ESSAYS ON CULTURAL AND CREATIVE INDUSTRIES: CLUSTERING, LOCATION AND EMPLOYMENT GROWTH

Lina Maddah

UNIVERSITAT
ROVIRA i VIRGILI

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Lina Souheil Maddah

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PH.D. DISSERTATION

Supervised by

Josep-Maria Arauzo-Carod

Department of Economics

UNIVERSITAT ROVIRA i VIRGILI

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FAIG CONSTAR que aquest treball, titulat **"Essays on Cultural and Creative Industries: Clustering, Location and Employment Growth"**, que presenta **Lina S. Maddah** per a l'obtenció del títol de Doctor, ha estat realitzat sota la meva direcció al Departament **de Economia** d'aquesta universitat.

HAGO CONSTAR que el presente trabajo, titulado "**Essays on Cultural and Creative Industries: Clustering, Location and Employment Growth**", que presenta **Lina S. Maddah** para la obtención del título de Doctor, ha sido realizado bajo mi dirección en el Departamento **de Economia** de esta universidad.

I STATE that the present study, entitled "**Essays on Cultural and Creative Industries: Clustering, Location and Employment Growth**", presented by **Lina S. Maddah** for the award of the degree of Doctor, has been carried out under my supervision at the Department **of Economics** of this university.

Josep Maria Arauzo Carod - DNI 38123372K (TCAT)

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Reus,

Els directors de la tesi doctoral
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To you, and mama, I dedicate this thesis!

Table of Contents

Chapter One

Introduction and Summary of the Thesis

1. Introduction

What is it that makes people happy? A general question that by no means I aim to answer in this thesis. Nonetheless, wrapping up three years of extensive research in my Ph.D. and writing down this introduction, I figured I've been researching, *economically*, industries that make people happy, *socially*. Departing from theories on regional economics, local development, urban growth, economic geography, industrial districts, location theory, and spatial spillovers, I explore Cultural and Creative Industries (CCIs, hereafter). The last two decades have witnessed a growing interest in appraising the contributions of CCIs to economic development. The latter being a wide branch that involves disaggregated dimensions ranging from employment growth as a core economic conception to more social dimensions among which is the notion of the *economics of happiness*. Departing from a political urge, and call, mainly in developed countries for the inclusion of CCIs in local development agendas, I present this thesis as a piece of work that serves this specific purpose. Such a call cannot be built but on a profound understanding of CCIs, departing from a common definition of the sectors, assessment of their economic contributions and consequently providing recommendations for designing a well-informed sustainable development model, targeting their role in the economic and social cohesion.

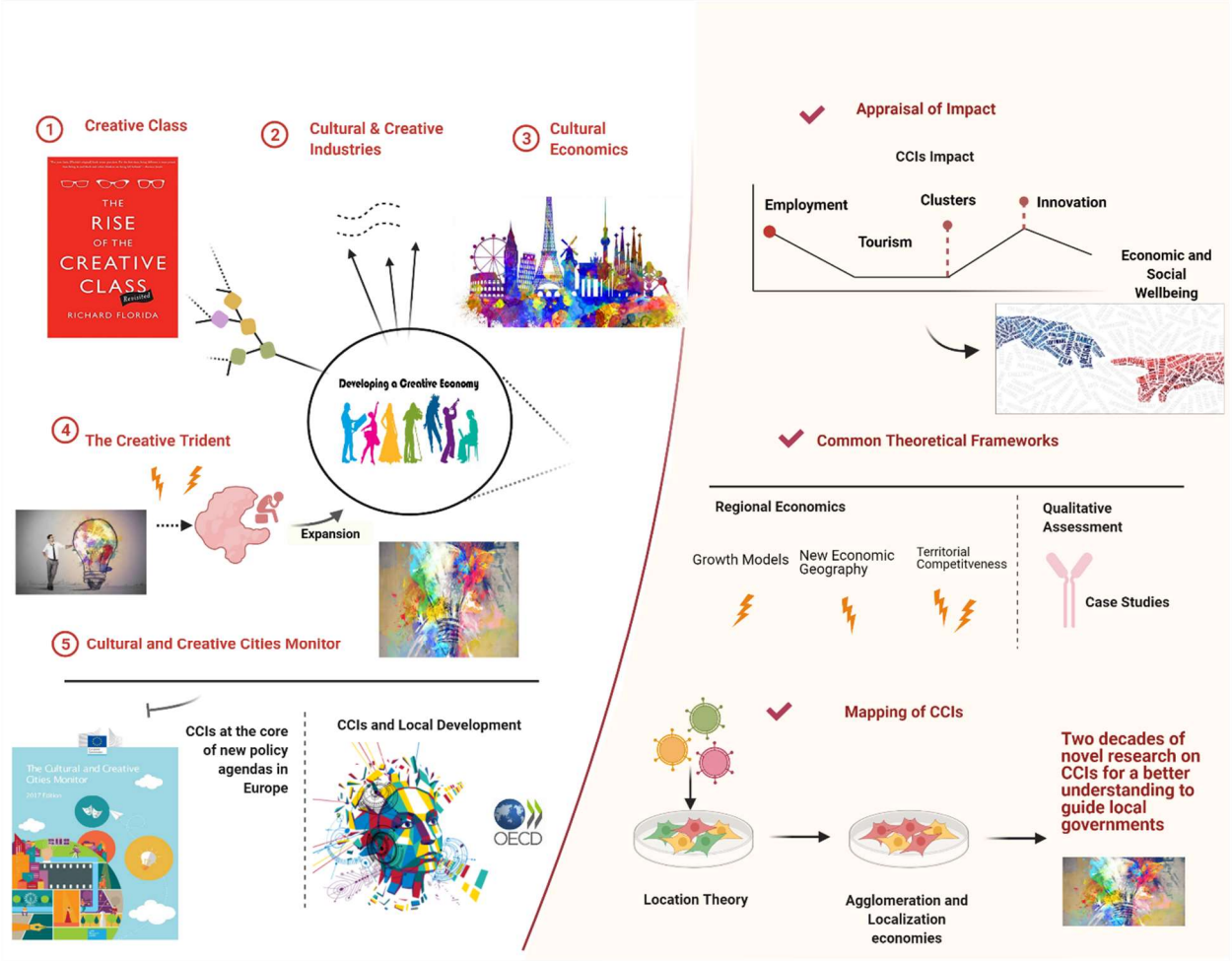
"*After a year of pandemic-induced lockdowns, there couldn't be a better time to appreciate the creative economy*" (UNCTAD, 2021). CCIs, being at the core of the creative economy, are hit the hardest by the pandemic corollaries. This leaves a significant impact on employment, mobility, livelihoods, and CCIs' value chains (from suppliers to service providers) all over Europe, and the rest of the world (UNESCO, 2021). CCIs are at a crossroad now, and despite their fragility at the moment, those sectors prove to be fundamental for the individual/social well-being (back in 2018, 81% of internet users in the EU used the internet for music, videos, and games according to EY Consulting (2021)[1] and for the economic transformation in the hopefully better coming years. In this thesis, I assess the effect of CCIs as these industries were before the pandemic and are expected to be again. The contribution of this thesis remains feasible for policy implications on employment, creative cluster policies, and smart specialization

[1] The European Grouping of Societies of Authors and Composers (GESAC) commissioned EY teams to produce a report on the state of the cultural and creative industries (CCIs) in Europe. EY, previously known as Ernst & Young is one of the largest professional services networks in the world.

