, such as upper secondary schooling rate (*Secondary Education*), have a negative, statistically significant effect. These facts are in overall accordance with the empirical/ exploratory research on the location of creative industries (Florida, 2002, 2005; Florida et al., 2008; Lazzeretti et al., 2012), contrasting with results obtained by studies (e.g., Arauzo-Carod and Manjón-Antolín, 2004; Arauzo-Carod and Viladecans-Marsal, 2009; Liviano and Arauzo-Carod, 2012) on the location of medium-to-low technology manufacturing firms (cf. Table 2), which can be explained by the specific requirements that creative firms usually have of a highly skilled labour force. These findings validate the implications of *Hypothesis 2a.* that the region's higher education human capital is positively related to creative firms' location decisions.

Concerning tolerance-related variables (institutional factors), we observe a positive, significant impact of immigrant legalization rate (*Foreigners*), denoting openness to immigrants/ newcomers, in location decisions. These decisions are negatively affected by the existence of social inequalities (*Social Inequality*) in the municipality, which finds support in the empirical literature that tolerant/ open environments are a locus of creative activities (Florida et al., 2008). The coefficient for cultural amenities (*Culture*) is significant and negative, which can be due to the fact that museums, libraries and cultural facilities are spread across inland and coastal municipalities, and are much more related with heritage and historical sites than with the contemporary art facilities, usually found in large metropolises as mentioned by Florida (2002, 2005). Summing up, although cultural infrastructures repel creative firms, their location choices favour more

tolerant and equal environments, where openness to newcomers and less social inequality are present. This evidence partially confirms *Hypothesis 3*.

Finally, the estimate for regional technological endowments (*R&D Firms*) shows a positive and significant coefficient, which corroborates the empirical literature (e.g., Autant-Bernard, 2006; Audretsch et al., 2007) that creative firms tend to favour municipalities where the stock of knowledge (developed by private firms) and the conditions for the innovative activity are higher. This confirms our *Hypothesis 4a*, that a region's technological endowments are positively related to creative firms' location choices.

Since human capital is not only an attribute of the region but also of the firm, in order to test *H2b.*, we estimate the baseline model for three groups of firms (cf. Table 6): firms with high educational levels (Model I), those with intermediate levels (Model II) and ones with basic levels (Model III). Depending on the type of firm (with high, intermediate or basic educational level), the location determinants differ. This means that *Hypothesis 2b*, postulating that the human capital/ educational level existent in creative firms is related to their location choices, is validated.

Specifically, firms with higher educational levels tend to favour location determinants such as (co)location economies (*LQ Creative Firms*; *LQ Knowledge Firms*) and within-industry variety (*Creative Diversity*) in order to take advantage of complementary linkages; higher education/ graduate human capital (*Higher Education*) in opposition to lower educational levels; tolerant environments (positive significant effect of *Foreigners*; negative significant sign for *Social Inequality*), and local innovation (*R&D Firms*) in their location choices (cf. Table 6, Model I). These factors generally describe creative firms' location determinants in the empirical literature, and they are usually found in large urban centres (Florida et al., 2008; Lazzeretti et al., 2012).

In turn, creative establishments with intermediate and basic educational levels tend to privilege more industrial diversity and not clustering with complementary creative/ knowledge industries; human capital (*Higher Education*), particularly evident in the case of intermediate-level firms; and institutional factors (positive, significant effect of *Foreigners*; significant negative impact of *Social Inequality*) for both types of firms (cf. Table 6, Models II and III).

Creative firms with higher educational levels are most likely to portray intellectual property activities which require a highly skilled labour force, and they are usually co-located with other innovative/ knowledge-intensive firms (e.g., Advertising and Marketing; Software and Digital media; Research), whereas establishments with intermediate/ basic educational levels, more concerned with leisure, entertainment and artistic activities (e.g., Film, Video and Photography; Music/ Entertainment and Performing arts), mainly tend to privilege industrial and socially diversified environments.

Table 6: Standard CLM estimates according to the educational level (high, intermediate, basic) in creative establishments (*n*=369; *j*=308 municipalities)

Location Determinants	**Explanatory Variables**	**Standard CLM Estimated Coefficients**		
		Model I - High educational level establishments	**Model II - Intermediate educational level establishments**	**Model III - Basic educational level establishments**
Agglomeration economies	Population Density	**0.0002**** (0.0000705)	**0.00001** (0.0001117)	**-0.00009** (0.0001497)
	LQ Creative Firms	**0.946**** (0.4927382)	**0.920** (0.6580498)	**1.831*** (0.7637896)
	LQ Service Firms	**-0.692** (0.5516932)	**-1.286*** (0.7615708)	**-0.034** (0.8838747)
	LQ Knowledge Firms	**0.903**** (0.3808698)	**0.584** (0.5456962)	**0.918** (0.6657408)
	Industrial Diversity	**0.096*** (0.0517234)	**0.180***** (0.0698426)	**0.239***** (0.0929636)
	Creative Diversity	**12.074***** (3.563947)	**10.376**** (4.731422)	**13.902**** (5.86167)
Human Capital	Higher Education	**0.231***** (0.0315043)	**0.247***** (0.0472813)	**0.028** (0.0687083)
	Secondary Education	**-0.005***** (0.0012599)	**-0.005***** (0.0018979)	**-0.002** (0.0024325)
Tolerance/ Openness	Culture	**-0.041***** (0.0143194)	**-0.014** (0.0228775)	**-0.041** (0.0276566)
	Foreigners	**0.178*** (0.093723)	**0.417***** (0.0991971)	**0.226*** (0.1333904)
	Social Inequality	**-0.084***** (0.0295553)	**-0.168***** (0.0381912)	**-0.176***** (0.0459044)
Technology	R&D Firms	**1.717*** (0.942001)	**-0.431** (1.467819)	**2.207*** (1.33419)
Nr. Observations / Cases		65,604 obs./ 213 cases	30,492 obs./ 99 cases	17,556 obs./ 57 cases