The presence of CCIs is not a novel phenomenon, however, the emphasis on CCIs as key economic players is trending given that CCIs have recently started to be incorporated in the agendas of the OECD and EU Commission. The focus on creativity and culture as core development tools have taken numerous forms/directions and "CCIs" is not the only term circulating in research. Other shared expressions are the *creative economy* by the UNCTAD and the *creative class,* since 2002, as introduced by Richard Florida in his book "The Rise of the Creative Class" (Florida, 2002). The author favors the significance of the creative class in driving urban and regional growth that has since been taken up by policymakers and academics in the field. Pier Luigi Sacco investigates *cultural economics* and argues that culture leads to coordination of horizontally integrated soft innovation processes, the creation of new forms of knowledge-intensive active citizenship, and the definition of new standards of wellbeing, to name but a few of its effects (Sacco *et al*., 2013). In prominent research conducted by Higgs *et al.* (2008), the concept of the *creative trident* was developed, bridging together CCIs and creative occupations. Furthermore, Coll-Martínez and Arauzo-Carod (2017) demonstrate the positive role of the "*creative milieu*" in attracting new firms. In a similar strand of research Boix *et al*. (2015) explore the *creative clusters* in major European metropolitan areas. Among others, the mentioned concepts and developments in research commonly reinforce the role of creativity in developed economies (Figure 1). With innovation being a key competitiveness indicator, CCIs play a leading role in countries where associated frameworks are intensively increasing as public policies for sustainable development consider CCIs both an enabler and main instrument to achieve allocated goals.

Additionally, though it is beyond the scope of this thesis to measure the social impact of CCIs, I cannot move forward without highlighting this role. "*CCIs are generally inclusive*", a major argument made by the (UNDP, 2019). Those sectors contribute to social inclusion, women empowerment, socio-economic progress, and sustainable human development (UNDP, 2019; UNESCO, 2017).

Figure 1. Academic Researchers and Policymakers: Scope of Work on Creative Economy



Source: Own elaboration.

In their recent report[2] on CCIs' assessment in the European context (the latest similar report being in 2014 (EY Consulting, 2014), EY Consulting (2021) reveals some interesting statistics on CCIs, that reflect on the industries' capabilities and economic contributions. By the end of 2019, the core activities of CCIs had a turnover of €643 billion and a total added value of €253 billion, accumulating 4.4% of EU GDP in terms of total turnover. The report highlights that the economic size of CCIs is larger than that of forceful industries in the EU, such as "the telecommunications, high technology, pharmaceutical or the automotive industry" (EY Consulting, 2021, p.2). The effectiveness of an industry's performance in the economy is as well commonly explained by its ability to create jobs and stimulate innovation.

[2] Rebuilding-europe.eu. 2021. *Rebuilding Europe: The cultural and creative economy before and after the COVID-19 crisis*. [online] Available at: <https://www.rebuilding-europe.eu/> [Accessed 2 February 2021].

Entrepreneurship activities in industries and the development/attraction of new creative jobs boost economic growth through introducing novel technologies and fostering innovative performance resulting in knowledge networking. According to EY Consulting (2021) [3] CCIs employed more than 7.6 million people in the EU-28 by the end of 2019 and created additional 700,000 jobs including authors and creative workers since 2013 (EY Consulting, 2021, p. 2).

Numerous authors and policymakers have emphasized the importance of CCIs as drivers of economic growth. In this sense, CCIs play a significant role in local development (OECD, 2018), economic development of nations (Nathan *et al*., 2015) regeneration of cities and fading urban economies, and employment growth (Lee, 2014, and Piergiovanni *et al*., 2012, among others). Additionally, CCIs also have a positive impact generated from multiplier effects (Murzyn-Kupisz and Działek, 2017), can robustly influence innovation in the wider economy (Bakhshi *et al*., 2013; Lee, 2014; Potts, 2009) and contribute to digital developments (Landry, 2008) and the development of clusters, tourist attractions and creating a positive image and recognition (Navarro *et al*., 2014).

Despite the growing research in CCIs, findings are both mixed and scarce. As only a small number of empirical work evaluates the impact of CCIs on employment, their spatial distribution patterns, and firms' location decisions at a local level, this area remains relatively unexplored despite the need for a more detailed understanding of the relationship between CCIs and economic growth. Unfortunately, research on the effects of CCIs suffers from extreme heterogeneity of the activities/occupations included and geographical areas, the specific focus, and demand v. supply effects. Therefore, I present in this thesis three individual papers: **Paper [1]** Cultural and Creative Industries as Drivers of Employment Growth at Local Level in Catalonia, **Paper [2]** Detection of Geographical Clustering: Cultural and Creative Industries in Barcelona and **Paper [3]** Location patterns of Cultural and Creative Industries: Role of Clustering[4].

[3] In EY Consulting (2021), only ten CCIs are included (Advertising, Architecture, Audiovisual, Books, Music, Newspapers and magazines, Performing arts, Radio, Video games, and Visual Arts). This is in line with the UNESCO's definition, and differs from that of DCMS (2001) and UNCTAD (2010), and from this thesis as well, as the former definition excludes creative activities such as fashion manufacturing, jewelry and design. However, EY (2021) remains the only recent source that provides a complete report on the assessment of the CCIs situation in EU-28.

[4] Details on the findings and contribution of each paper is presented in Section 3 of this introductory chapter

The common features among the three papers are (1) the exploration of industry-specific CCIs (not only CCIs agglomerated altogether), (2) the focus on the spatial agglomeration at the local level, and (3) the building block being the field of regional economics. Independently for each of the three papers, I present a supporting literature review on preceding findings on the following relevant dimensions: (1) CCIs as drivers of economic growth, (2) CCIs and clustering theories, and (3) location theory and location decisions of firms. The provided literature rests at the heart of Regional Science, the field that started to gain popularity since 1956 as articulated in the work of Walter Isard (Isard, 1956). Since then, the incorporation of the spatial aspect in the Economics discipline has developed. More recently, the concept of spatial economic theory has been further emphasized in the "Regional Economics" book by Roberta Capello in 2007 where Mashisha Fujita argues that "young economists are trying vigorously to push forward frontiers of research with the intent of elucidating ways to successfully merge the new economic geography with endogenous growth theory" (Capello, 2007, p.XV). I thus follow this path, also I approach the CCIs' investigation, departing from a major new-Marshallian and neo-Schumpeterian literature (Capello, 2007; Hanusch and Pyka, 2007) assuming that local externalities are fundamental for the production and innovative capacity of firms.