***, **, * one, five and ten percent significance levels, respectively. Standard Errors in brackets.
Source: Authors' computations based on STATA 13 ® and micro-data from the Linked Employer-Employee Databases, GEE/ ME, Portugal (year 2009).

Technology is also a characteristic of the industry sector to which a firm belongs. Thus, in order to test for the *Hypothesis 4b*, we estimate four models according to the technological intensity of the industry to which the creative establishment belongs: 'very high-tech' (Model I), 'high-tech' (Model II), 'medium-to-high tech' (Model III), and 'medium-tech' (Model IV) (cf. Table 7).

Table 7: Standard CLM estimates according to technological intensity of creative firms (*n*=369; *j*=308 municipalities)

Location Determinants	**Explanatory Variables**	**Standard CLM Estimated Coefficients**			
		Model I – Very-High tech creative firms	**Model II - High-tech creative firms**	**Model III - Medium-High-tech creative firms**	**Model IV - Medium-tech creative firms**
Agglomeration economies	Population Density	**0.0001** (0.0000939)	**1.22e-06** (0.0000814)	**0.0003**** (0.0001481)	**0.0002** (0.0002621)
	LQ Creative Firms	**0.783** (0.6313214)	**1.341***** (0.5018942)	**0.149** (0.9689093)	**2.014** (1.500396)
	LQ Service Firms	**-0.396** (0.767213)	**-0.545** (0.5837014)	**-1.617*** (0.913261)	**0.200** (1.882107)
	LQ Knowledge Firms	**1.073**** (0.4863913)	**1.159***** (0.4017348)	**-1.563*** (0.8547248)	**0.897** (1.460686)
	Industrial Diversity	**0.2786***** (0.0933306)	**0.157***** (0.0581652)	**0.146*** (0.0847599)	**-0.052** (0.0784532)
	Creative Diversity	**10.057**** (4.575143)	**13.278***** (3.625556)	**5.233** (7.408923)	**24.362*** (12.0456)
Human Capital	Higher Education	**0.223***** (0.0422254)	**0.183***** (0.0366901)	**0.227***** (0.0639556)	**0.290**** (0.1453894)
	Secondary Education	**-0.007***** (0.0017053)	**-0.004***** (0.0013831)	**-0.00009** (0.0023451)	**-0.008** (0.0049457)
Tolerance/ Openness	Culture	**-0.036*** (0.0193225)	**-0.030*** (0.0162479)	**-0.013** (0.0294751)	**-0.075** (0.0474394)
	Foreigners	**0.316***** (0.1104592)	**0.275***** (0.0828753)	**0.359***** (0.1454878)	**-1.639** (1.343929)
	Social Inequality	**-0.129***** (0.0418044)	**-0.145***** (0.031077)	**-0.015** (0.0478961)	**-0.227***** (0.0859189)
Technology	R&D Firms	**1.251** (1.28737)	**0.616** (1.080231)	**1.965** (1.564127)	**4.829**** (2.397027)
Nr. Observations / Cases		37,576 obs./ 122 cases	54,208 obs./ 176 cases	15,400 obs./ 50 cases	6,468 obs./ 21 cases

***, **, * one, five and ten percent significance levels, respectively. Standard Errors in brackets. The division in terms of technology-intensity was made following the taxonomy of Silva and Teixeira (2011).
Source: Authors' computations based on STATA 13 ® and micro-data from the Linked Employer-Employee Databases, GEE/ ME, Portugal (year 2009).

In the case of very high and high-technology creative establishments, agglomeration economies due to the co-location with creative and knowledge-based firms (*LQ Creative Firms*; *LQ Knowledge Firms*); urbanization economies from related variety (*Industrial* and *Creative Diversity*); higher levels of human capital (*Higher Education*); and institutional factors of tolerance (*Foreigners*; *Social Inequality*) play important roles as location determinants. In the case of medium-to-high and medium-technology creative establishments, decisions are mainly affected by human capital (*Higher Education*) and institutional tolerance-related factors (*Foreigners*; *Social Inequality*). Moreover, these firms avoid or are indifferent to the co-location with creative/ knowledge-based activities, as shown by the sign and significance of *LQ Creative Firms* and *LQ Knowledge Firms* (cf. Table 7, Models III and IV). This provides evidence for different patterns of location behaviour according to the technology-level of creative firms, which validates our *Hypothesis 4b*.