More specifically, Paper [1] studies the effect of Cultural and Creative Industries (CCIs) on generating employment growth in Catalonia at a local level between 2001 and 2011. Besides the traditional ordinary least square regression, this paper employs a quantile regression technique. This technique gives insights into the effects of the determinants on different types of municipalities in Catalonia, revealing an urban/rural difference. Paper [2] investigates the spatial distribution of CCIs in the Functional Urban area of Barcelona (FUAB). This paper studies the geography of CCIs for the years 2009 and 2017. This is done by the use of spatial scan statistics, and a novel geographical detection tool: SaTScan (Kulldorff, 1997). The application of this method allows the identification of significant clustering at a local level. Doing so enables the assessment of the evolution of clusters over time and their life-cycle. Paper [3] studies the determinants of CCIs location decisions: the location patterns of firms and the role played by existing clusters of these industries (identified in the previous paper). The paper aims to identify if clusterization of CCIs provides strong locational advantages for entering firms or if, on the contrary, firms also consider not clustered areas. To this end, several count data models are estimated.

The three papers of this thesis add to the existing empirical literature the evidence on the impact of CCIs on employment growth at the local-level, clustering, and determinants of firms' location decisions. This is accomplished by the adoption of a novel data set at a very detailed geographical level, that enables to control for the effects related to firms, to all branches of the CCIs in which the firms operate, and lastly, also for the characteristics of the geographical regions where the firms are located. The industry-specific analysis, a combination of spatial scan statistics with various econometrical methods, enables to alleviate the heterogeneity of firms and municipalities.

Section 2 provides a background on the data compilation process and discusses the econometrical and measurement strategies and statistical techniques. Section 3 provides broader summaries of the three papers included in this thesis.

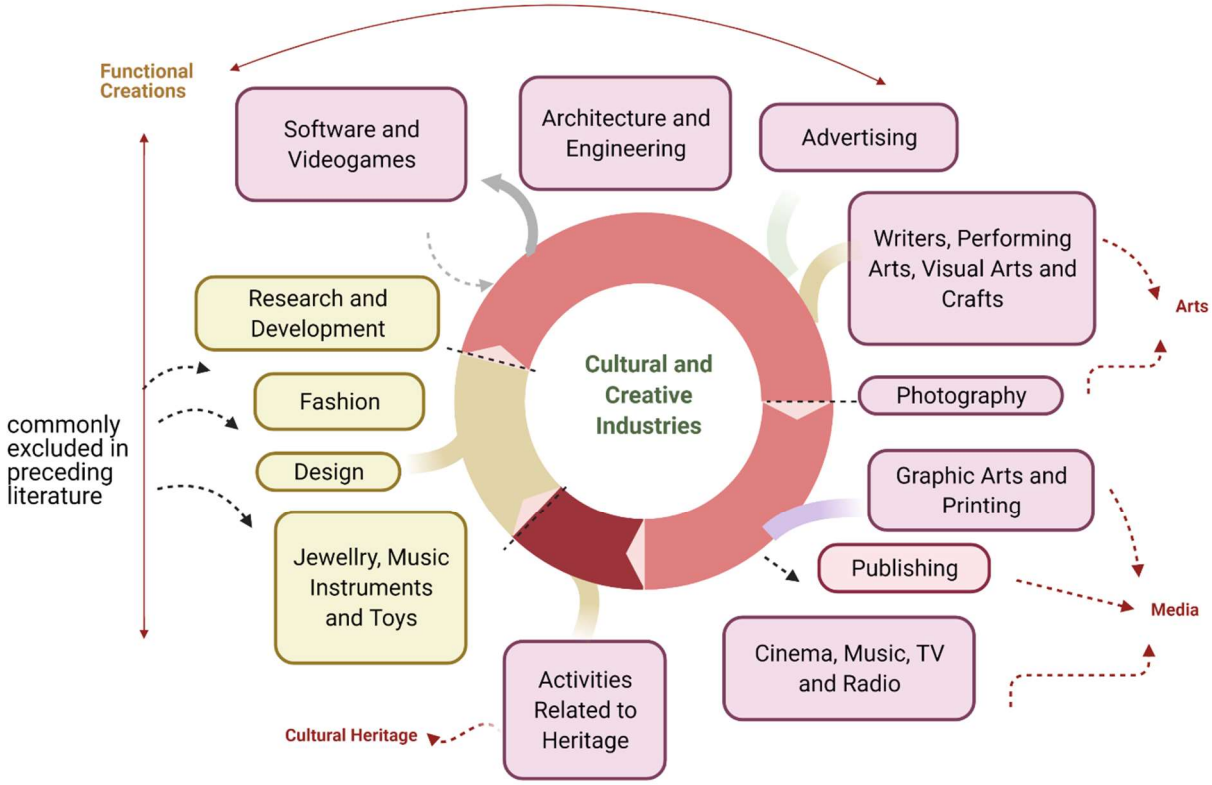
2. Data, Measurements, and Methodological considerations

2.1 Datasets

I start with the data on CCIs' classification. As mentioned earlier, researchers and policymakers identify and categorize CCIs in various ways, depending on the actual purpose of evaluation, data availability, and geographical context (see Sánchez-Serra, 2016 for a detailed analysis). For the purpose of this thesis, CCIs are grouped under thirteen industries (Figure 2) common for the three papers, except that the Design Sector is excluded in Paper [1] because of data limitations. For Paper [1] the data is obtained from the IDESCAT (Catalan Statistical Institute), and the Census of Population and Housing for, 2001 and 2011, from the INE (Spanish Institute of Statistics). The census is a statistical operation performed every ten years by INE, which provides a headcount of the population residing within the territory of a particular country and its geographical distribution. Territorially speaking, it provides information at a municipal (including census tracts and districts) and county level, as well as for Catalonia. The 2001 Population Census used, for the first time, the CCAE-2009 (acronym for Classificació Catalana d'Activitats Econòmiques). Furthermore, industrial sector in which firms operate is identified with a 4-digit level of the CCAE-2009, which corresponds at 4-digit level to the European standard NACE rev.2. I use this correspondence to identify sectors following NACE rev.2, homogenously throughout the thesis. To this end, I construct a dataset for Paper [1] on

total employment and CCIs employment, along with other municipalities' data, inclusive of 943 Catalan municipalities (Catalonia has 948 municipalities, but I dropped out 5 of them because of lack of data).

Figure 2. Cultural and Creative Industries'Identification



Source: Own elaboration, definitions on CCIs are adapted from DCMS (2001, 2013) and UNCTAD (2010).

For Papers [2] and [3] I use the annual reports of Spanish firms that form a basis of the compiled micro-level datasets. This data is provided by SABI (an acronym for Iberian Balance Analysis System) that collects economic information on an extensive list of businesses in Spain. SABI collects data from the Spanish Mercantile Registry, where firms have to deposit their balance sheets on an annual basis[5]. It is a unique web tool developed by INFORMA D&B in

[5] SABI is the most common database to analyze firms' location distribution for the Spanish case, although it has some limitations, such as size coverage (i.e., it focuses mainly on medium-sized and large firms) and the profile of firms (i.e., it is about firms' headquarters, not about firms' establishments).This means that for firms with more than one establishment, as provided by SABI, cannot be disaggregated to the single establishments and the information are ascribed to that establishment, registered as firms' headquarters. Obviously, having disaggregated information for all

collaboration with Bureau Van Dijk, and provides data on over 2.7 million Spanish companies. The biggest advantage SABI has is that individual firms are geo-referenced at their latitudinal and longitudinal coordinates. As the methodology in Papers [2], and relatively in Paper [3], is merely geographical, this type of data is fundamental for the execution of the analysis. Furthermore, the industrial sector, in which firms operate, is identified with a 4-digit level of the European Standard NACE rev.2. Unlike 2017, the industrial sector from SABI for the year 2009 was provided following the NACE 93 Rev.1 Classification. Therefore, I used the correspondence with NACE Rev. 2 to have a homogenous set of CCIs identified for both years 2009 and 2017. I use QGIS for the geolocation of all firms (using X-Y coordinates) and allocation of each to its relevant district. Most of the remaining municipal and district characteristics (e.g., population size, population density, income level) are retrieved/calculated from IDESCAT.