Finally, in order to account for the inter-territorial spillovers of neighbouring municipalities in creative firms' location choices (*H5*), we estimate an 'enlarged' model, adding the spatial lags of each explanatory variable in the CLM (cf. Table 8).

It is evident from the estimates that when including the attributes of neighbouring regions, the most important determinants of creative firms' location choices remain much the same as in the standard CLM estimations (Table 5). The attributes of chosen locations have a significant effect on firms' decisions while those of nearby regions only show significance for the case of *Secondary Education_spl* and the institutional factor *Social Inequality_spl*. Here, it is possible that since upper secondary education is a variable which is widely distributed throughout the country, and social inequality is an institutional factor, their effects may extend beyond the boundaries of each municipality. In short, *Hypothesis* 5 (*H5*) is partially sustained by the data.

Although it is critical to account for inter-territorial spillovers, in the particular case of our database, location behaviour is strongly shaped by municipality characteristics and not by the aspects of contiguous regions. This can be understood in that creative firms are mainly located in large or important urban centres, with an ample supply of resources (e.g., human capital, knowledge networks and technological endowments), related variety and large consumer markets, with little need to resort to resources beyond the borders of their region.

Table 8: CLM with spatially lagged variables - parameter estimates (*n*=369 cases/ creative establishments; *j*=308 alternatives/ municipalities)

Hypotheses	Variable/ Location Determinant	Estimated Coefficient	Standard Error
H1. Agglomeration (location and urbanization) economies	Population Density	**0.0002****	0.0001019
	LQ Creative Firms	**0.879****	0.4047041
	LQ Service Firms	**-0.147**	0.484064
	LQ Knowledge Firms	**0.785****	0.3524896
	Industrial Diversity	**0.068***	0.0400985
	Creative Diversity	**10.925*****	2.871029
H2. Human Capital	Higher Education	**0.165*****	0.0394276
	Secondary Education	**-0.00007**	0.0014653
H3. Tolerance/ Openness	Culture	**-0.033**	0.0219262
	Foreigners	**0.293****	0.1279316
	Social Inequality	**-0.063****	0.0313443
H4. Technology	R&D Firms	**2.194****	0.9108805
H5. Inter-territorial spillovers of neighbouring regions	Population Density_spl	**0.0003**	0.0002221
	LQ Creative firms_spl	**1.178**	1.017497
	LQ Service firms_spl	**-1.062**	0.7401107
	LQ Knowledge firms_spl	**-0.034**	0.7902569
	Industrial Diversity_spl	**0.028**	0.0544824
	Creative Diversity_spl	**10.645**	7.551003
	Higher Education_spl	**0.026**	0.0945354
	Secondary Education_spl	**0.005****	0.0025297
	Culture_spl	**-0.002**	0.0551487
	Foreigners_spl	**-0.009**	0.1638044
	Social Inequality_spl	**-0.067***	0.03949
	R&D Firms_spl	**-2.288**	1.622236
Log-likelihood	-1548.1567		
Wald chi2(24)	1229.31 [Prob > chi2 = 0.0000]		
Pseudo R^2	0.2678		
Nr. Observations	113,652		
Likelihood-ratio (LR) test	$LR_{full/\ restricted} = 497.16$ [Prob > chi2 = 0.0000]		

***, **, * one, five and ten percent significance levels, respectively. Source: Authors' computations based on STATA 13 ® and micro-data from the Linked Employer-Employee Databases, GEE/ ME, Portugal (year 2009).

4.2. Empirical results by creative industry sector

The location patterns of creative industries reveal heterogeneous characteristics across creative sector groups (Cruz and Teixeira, 2014). Thus, it is expected that creative firms' location behaviour is differentiated according to the industry sector to which they belong.

Indeed, standard CLM estimates by sector (cf. Table 9) indicate that creative establishments/ start-ups are affected by different combinations of location factors, depending on their industry sector.

Creative firms in the sectors of 'Advertising and Marketing' and 'Software and Digital media' tend to favour regions with higher concentrations of creative and knowledge-based activities, benefiting from synergies of co-location with complementary industries and from industrial and creative diversification/ related variety; with higher human capital and tolerance/ openness, reflected by the foreigners' acceptance rate and lower levels of social inequality. These location factors, characterizing large urban centres (such as Lisbon and Oeiras), support the arguments usually raised in the empirical literature on creative industries (e.g., Florida, 2002, 2005; Florida et al., 2008; Lazzeretti et al., 2012; Cruz and Teixeira, 2014).

In turn, establishments that belong to 'Publishing', 'Architecture', 'Design' and 'Film, Video and Photography' industries, mostly located across intermediate or important urban centres in the North-Centre of the country, share some similarities in their major determinants, mostly related with industrial/ related diversity, institutional and human capital factors.

In the 'Publishing' industry, where firms are quite dispersed across intermediate urban centres in the country's North-Centre (around Porto, Coimbra and Lisbon), firms emphasise creative diversity, human capital and social equality as location determinants.

In the 'Design' sector, where firms are mainly located in Northern intermediate urban centres (around Porto), creative establishments tend to favour municipalities with industrial diversity, lower concentrations of services-based firms, higher levels of human capital and lower social inequalities. The clustering of services mainly occurs in inland/ coastal/ tourism municipalities, thus the negative estimate in Design (cf. Table 9) might be explained by design firms' preference to locate near relevant manufacturing

industries (e.g., fashion/ textiles design, furniture/ equipment design, industrial/ product design, graphic design), that are mostly located in the North of Portugal.

Concerning 'Architecture', creative establishments favour co-location with other creative activities, creative diversity/ related variety and higher levels of human capital. These firms tend to be located in intermediate urban centres in the North-Centre municipalities (mainly around Porto).

Firms belonging to 'Film, Video and Photography' prefer regions with lower social inequalities and higher levels of human capital. These firms are scattered all over the territory, with some prevalence around and in the two largest urban centres (Lisbon and Porto).

In the 'Research' sector, creative establishments prefer to locate where there are high levels of human capital (higher education) and avoid municipalities with lower levels of human capital (secondary education), mainly privileging cities with universities, higher-education institutions and research centres. In contrast, firms belonging to 'Music, Entertainment and the Performing arts' avoid locations with higher concentrations of knowledge-based activities and reveal a preference to locate in regions with larger consumer markets/ population density and higher openness/ immigration acceptance rate (mainly tourism/ coastal municipalities).

Table 9: Standard CLM estimates according to the industry sector of creative firms (*n*=369; *j*=308 municipalities)

Location Determinants	Explanatory Variables	Standard CLM Estimated Coefficients							
		Advertising and Marketing	**Architecture**	**Design**	**Film, Video and Photography**	**Music/ Entertainment/ Performing Arts**	**Publishing**	**Software and Digital Media**	**Research**
Agglomeration economies	Population Density	**-0. 00007** (0.00001281)	**-0.0001** (0.0001833)	**0.0003** (0.0002055)	**0.0002** (0.0002027)	**0.0003**** (0.0001471)	**0.0001** (0.0002316)	**0.0001** (0.0000974)	**-0.0002** (0.0006399)
	LQ Creative Firms	**1.405**** (0.7455554)	**1.927*** (1.026236)	**1.878** (1.567831)	**0.336** (1.365024)	**0.268** (1.007442)	**1.633** (1.337802)	**0.586** (0.6696571)	**3.477** (2.947186)
	LQ Service Firms	**0.395** (0.9015368)	**-0.093** (1.103724)	**-3.404**** (1.644903)	**-0.732** (1.574931)	**-0.900** (0.9261011)	**-1.926** (1.606551)	**-0.278** (0.7970052)	**-0.609** (3.801012)
	LQ Knowledge Firms	**1.762***** (0.5980288)	**0.571** (0.9240992)	**0.278** (1.035118)	**1.213** (0.9725224)	**-1.731**** (0.9111739)	**0.640** (1.156567)	**1.345***** (0.4947524)	**-3.455** (2.882078)
	Industrial Diversity	**0.211**** (0.0994548)	**-0.003** (0.0827178)	**0.319**** (0.156575)	**0.247** (0.1678719)	**0.112** (0.0861024)	**0.017** (0.0793844)	**0.262***** (0.0975237)	**0.572** (0.4215791)
	Creative Diversity	**12.809**** (5.386207)	**14.604**** (7.267346)	**47.619** (37.15703)	**7.715** (9.880865)	**5.522** (7.670051)	**21.380**** (11.06376)	**8.486**** (4.822228)	**53.968** (83.35619)
Human Capital	Higher Education	**0.141**** (0.0588203)	**0.175**** (0.0707806)	**0.263***** (0.0976433)	**0.210**** (0.0986452)	**0.216***** (0.0654959)	**0.283***** (0.1083696)	**0.212***** (0.0447214)	**0.455**** (0.226402)
	Secondary Education	**-0.006***** (0.0022617)	**0.0002** (0.0026878)	**-0.005** (0.0032788)	**-0.008**** (0.003861)	**0.0002** (0.0024459)	**-0.006** (0.0040422)	**-0.006***** (0.0017459)	**-0.023*** (0.0130423)
Tolerance/ Openness	Culture	**-0.0288** (0.0246094)	**-0.0249** (0.0366109)	**0.026** (0.0712167)	**-0.029** (0.0387393)	**-0.020** (0.0308938)	**-0.051** (0.0413634)	**-0.039**** (0.0202847)	**0.139** (0.1634629)
	Foreigners	**0.337***** (0.1141239)	**0. 139** (0.1602713)	**0.404** (0.2596056)	**0.032** (0.3918062)	**0.318**** (0.1493572)	**-0.255** (0.6586536)	**0.317***** (0.111326)	**0.310** (0.9403586)
	Social Inequality	**-0.189***** (0.050074)	**-0.0736** (0.0620039)	**-0.143*** (0.0783756)	**-0.137*** (0.080603)	**-0.015** (0.0506231)	**-0.181***** (0.0651687)	**-0.114***** (0.0439651)	**-0.298** (0.2237966)
Technology	R&D Firms	**1.522** (1.571605)	**-0.199** (2.583797)	**-2.566** (3.234796)	**2.351** (2.298705)	**2.587** (1.598248)	**2.713** (2.136133)	**1.137** (1.362779)	**3.665** (4.794155)
Nr. Observations / Cases		24,024 obs./ 78 cases	12,320 obs./ 40 cases	8,932 obs./ 29 cases	8,624 obs./ 28 cases	13,860 obs./ 45 cases	8,316 obs./ 27 cases	33,880 obs./ 110 cases	3,696 obs./ 12 cases