In the data compilation process, the size of the datasets was reduced in several steps. Observations with missing geographical data were dropped from the empirical analysis, in order to keep only firms with geo-referenced data. For Paper [2] only data on the spatial distribution of firms for 2009 and 2017 for the Functional Urban Area of Barcelona (FUAB) was categorized and used. For Paper [3] I include years 2010 through 2013. From this firm-level data, I conclude a dataset on entries, at the FUAB level. Again, using QGIS, all firm entries are geolocated at the municipality and districts' levels.

The above-described data reduction processes resulted in two micro-level datasets: The first dataset covers all firms, with geo-referenced data active at some point during the years 2009 and 2017. The first one is just after the economic downturn (2007) that pushed thousands of firms out of markets, whilst the second one, belongs to the beginning of the economic recovery, although the number of firms was still lower than at the beginning of the period. The dataset compromises 130,313 total firms in FUAB in 2009, among which 10,635 are firms in the CCIs (8.16%), and 98,422 total firms located in the same area in 2017, among which 8,775 belong

the establishments would allow a much more precise analysis, especially as regards the spatial distribution of economic activity. However, this bias is not presumed to be relevant given that, according to data from 2006, multi firms are over 1% of the total (Jofre-Monseny *et al.*, 2018).

to CCIs (8.94%). This dataset forms the basis of the empirical analysis of Paper [2]. The second one is employed in Paper [3] and includes firms with geo-referenced data, entering the FUAB from 2010 through 2013, with total entries of 8,730 firms (cumulative), among which 885 are CCIs and 7,845 are Non-CCIs. As well the dataset includes entries for each CCI subsector.

2.2 Measuring Employment Growth, Clustering and Location Decisions of Firms

As mentioned earlier, this thesis investigates issues related to employment growth, the spatial distribution of CCIs in FUAB, and location decisions of firms. In this sub-chapter, measurement issues related to the dependent variables of interest in the individual papers are highlighted.

Employment Growth

Employment Growth is addressed in Paper [1] of the thesis. This paper aims to assess the impact of specialization in CCIs on total employment growth in Catalan municipalities between 2001 and 2011. To measure employment growth, I use employment data for the two years. The literature is far from conclusive on what measure is best to use. However, I follow Glaeser *et al*. (1992) and use log growth rates, which are often used in economic modeling and empirical work. For example, researchers often just use the change in the log: Δ ln(Yt). The growth rates of a variable are approximately equal to the difference logarithms (Eq. 1):

$$\frac{x_{t+1}-x_t}{x_t} \approx ln(x_{t+1}) - ln(x_t) \quad \text{(Eq. 1)}$$

Furthermore, the econometrical strategy adopted in this paper, a quantile regression, is expected to perform computationally better with this variable. Employment growth distribution is far from a Gaussian distribution in this case. In particular, the distribution shows heavy tails, indicating that municipalities with extreme growth rates in Catalonia exist more often than would be the case based on a Gaussian distribution. In other words, the employment growth rate distribution highlights the presence of various outliers. Due to data limitations, this paper does not address CCIs employment growth between 2001 and 2011, and thus, considers total growth of employment, which specifically delimits the scope of the paper.

Spatial Distribution of firms/Clusters

In Paper [2] the focus is on "place". The city of Barcelona is the core of the FUAB, and the remaining 137 municipalities, are its periphery. The unit of analysis is the census tract[6]. Concretely, the FUAB is divided into 3,050 census tracts, and using GIS software, through a geocoding process based on coordinates of each firm (latitude and longitude), the total number of firms in each census tract is calculated, as well as the number of firms in CCIs. To visualize and interpret CCIs' clusters in FUAB, I propose and use a geospatial technique, the Scan-test (Kulldorff, 1997). In preceding literature, agglomerations of firms and clusters have been traditionally measured by Location Quotient or similar indices, and not merely geographical techniques (Lazzeretti *et al.*, 2008). Among the geographical typologies commonly applied for cluster identification are (1) Anselin's Local Moran Technique (Anselin, 1995) (2) Point locations (the most intuitive approach for detecting agglomeration) clusters are identified as the locations with the highest number of incidents (Mateos-Garcia and Bakhshi, 2016), applied for CCIs clustering in the UK) (3) Hierarchical techniques, among which is the Nearest Neighbor Hierarchical Clustering applied by Boix *et al.* (2015) (4) Density techniques: mainly the kernel density method using GIS, applied recently for CCIs by Netek *et al*. (2019) (5) The K-means technique applied by Zhao *et al.* (2020) on a recent exploration of CCIs in Shanghai) (6) Risk-based techniques, such as the scan-test, that identify clusters in relation to an underlying base 'at risk' variable, such as population, employment (Kulldorff, 1997), or, as referred in this paper, firms in CCIs.

Despite the advantages that previous techniques provide, the scan-test approach using SaTScan, provides a novel edge in CCIs clusters' identification. SaTScan uses Monte Carlo hypothesis testing to produce a p-value for the null hypothesis that no clusters are present. With this approach, I build on the reason of clustering presented by Lazzeretti *et al*. (2012) and approach the clusters analysis in a geographical way similar to Boix *et al.* (2015). However, I complement preceding findings through the application of a novel statistical method in spatial analysis of firms. This paper is the first one to implement a risk-based technique, the scan-test,

[6]Census tract (CT) *"Secciones Censales*", represents the smallest territorial unit for which population data are available in Spain. The number of inhabitants of each CT ranges from between 1,000 and 2,500 inhabitants. We consider this spatial unit as a reference to identify spatial clusters. Latitudinal and longitudinal coordinates (centroids) were assigned to each CT and the distance between two CTs was defined as the distance between centroids.

to CCIs' cluster analysis, and among the few to explore this methodology in the study of industrial agglomeration in general, following López and Páez (2017).

Location Decision of Firms

The purpose of Paper [3] is to understand how industry-specific clusters of CCIs in 2009 (identified in Paper [2]) may modulate the location decision of firms. The dependent variable is the number of new firms located in one of the 137 municipalities of FUAB plus the 10 districts of Barcelona city, between 2010 and 2013. Thus, the location decision of firms in CCIs is examined. The key consideration in this paper is defining a measurement of entry. Frequently, in relevant empirical studies, the two measures of entry are net entry (gross entry minus gross exit) and gross entry. In contrast to net entry, gross entry measures the number of entering firms independently from exiting firms. In some cases, the *net entry* accounts for only a tiny fraction of *gross entry (Brandt, 2005)*. Considering the purpose of this paper, gross entry measure is preferred, which is the strategy followed as well by most studies on location analysis. Only entering firms are counted, based on information on the firm's establishment date from SABI (derived from the firms' Annual Reports in the Spanish Mercantile Register). Firms with gaps in their reports or missings in establishment dates and geolocation were dropped from the study. Similar to Paper [2], all firms are geocoded and located using QGIS, and only firms within the FUAB are kept.