***, **, * one, five and ten percent significance levels, respectively. Standard Errors in brackets. The sector of 'TV and Radio' had no observations in our database of 369 new creative establishments.

Source: Authors' computations based on STATA 13 ® and micro-data from the Linked Employer-Employee Databases, GEE/ ME, Portugal (year 2009).

5. Conclusions

This paper makes two contributions to the literature. First, we analyse the location behaviour of creative industries as a distinct group of industries, using highly detailed data at firm micro-level. Second, we study the role played by the location determinants according to creative firms' attributes, using a modelling framework from the perspective of the RUM-Discrete choice model approach in a context where the research on creative industries is still at an exploratory level.

Using a conditional logit model on the overall analysis of location determinants, with the particular advantage of allowing us to analyze location attributes and firms' characteristics, our findings suggest that creative firms, as a whole, share similarities in their location behaviour with other industries namely, the manufacturing sector. However, there are determinants that are specific to these firms and affect their location choices, most notably urbanization economies, human capital and tolerance/ institutional factors.

Similar to the results obtained on the study of manufacturing industry sectors (e.g., Arauzo-Carod and Viladecans-Marsal, 2009; Alamá-Sabater et al., 2011; Manjón-Antolín and Arauzo-Carod, 2011; Liviano and Arauzo-Carod, 2012), location economies are important factors driving creative firms' decisions. These firms tend to locate where other creative and knowledge-based activities are clustered in order to benefit from local input sharing (labour pool, infrastructures and suppliers), interdependencies and local networking. Such findings suggest that regional policies directed to promote the spatial clustering of creative businesses should take into account the importance of co-location with other related industries (namely, creative/ innovation/ knowledge-based activities) in the region.

We also found evidence on the particular role of urbanization economies, where creative firms favour proximity to urban environments and large consumer markets, as well as to related industries (industrial and creative diversity), corroborating previous exploratory studies (Florida, 2002, 2005; Florida et al., 2008; Lazzeretti et al., 2012). Concerning human capital, where effects are expected to be dependent on the industry sectors analyzed (cf. Section 2), our data proves that the role of human capital/ skilled labour is highly significant in creative firms' location decisions. Here, the region's graduate human capital - contrary to lower levels of education - has positive and highly

significant effects on firms' location choices. Also the human capital existent at the firm level is determining in its location choices. This is particularly explained by the demand for highly skilled labour. These requirements also explain why creative firms prefer to locate in tolerant/ open environments, favouring newcomers and social equality. A tolerant atmosphere allows for a higher accumulation of human capital and creative workers, complementary skills embodied in newcomers, and where artistic networks act as channels of information among firms/ industries.

Another finding is that R&D/ technological endowments also attract creative firms, given that technology provisions are a critical asset in promoting an environment where externalities arise in the form of tacit knowledge and encourage the creation of further knowledge and creative activities (Audretsch et al., 2007).

Thus, the more diversified, tolerant and innovative a region is the more favourable it will be for urbanization economies and a higher accumulation of human capital, which positively affect creative firms' location decisions, as proven in our findings. This causality should be acknowledged in terms of regional policy implications.

Another finding is that, despite the importance of inter-territorial spillovers (e.g., Autant-Bernard, 2006; Ellison et al., 2007; Alamá-Sabater et al., 2011), creative firms' location behaviour is strongly influenced by municipality characteristics and not by the aspects of contiguous regions. This may be due to the fact that creative firms prefer to locate in large urban centres with an ample resource supply and little need to resort to those beyond the borders of each region. This suggests that creativity-oriented policies may be more effective if they focus on the municipality level and on local regional determinants (e.g., local consumer markets, local networking, related variety, human capital, tolerance/ community safety, technology), since creative processes mainly happen at a localized level.

Finally, our findings show differentiated patterns of location behaviour according to the creative firm's educational level, its technology-intensity and the creative industry sector to which it belongs. This indicates that creative firms/ industries should be analyzed in accordance with their heterogeneity in location behaviours. Local policies for creativity and regional development should be designed according to the creative industry sector and the attributes of creative firms' (e.g., knowledge-intensive sectors, such as 'Advertising/ Marketing' and 'Software/ Digital media'; research-based

('Research'); leisure-oriented ('Film, Video and Photography'/ 'Music/ Entertainment/ Performing arts'; functional/ related to the manufacturing sectors, in the cases of 'Architecture', 'Design' and 'Publishing'), in order to become more effective regional improvement tools.