2.3 Methodological considerations and econometrical methods

Paper 1

The role of CCIs' specialization in employment growth in Catalonia is examined in Paper [1]. The econometric strategy consists of three stages: first, a baseline OLS specification (Ordinary Least Squares) is estimated separately for i) all municipalities, ii) all municipalities except outliers, iii) outliers; secondly, an OLS specification focusing on sectoral specialization using subsector Location Quotient[7] (an acronym for LQ), instead of overall LQ specification is estimated; and thirdly, a Quantile Regression (QR) and an Interquantile Regression (IQR) are

[7] $LQ_i = \left(\frac{e_i}{e}\right)/\left(\frac{E_i}{E}\right)$ where $e_i =$ Local employment in industry i; $e =$ Total local employment; $E_i =$ Regional employment in industry i; $and\ E =$ Total regional employment

estimated. The popularity of QR in academic research estimating growth econometric models has increased over the past decade. As mentioned earlier, the heavy-tailed shape of the employment growth distribution has numerous consequences for the estimation strategy. At a local level, the exploratory analysis confirms that the distribution of employment growth in Catalonia does not exhibit characteristics of a normal distribution. Small municipalities show immense employment dynamism in relative terms, while this is not the case for larger municipalities, and Barcelona specifically, which has the lion's share of total employment in Catalonia.

Accordingly, the analysis in this paper departs from an OLS to identify the effects of the CCIs' specialization over employment growth in the "average" municipality in Catalonia; yet as pointed above, an "average" municipality in Catalonia hardly grows in terms of employment. This explains why the OLS specification is estimated separately for three categories of municipalities. Then the sectoral LQ OLS specification allows for the analysis of each CCI subsector separately. Another methodological choice undertaken is the inclusion of the spatial lagged explanatory variable. To account for spatial dependence in CCIs, the spatially lagged variables for specialization at the subsector level, are incorporated in separate models. Using both highly disaggregate spatial units and spatial lagged variables helps to tackle endogeneity problems.

To this end, given the employment growth variable characteristics, the quantile regression is deemed suitable as the latter has major advantages over OLS in interpreting employment growth at a local level: (1) QR is more robust to outliers[8] and therefore, it performs better in heavy-tailed distribution as emphasized by Cameron and Trivedi (2010) that median regression is more robust to outliers than mean regression (p.205), and (2) QR permits to disentangle the effects of the explanatory variables (i.e., CCIs specialization and industry-specific specialization) on different parts of the employment growth distribution. Hence, QR is handful for building a more complete picture that provides information about the outcome *y* and the regressors *x* at different points in the conditional distribution of *y* (Cameron and Trivedi, 2010, p. 205). Thus, for example, the specialization in CCIs can be examined for municipalities in the upper 10% of the employment growth range. As a result, we can specifically understand

[8] It is assumed that an observation (i.e., municipality) remains in the same (growth) quantile of the distribution during the period under investigation (Cameron and Trivedi, 2010)

how specialization in CCIs could have a different impact on a municipality based on where its employment growth is located in the distribution.

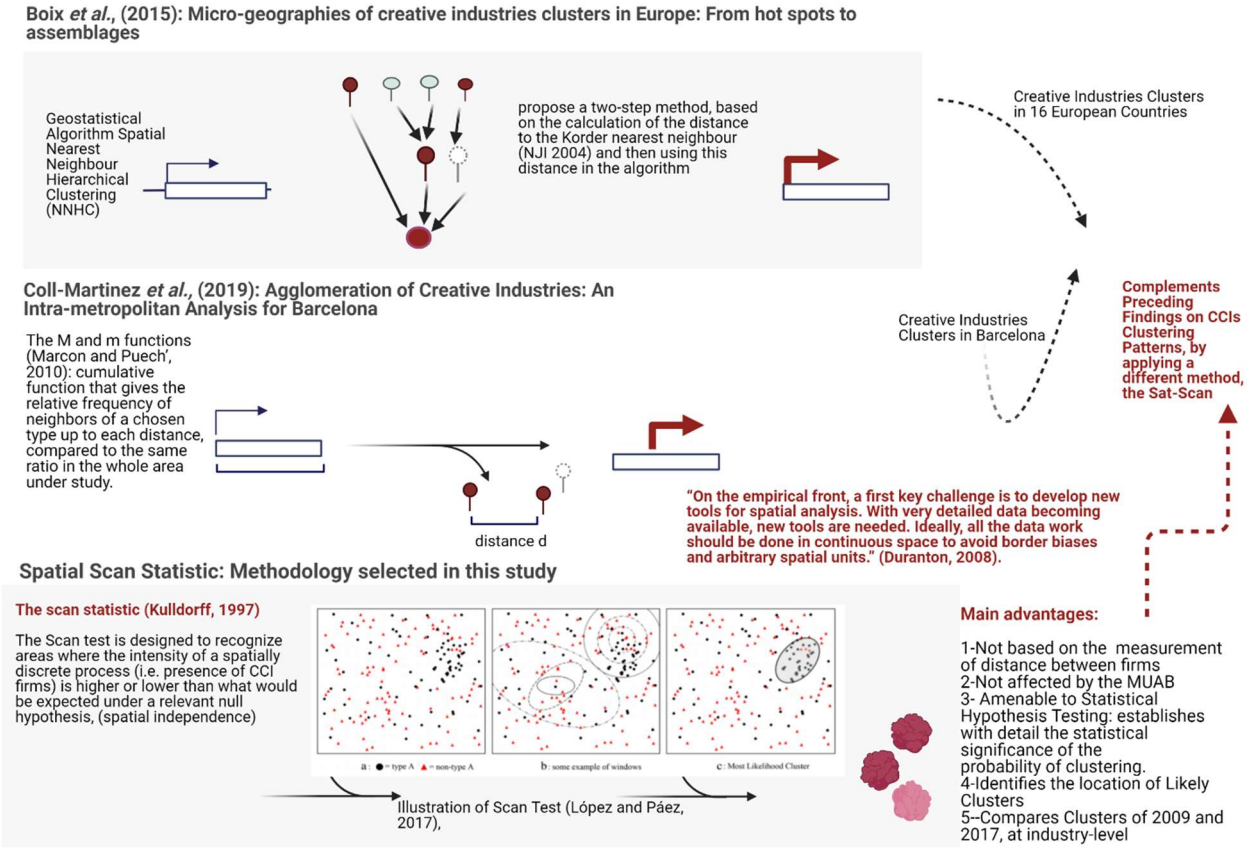
Paper 2

In Paper [1] the degree of specialization in CCIs is measured by the Location Quotient which is one of the commonly used measures for spatial agglomeration[9] (e.g., Lazzeretti *et al.*, 2012, for CCIs in Italy and Spain). Despite being a useful statistical measure, geographical characteristics do not play any role in its calculation, as criticized by Arbia (2001). Similarly, López and Páez (2017) argue that such measures have major shortcomings, mainly (1) they discretize space into a set of geographical units, thus causing the eminent Modifiable Areal Unit Problem (MAUP) and (2) most of them do not otherwise use the spatial dimension of data. Essentially in CCIs literature, I mention two studies that have tried to overcome such problems through the application of more accurate geographical analysis: (1) Boix *et al*. (2015) applied the nearest neighbor clustering algorithm (NNC), and (2) Coll-Martínez *et al.* (2019) applied the *M* and *m* functions. These two insightful approaches refer to what Arbia (2001) has termed as "third-generation methods", which are measures that explicitly consider geographical information.