Extending our scope to firms belonging to other industry sectors that could share (or not) some specificities of their location behaviour with creative firms would allow a comparative analysis with a better characterization of creative industries. Also, an extended analysis on the characteristics (e.g., sales, number employees/ size, employees' age) of creative firms should be helpful to bringing more information on the topic, given that location behaviour is affected by firms' attributes. In terms of methodology, the use of more recent data at micro-level and more robust estimation methods (nested logit, mixed logit) would provide a suitable, updated analysis of these firms' location choices and regional determinants, that would also add to the scope of this study.

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References

Alamá-Sabater, L., Artal, A., Navarro-Azorín, J.-M. (2011), "Industrial location, spatial discrete choice models and the need to account for neighbourhood effects", *Annals of Regional Science*, Vol. 47, pp. 393-418.

Arauzo-Carod, J-M. (2007), "A note on spatial autocorrelation at a local level", *Applied Economics Letters*, Vol. 14, pp. 667-671.

Arauzo-Carod, J-M. (2008), "Industrial Location at a Local Level: Comments on the Territorial Level of the Analysis," *Tijdschrift voor Economische en Sociale Geografie - Journal of Economic and Social Geography*, Vol. 99, pp. 193-208.

Arauzo-Carod, J-M., Manjón-Antolín, M. (2004), "Firm size and geographical aggregation: An empirical appraisal in industrial location", *Small Business Economics*, Vol. 22, pp. 299-312.

Arauzo-Carod, J-M., Viladecans-Marsal, E. (2009), "Industrial location at the intra-metropolitan level: The role of agglomeration economies", *Regional Studies*, Vol. 43, Nº4, pp. 545-558.

Arauzo-Carod, J-M., Liviano-Solis, D., Manjón-Antolín, M. (2010), "Empirical studies in industrial location: An assessment of their methods and results", *Journal of Regional Science*, Vol. 50, Nº3, pp. 685-711.

Arauzo-Carod, J-M. (2013), "Location determinants of new firms: does skill level of human capital really matter?", *Growth and Change*, Vol. 44, Nº1, pp. 118-148.

Asheim, B. (1996), "Industrial districts as learning regions: a condition for prosperity?", *European Planning Studies*, Vol. 4, Nº4, pp. 379-400.

Audretsch D., Feldman, M. (1996), "R&D spillovers and the geography of innovation and production", *The American Economic Review*, Vol. 86, Nº3, pp. 630-640.

Audretsch, D., Falck, O., Heblich, S. (2007), "It's all in Marshall: the impact of external economies on regional dynamics", CESifo working paper, No. 2094.

Autant-Bernard, C. (2006), "Where Do Firms Choose to Locate their R&D? A Spatial Conditional Logit Analysis on French Data," *European Planning Studies*, Vol. 14, pp. 1187-1208.

Baldwin, J., Brown, W., Rigby, D. (2010), "Agglomeration economies: Microdata panel estimates from Canadian manufacturing", *Journal of Regional Science*, Vol. 50, Nº5, pp. 915-934.

Bertacchini, E., Borrione, P. (2013), "The geography of the Italian creative economy: The special role of the design and craft-based industries", *Regional Studies*, Vol. 47, Nº2, pp. 135-147.

Boix, R., Lazzeretti, L., Capone, F., De Propris, L., Sánchez, D. (2013), "The geography of creative industries in Europe: Comparing France, Great Britain, Italy and Spain", in L. Lazzeretti (ed.), *Creative Industries and Innovation in Europe: Concepts, Measures and Comparative Case Studies*, pp. 23-44, New York: Routledge.

Capone, F. (2008) "Mapping and analysing creative systems in Italy (1991–2001)", in P. Cooke and L. Lazzeretti (eds.), *Creative Cities, Cultural Clusters and Local Economic Development*, Chapter 14, pp. 338-364, UK: Edward Elgar.

Carlton, D. (1983), "The location and employment choices of new firms: an econometric model with discrete and continuous endogenous variables", *The Review of Economic and Statistics*, Vol. 65, pp. 440-449.

Cruz, S., Teixeira, A. (2013), "Assessing the magnitude of creative employment: a comprehensive mapping and estimation of existing methodologies", *European Planning Studies* (DOI: 10.1080/09654313.2013.822475).

Cruz, S., Teixeira, A. (2014), "The neglected heterogeneity of spatial agglomeration and co-location patterns of creative employment: evidence from Portugal", *Annals of Regional Science* (forthcoming).

Devereux, M., Griffith, R., Simpson, H. (2004), "The geographic distribution of production activity in the UK", *Regional Science and Urban Economics*, Vol. 34, Nº5, pp. 533-564.

Devereux, M., Griffith, R., Simpson, H. (2007), "Firm location decisions, regional grants and agglomeration externalities", *Journal of Public Economics*, Vol. 91, pp. 413-435.

Drukker, D., Peng, H., Prucha, I., Raciborski, R. (2013), "Creating and managing spatial-weighting matrices with the spmat command", *The Stata Journal*, Vol. 13, Nº2, pp. 242-286.