In this paper, I apply an alternative spatially explicit approach, in line with Arbia (2001), and following López and Páez (2017) the Scan-test methodology compliments preceding literature on CCIs agglomeration, mainly through exploiting a newly-used method in the analysis of industries' agglomeration and clusters identification. Methodological details are provided in Figure 3. This method offers numerous advantages: (1) it is capable of precisely detecting clusters (Most Likely Clusters and Secondary clusters) (2) it is amenable to statistical hypothesis testing[10] (López and Páez, 2017), and (3) it is not distance-based and the reference used is the geographic concentration of CCIs firms relative to all firms. Additionally, the novel contribution of this paper is that it presents and analyzes the "trends" of CCIs clustering, as the study covers two years, 2009 and 2017. All outcomes from SaTScan are then exploited using QGIS.

[9] Other commonly used indices in literature are the Ellison-Glaeser index (Ellison and Glaeser, 1997) and the Gini coefficient, among others.
[10] The significance level is essential to test whether this local excess of events (in this case the existence of CCIs firms) is the product of mere chance or not (Kulldorff, 1997).

Figure 3. Methodological Considerations: NNHC, *M* and *m* Functions, Scan-test



Source: Own elaboration.

Paper 3

In Paper [3] the location decision of firms, modulated by the previously identified clusters (from Paper [2]) is examined. The dependent variable is the number of firms entering a spatial unit (municipality/district), which is a discrete non-negative integer. To estimate a possible relationship between clusters' existence and firms' entries at a local level, and given the nature of the dependent variable, the study follows the preceding research on the location of firms (see Arauzo-Carod *et al.,* 2010, for a review about empirical location literature). For modeling the discrete outcome, as the first methodological consideration in this paper, I employ count-data models in conducting this empirical analysis. The descriptive statistics of the dependent variables show signs of overdispersion and zero inflation, as a matter of example, zeroes scored an average of 50% for entries at industry-specific CCIs. But this wasn't the case for the entries of total firms and non-creative firms. According to Cameron and Trivedi (1998), count-data models have the capacity to deal with the "zero problem". This problem is very common in studies on firms' entries, mainly those which estimate entries in a highly disaggregated spatial

unit (Arauzo-Carod, 2008). Still, considering municipalities/districts which are not receiving any entry is essential as this provides relevant information because the characteristic of these units (mainly the existence of a CCI cluster/or not) can help to explain why they have not been chosen by any firm to locate (i.e., spatial units where y=0). Otherwise, the results will be biased. The structure of the count-data models allows the handling of both positive and zero entries given that both types of dependent variables contribute to the estimation (Cameron and Trivedi, 1998). Another main methodological concern when using a CDM to analyze location patterns is to follow one of the two potential schemes (Arauzo-Carod, 2008; *Guimarães et al.,* 2003): *i)* to consider that location decisions are taken according to a vector of variables shared by all entrants ($z_{ij} = z_i$), and *ii)* to consider that location decisions are taken according to a vector of variables shared by groups of entrants ($z_{ij} = z_{ig}$) for g = 1, 2,…, G, where G is the number of groups). In this paper grouping of entrants is done using the specific CCI to which each firm belongs, although CCIs are also considered altogether, as well as non-CCIs as all firms.

In the selection among count data models, the departure point is the Poisson Model (PM). This model has an advantage in dealing with the excess zeroes problem, however, has limited capabilities in dealing with "overdispersion" (the variance > the mean). As the descriptive statistics in this paper specify that there is an overdispersion problem, there are mainly two potential solutions: 1) apply the Negative Binomial model (NBREG) or 2) maintain the conditional mean assumption E(ylx) = exp(x'β), and in this case, one can proceed to use the Poisson maximum likelihood estimator (MLE) to obtain a robust estimate of the variance-covariance matrix of the estimator (VCE) (Cameron and Trivedi, 1998, p.556).

Accordingly, the following approaches are chosen: (1) The Poisson Maximum Likelihood estimator for the dependent variable *All Firms entries* (2) The Zero-Inflated Negative Binomial model (ZIPM) for *CCIs entries* and *industry-specific entries*, and (3) The Negative Binomial Regression model (NBREG) for *Non-CCIs entries*. The results of models are quite similar; however, based on the Akaike information criterion, the favored model for entries is selected. On a final note, similarly to Paper [1] to control for the spatial dependence, the spatially lagged variable of the existence of CCI cluster, and then for the existence of subsectoral clusters is incorporated in the model.

3. Summary of the Papers

Paper [1]:

"Cultural and Creative Industries as Drivers of Employment Growth at Local Level in Catalonia" (*co-authored with Josep-Maria Arauzo-Carod*)

Paper [1] analyses the role played by cultural and creative industries (CCIs) in employment growth in Catalonia between 2001 and 2011. This is a novel approach as, differently to most of the previous contributions, several profiles of municipalities (i.e., small, medium, and large) and CCIs subsectors are considered. Hence, the motive for concentrating on spatial analysis is an observed lack of enough empirical research on CCIs' role in employment growth, especially at a local level (Collins and Cunningham, 2017; Escalona-Orcao *et al*., 2016).

In general terms, the literature shows two types of results regarding the effect of CCIs on employment growth. The first argues that these industries act positively on the economy as a whole, while the second identifies certain heterogeneous effects depending on urban/rural profiles. To contribute to this literature, as mentioned earlier, the ordinary least squares regression is combined with a quantile regression technique, to estimate this relationship.

The results indicate that specialization in CCIs does not boost employment growth in all circumstances, but only for high-growth employment areas. The unequal spatial distribution of the effect of specialization on employment growth suggests that CCIs may play a role in job creation in rural and peripheral areas (predominantly small outlier municipalities). This is a novelty given the lack of analyses about that profile of municipalities, and departing from additional findings on heterogeneous effects of CCIs subsectors, policy measures regarding CCIs should be more selective and focus on these industries/areas where there is a potential effect over employment.

Furthermore, the results corroborate those of Lee (2014) in the UK that creative industries drive employment growth in other sectors; however, when only urban areas are considered, CCIs do not increase employment. Also, the results of this paper fit with the findings of (Lazzeretti *et al*., 2017), for Italy in the sense that the positive effects of CCIs are limited to certain industries. Yet, the results contradict Mossig (2011) on the capacity of rural areas to channel CCIs specialization into overall employment growth. Given the Catalan context and the data timeframe, Jacobs' externalities (diversification among all sectors) are not found to be capable

of generating employment growth at a local level opposing to existing literature (Bishop and Gripaios, 2009; Glaeser *et al*., 1992; O'Connor *et al*., 2018).