Duranton, G., Puga, D. (2004), "Micro-foundations of Urban Agglomeration Economies," in V. Henderson and J.-F. Thisse (eds.), *Handbook of Regional and Urban Economics Vol. 4*, pp. 2063-2117, Amsterdam: North Holland.

Ellison, G., Glaeser, E. (1997), "Geographic Concentration in U.S. Manufacturing Industries: A Dartboard Approach", *Journal of Political Economy*, Vol. 105, pp. 889-927.

Ellison, G., Glaeser, E., William, K. (2007), "What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns", NBER Working Paper No. 13068 (2007).

Feldman, M. (2000), "Location and innovation: The new economic geography of innovation, spillovers, and agglomeration", in G. Clark, M. Feldman and M. Gertler (eds.), *The Oxford Handbook of Economic Geography*, pp. 373-394, Oxford: Oxford University Press.

Figueiredo, O., Guimarães, P., Woodward, D. (2009), "Localization economies and establishment size: was Marshall right after all?", *Journal of Economic Geography*, Vol. 9, pp. 853-868.

Florida, R. (2002), *The rise of the Creative Class – and How it's Transforming Work, Leisure, Community and Everyday Life*, New York: Basic Books.

Florida, R. (2005), *Cities and the Creative Class*, New York: Routledge.

Florida, R., Mellander, C., Stolarick, K. (2008), "Inside the black box of regional development - human capital, the creative class and tolerance", *Journal of Economic Geography*, Vol. 8, pp. 615-649.

Fujita, M., Thisse, J.-F. (2002), *Economics of Agglomeration: Cities, Industrial Location and Regional Growth*. Cambridge: Cambridge University Press.

Guimarães, P., Figueiredo, O., Woodward, D. (2004), "Industrial location modelling: Extending the random utility framework", *Journal of Regional Science*, Vol. 44, Nº1, pp. 1-20.

Guimarães, P., O. Figueiredo, Woodward, D. (2011), "Accounting for neighboring effects in measures of spatial concentration", *Journal of Regional Science*, Vol. 51, Nº4, pp. 678-693.

Hansen, H. (2007), *Technology, Talent and Tolerance - the Geography of the Creative Class in Sweden*, Sweden: Lund University publications.

Harris, R. (2011), "Models of regional growth: Past, present and future", *Journal of Economic Surveys*, Vol. 25, Nº5, pp. 913-951.

Hoover, E. (1937), *Location Theory and the Shoe and Leather Industries*. Cambridge, MA: Harvard University Press.

Instituto Nacional de Estatística/ INE (2007), *Classificação Portuguesa das Actividades Económicas*, http://www.ine.pt/ine_novidades/semin/cae/CAE_REV_3.pdf [accessed September 2014].

Jacobs, J. (1969), *The Economy of Cities*, New York: Vintage.

Jaffe, A., Trajtenberg, M., Henderson, R. (1993), "Geographic localization of knowledge spillovers as evidenced by patent citations", *Quarterly Journal of Economics*, Vol. 79, pp. 577-598.

Krugman, P. (1991), "Increasing Returns and Economic Geography', *Journal of Political Economy*, Vol. 99, Nº3, pp. 483-99.

Lazzeretti, L., Capone, F., Boix, R. (2012), "Reasons for clustering of creative industries in Italy and Spain", *European Planning Studies*, Vol. 20, Nº8, pp. 1243-1262.

Lazzeretti, L. (2013), *Creative Industries and Innovation in Europe: Concepts, Measures and Comparative Case Studies*, New York: Routledge.

Liviano, D., Arauzo-Carod, J-M. (2012), "Industrial location and spatial dependence: An empirical application", *Regional Studies*, DOI:10.1080/00343404.2012.675054.

Manjón-Antolín, M., Arauzo-Carod, J.-M. (2011), "Locations and relocations: determinants, modelling, and interrelations", *Annals of Regional Science*, Vol. 47, pp. 131-146.

Markusen, A. (2006), "Urban Development and the Politics of a Creative Class: Evidence from the Study of Artists", *Environment and Planning A*, Vol. 38, Nº10, pp. 1921-1940.

Marshall, A. (1890/1920), *Industry and Trade*, 3rd edn. 1920, London: Macmillan.

McFadden, D. (1974), "Conditional logit analysis of qualitative choice behavior (chapter 4)" in P. Zarembka (ed.) *Frontiers in Econometrics*, pps. 105-142, New York: Academic Press.

Mellander, C., Florida, R., Asheim, B., Gertler, M. (2013), *The Creative Class goes global*, New York: Routledge.

Melo, P., Graham, D., Noland, R. (2009), "A meta-analysis of estimates of urban agglomeration economies", *Regional Science and Urban Economics*, Vol. 39, Nº3, pp. 332-342.

Miguel-Molina, B., Hervas-Oliver, J., Boix, R., Miguel-Molina, M. (2012), "The importance of creative industry agglomerations in explaining the wealth of European regions", *European Planning Studies*, Vol. 20, Nº8, pp. 1263-1280.

Puga, D. (2010), "The magnitude and causes of agglomeration economies", *Journal of Regional Science*, Vol. 50, Nº1, pp. 203-219.

Scott, A. (2006), "Creative Cities: conceptual issues and policy questions", *Journal of Urban Affairs*, Vol. 28, Nº1, pp. 1-17.

Scott Long, J., Freese, J. (2006), *Regression Models for Categorical Dependent Variables Using Stata - Second Edition*, College Station, Texas: Stata Press.

Silva, E., Teixeira, A. (2011), "Does structure influence growth? A panel data econometric assessment of "relatively less developed" countries, 1979–2003", Industrial and Corporate Change, Vol. 20, Nº2, pp. 457-510.

Tödtling, F., Lehner, P., Trippl, M. (2004), "Knowledge intensive industries, networks, and collective learning", *SRE-Discussion 2004/02*, Department of Urban and Regional Development, Vienna University of Economics and Business, Vienna.

Appendix

The theoretical framework of our discrete choice model is based on the Random Utility Model (RUM) (McFadden, 1974; Carlton, 1983). Here, it is assumed that a firm/ plant i ($i = 1,\ldots, N$) chooses its location among a fixed set of J alternatives of location. Selecting a particular site $j = 1,\ldots, J$, each firm i obtains a profit of π_{ij}.

Profits are not observable, and the profit function, linear in the parameters, can be written as it follows:

$$\pi_{ij} = \boldsymbol{X}_j \beta + \boldsymbol{Z}_i \gamma + \boldsymbol{\varepsilon}_{ij} \quad \text{(A1)}$$

where $\boldsymbol{X}_j$ is a vector of alternative-specific regressors (attributes of choices), $\boldsymbol{Z}_i$ a vector of case-specific regressors (attributes of firms), and $\boldsymbol{\varepsilon}_{ij}$, a random disturbance.

Firm i chooses location j over location k if and only if:

$$\pi_{ij} \geq \pi_{ik}, \forall\, k \neq j,\ k = 1,\ldots, J \quad \text{(A2)}$$

Associated with the RUM theoretical approach is the Conditional Logit Model (CLM) (Carlton, 1983) that has been commonly applied as the econometric setting to estimate the coefficients and relevant parameters in the choice location behaviour of firms (Arauzo-Carod et al., 2010; Guimarães et al., 2004). The main advantage of the RUM-CLM is that it can be used as a theoretical framework and also be empirically applied to extensive databases at a micro level (Arauzo-Carod et al., 2010).

It is assumed that the disturbances $\boldsymbol{\varepsilon}_{ij}$, which represent the non-observed effects (firms' idiosyncrasies/ unobserved choice features), follow a Weibull distribution and are independent and identically distributed across firms and alternatives (McFadden, 1974). The probability that the firm i chooses alternative j is given by:

$$P_{ij} = \Pr(\pi_{ij} \geq \pi_{ik}, \forall\, k \neq j,\ k = 1,\ldots, J) \quad \text{(A3)}$$

In the case of the Conditional Logit Model (CLM),

$$P_{i\,j/k} = \frac{\exp\left(\boldsymbol{X}_{ij}\,\boldsymbol{\beta} + \boldsymbol{Z}_{\boldsymbol{i}}\,\boldsymbol{\gamma}_j\right)}{\sum_{\boldsymbol{k}=1}^{J} \exp\left(\boldsymbol{X}_{ik}\,\boldsymbol{\beta} + \boldsymbol{Z}_{\boldsymbol{i}}\,\boldsymbol{\gamma}_k\right)} \quad \text{, with } j = 1,\ldots, J \text{ alternatives} \quad \text{(A4)}$$

Given the general case of the standard CLM:

$$P_{il} = \frac{\exp\left(\boldsymbol{X}_{il}\,\boldsymbol{\beta}\right)}{\sum_{\boldsymbol{k}=1}^{J}\exp\left(\boldsymbol{X}_{ik}\,\boldsymbol{\beta}\right)} \quad \text{is the probability of choice of locating at location } l \tag{A5}$$

and

$$P_{im} = \frac{\exp\left(\boldsymbol{X}_{im}\,\boldsymbol{\beta}\right)}{\sum_{\boldsymbol{k}=1}^{J}\exp\left(\boldsymbol{X}_{ik}\,\boldsymbol{\beta}\right)} \quad \text{is the probability of choice of locating at location } m \tag{A6}$$

then, the ratio of the probabilities of locating at *l* versus *m* is given by:

$$\frac{\boldsymbol{P}_{il}}{\boldsymbol{P}_{im}} = \frac{\exp\left(\boldsymbol{X}_{il}\,\boldsymbol{\beta}\right)}{\exp\left(\boldsymbol{X}_{im}\,\boldsymbol{\beta}\right)} = exp[\,(X_{il} - X_{im})\,\boldsymbol{\beta}\,] \quad \forall\, l \neq m \tag{A7}$$

which reveals a uniform pattern of substitutability between location choices and depends on the characteristics of locations *l* and *m*. If the probability ratio between any two location alternatives is given by expression (A7), then that ratio equals to ***exp(β)*** when we consider a unit change, between alternatives, in the explanatory variable ***X*** (Scott Long and Freese, 2006).