These findings suggest that CCIs, have a role to play in remote areas which can surprisingly, sometimes, provide a better CCI environment for generating employment growth than urban cities. This contributes to preceding literature on the importance of remote areas having their particular behaviours or channels to expand creativity and economic development (McGregor and Gibson, 2009) and that CCIs in remote areas can also help develop social networks and interconnections among workers (Harvey and Groutsis, 2014), which assumingly strengthens their ability to attract the creative class. Furthermore, this conclusion confirms arguments by Escalona Orcao *et al*. (2016) that the presence of creative activities in a remote area is both an indicator and a determinant for its development, an argument that can essentially guide policymakers in rural development.

The results thus propose that, given heterogenous industry-specific characteristics among CCIs, the cultural and creative workers, and workers in general, can be attracted to small remote cities which offer a variety of qualities/incentives that cannot be found in urban environments, such as residential affordability, creative environment and attractive landscapes (McGranahan *et al*., 2010), a more relaxing lifestyle (Towsend *et al*., 2017), and a better quality of life as it provides a context for workers to afford expression of identity (European Commission, 2009).

Hence, the findings can complement viewpoints that some creative firms (and their employees) are establishing a strong relationship with rural places (McGranahan and Wojan, 2007) and that small cities are also successful in attracting creative workers (Denis-Jacob, 2011) who themselves, in turn, exploit local and new knowledge and build external connections that attract other workers. Janc *et al.,* (2020) argue that those creative workers are mostly "young people" starting a new life in rural parts, opening new creative firms which are small in scale and might drive job creation. This reflects that the characteristics of an outlier municipality, accompanied by a strengthened presence of CCIs can develop the rural creative economy.

Thus, the major contribution of this paper is that it challenges predominant arguments that creative economy is strictly related to urbanization (Kozina and Clifton, 2019), and hence, I argue, in line with Scott *et al.* (2018) that the potential of small and rural regions needs to be revisited around their economic development potential, and given that creativity is an inherent feature of rural communities, its role on the whole economy is yet to be exploited. Furthermore, the potentialities of CCIs should be carefully analyzed by taking into account specific industries

and spatial units, given that the expected effects are quite heterogeneous in the combined industry/space dimension. It is important to clarify that this paper is not diminishing the potential effects of CCIs in urban areas but trying to precisely specify the conditions under which these positive effects can arise.

These results can be useful in their application in the development of rural creative economies to complement urban ones. Despite the urban bias found in the literature, neglecting smaller and rural areas is a serious shortcoming because of the urgent need to disentangle the economic mechanisms operating in these industries. This is a key point since public investments favoring CCIs are very appealing nowadays, but it is not at all clear whether all these investments can be justified, or whether they should be focused on more specific areas (i.e., not always urban ones) in which the expected returns could be much higher.

With this being said, the thesis proceeds by shifting analysis from general to specific, i.e., from Catalonia into the Functional Urban Area of Barcelona (FUAB) considering core and periphery municipalities to identify alternative patterns of CCIs, not in terms of employment generation, but more into clustering and location decisions of firms, a branch which bridges economic geography and location decisions of CCIs and has implications on policies allocated to economic development, urban planning, innovation and knowledge transfer in the region (Paper [2] and Paper [3]).

Paper [2]:

"Detection of Geographical Clustering: Cultural and Creative Industries in Barcelona"
(co-authored with Josep-Maria Arauzo-Carod and Fernando López Hernández)

Although several studies have made contributions on CCIs clustering (Lazzeretti *et al.*, 2008; De Vaan *et al*., 2012; Boix *et al*., 2015) there exists a need to understand how clusters change, grow or decline and what processes influence their geographical concentration and knowledge embeddedness, with a variety of theoretical efforts and empirical means (Boschma and Frenken, 2006; Lorenzen and Frederiksen, 2004). This is an initial attempt to identify CCIs clusters' evolution over a period of time, to understand their lifecycle and progression. Though the benefits of clusters have been assorted in preceding literature (Marshall, 1920; Porter, 2008; Delgado *et al.,* 2010), this paper attempts to fill an existing gap in understanding those patterns for CCIs by exploiting Kulldorff's scan statistics approach using SaTScan as an additional

input to existing work on "third-generation methods"[11] for identifying significant industrial agglomeration.

Based on the previously explained methodology, the results show that CCIs firms tend to cluster, especially in core or urban areas (e.g., in and around Barcelona) in line with (Boix *et al.,* 2015; Coll-Martínez *et al.,* 2019). This is logically relevant provided that Barcelona city, offers a cultural and creative climate conducive to their development. This finding further validates the preceding discussion on the importance of the quality of place and urban locations (Gong and Hassink, 2017) and cultural heritage in attracting CCIs (Mommaas, 2004).

Within the context of geographical locations, results contribute to the understanding of structural differences at the subsector level in terms of clustering. More specifically, symbolic knowledge-based subsectors (media and art-related activities) significantly cluster in and around Barcelona city, mainly driven by the necessity for such type of firms to be closer to the center results from their increasing need to regularly interact face-to-face. This emphasizes the role of the specialized spatial context in which the actual exchange processes and interactions take place (Fleming and Frenken, 2007) particularly for the case of creative industries like media or cultural industries which concentrate in single cultural city quarters (Scott, 2004). Hence, the very "fluid" environment of the economies of cities (Scott, 2010) like Barcelona, shows that firms and workers that make them up come together in social networking and continuous contact which helps unleash diverse innovative synergies.

Furthermore, the results from other patterns identified reveal a role that shall not be underestimated, for periphery areas of the FUAB (again highlighting the distant areas as in Paper [1]). Mainly, analytical knowledge-based industries such as the Research and Development (R&D) cluster outside the main city while Software and Videogames take a sub-urbanization approach while sustaining its core cluster in the city center. This sort of sub-urbanization can be explained by the characteristics of the periphery municipalities that show

[11] Literature on industrial agglomeration classifies the clusters' analysis methodologies into three generations (Chain *et al.,* 2019): *i)* the first generation assesses whether the concentration of industry *x* is above/below other industries, or overall activity (e.g., the Location Quotient and Gini coefficient), *ii)* the second generation compares the concentration of industry *x* with the one obtained if the location of economic units follow a random pattern (Ellison and Glaeser, 1997), and *iii)* the third generation methods are allocated to more geographically explicit techniques that overcome the modifiable areal unit problem (MAUP) (see detailed analysis in Boots and Getis (1988) and Arbia *et al.* (2010))

obvious interaction among cluster actors (e.g., public institutions, research centers, and universities). The results confirm prevalent arguments on how localization economies form an inducive infrastructure for the attraction of tech firms and the development of spin-off dynamics (Caragliu *et al.,* 2015; Asheim *et al.,* 2017). Similar findings on periphery-oriented clusters correspond mainly to Architecture, Fashion, Graphic Arts, and Jewellery. Noticeably, locational behavior has something to do with the previous economic activities carried out at the local level (i.e., path dependence), factor endowment, and the creative "atmosphere" that attracts and retains certain activities, mainly manufacturing ones. This is in line with Bain (2016) who argues that creative clusters are also flourishing outside the core of cities, and these areas are no longer necessarily "uncreative zones". Likewise, the findings validate the arguments on the significant role of periphery urban areas "outside the more privileged foci of production, work, and social life" (Scott, 2010, p. 29). Explicitly, the sustaining cluster of fashion is similar in its context to Third Italy (Becattini, 2002). Accordingly, though the importance of big central cities shall not be underestimated, still periphery areas with productive capacities shall be highlighted. Hence, the argument by Evans (2005) that the cultural quarter has a stronger magnetic effect than Marshallian 'knowledge and technology clusters' (p. 74), can be challenged calling for more attention to differentiate among the knowledge bases of specific CCIs to be able to assess their linkage preference towards a cultural heritage or other industry-specific requirements.

Within the context of cluster lifecycle, clustering patterns are quite stable in the short and medium-term. This reflects that the majority of the clusters identified in 2017 are in their growth and mature/sustaining stages evolving from already established ones in 2009, with exceptions to the presence of new *embryo* clusters (emerging): (1) the emerging cluster of R&D can be explained in the context (Zucker *et al.,* 1998) emphasizing the importance of a strong scientific base as a prerequisite for the emergence of a cluster and (2) the emerging cluster of fashion, also in the periphery, can be related to the need for manufacturing plants to construct in remote areas to avoid congestion effects (Klepper, 1997; Klepper, 2007), also the increasing codification of knowledge in manufacturing firms in the maturing industry (which is the case of fashion firms in Catalonia) decreases the necessity for those firms to be near the places where this knowledge is created. What those results imply is that the embryo/emerging clusters can be better explained in the interrelation between the specific industrial demand for infrastructure that induces technological innovation on one hand and location (municipality) supplies on the other.

Furthermore, the results show that the core of FUAB also has the potential for attracting new firms/industries not previously agglomerated there. Architecture and Engineering is one example of an emerging cluster in the core. As this industry merges a synthetic and symbolic knowledge base, it is not surprising that it also needs locations for informal interaction (face-to-face communication) and buzz generated from the cultural habits and norms and the social networking that influences, and is influenced by, the architecture in the city. As well it provides a closer interaction with customers and suppliers. Correspondingly is the case for the photography emerging cluster.

Another contribution to existing literature and a novel one from this study is from cluster lifecycle analysis. The clustering patterns over a period of nine years reflect that the maturity of an existing cluster or the emergence of a new one is not a "coincidence" and can be rather explained by understanding the local environment and the related variety among CCIs at the subsector level. This reinforces the argument of Boschma and Wenting (2007) that locations with older but related industries have a higher likelihood of forming a cluster. With this being said, the findings confirm two major economic claims (1) Jacob's claim on the development of new work on the basis of old work as a 'branching' process that is fundamental to the way that economic growth happens in cities (Hospers, 2006) (2) Schumpeter's claim on how economies evolve through the process of new innovation and path *interdependence*, not only dependence (depending on the knowledge base of the CCI subsector).

Clusters' evolution shows that clusters change in size, shrink (an example is the advertising clusters spatial boundaries leading to more localized sectors) or expand (the cinema, music, Tv, and radio clusters that merged into a larger one incorporating geographically proximate neighborhoods and districts). This process reveals linkages to knowledge flows within and outside the cluster, suggesting that knowledge embeddedness can either widen the spatial boundary of a cluster or narrow it down. Mature and sustaining clusters evolve in shape and geographical orientation as the elliptic shape of the cluster changes, or transforms. Strong and growing clusters can integrate previously unconnected economic activities in distant or adjacent areas into the cluster and, in doing so, enlarge their spatial boundaries, a finding in line with Menzel and Fornahl (2009). This trend can be explained in the context of related variety (Frenken *et al.,* 2007) which characterizes the heterogeneity among CCIs yet their perceptions' interrelation which provides that social proximity can maximize the potential for

learning opportunities. Moreover, the findings again emphasize the heterogeneity among CCIs and challenge the general argument in literature that there is a tendency of CIs to conglomerate being consistent *wherever they locate* (Coll-Martinez and Arauzo-Carod, 2017; and Currid and Williams, 2010) as the results imply that there are important synergies between some creative sectors, but not others. This is in line with (Chapain *et al.,* 2010) as conglomeration patterns depend on the particularity of the knowledge base of the industries. Also, findings reveal in line with Menzel and Fornahl (2009) that the cluster lifecycle is prone to local particularities and not merely a local depiction of industry lifecycle.

The paper further provides some insight on the role of policy intervention through general evidence of several programs that were selected for general scrutiny (@22 district, Barcelona Art Factories, Disseny Hub Barcelona, and The Creative Research park, among others). The role of institutions and local policies is highlighted and is assumed to modulate the sustaining and emerging clusters in the core of FUAB. Although from the results it is not possible to identify the specific nature and direction of the relationship between previous public intervention/funds and the firms inside CCIs clusters, there is empirical evidence suggesting their positive role over the development of creative clusters (Turok, 2003; and Foord, 2009), so it is reasonable to assume that these patterns apply also for the case of Barcelona.

Paper [3]:

"Location patterns of Cultural and Creative Industries: Role of Clustering"
(co-authored with Josep-Maria Arauzo-Carod and Fernando López Hernández).

Preceding literature on clustering distinguishes between spatial clustering and functional clustering (Fornahl and Hassink, 2017, and Zheng and Chan, 2014). After identifying spatial clusters of CCIs subsectors in Paper [2], Paper [3] is an extension to explore the "functionality" of those clusters in terms of their ability to influence the location decisions of CCIs and Non-CCIs firms, which in turn strengthens the inter-linkages among firms and attract creative class (Florida, 2002; Scott, 2004). Addressing this dimension is going a step forward in the literature, as spatial clustering is more valued if its capable of bridging activities and assisting entrepreneurship, and evidence can thus be translated to more effective and efficient policy instruments.

Thus, departing from previous identification of significant clusters of CCIs in Paper [2] location determinants of firms and whether entering firms are attracted to existing clusters are analyzed. Hence, the contribution of this paper to the existing literature is exploring whether clusterization of CCIs provides strong locational advantages for entering firms or if, on the contrary, firms also consider not clustered areas. The study uses firms' data from Mercantile Register (SABI), and exploits count data models in the analysis, as elaborated in previous sections.

Main results reveal that the existence of any CCI cluster in a municipality/district encourages firms of any category (CCIs and Non-CCIs) to locate in the same municipality/district. This finding emphasizes the argument on CCIs clusters' ability to foster other economic activities and not only CCIs. These results are in line with preceding findings on the association between CCIs concentration and the entry of new firms at a municipality level (Scott, 2000; Stam *et al.,* 2008) and complement the body of literature that shows that CCIs clusters have agglomerative effects, provides creative environment advantages that are highly beneficial to artists and enterprises (Mommaas, 2004; Scott, 2000).

The results also reveal a spatial spillover effect among clusters; mature clusters attract new firms to locations within the cluster itself and its neighboring municipalities/districts as well. This finding confirms the previous discussion in Paper [2] on the cluster evolution and the enlarging of the spatial boundaries of some strong and growing clusters over time and is in line with Menzel and Fornahl (2009), who explain that boundaries widen when other cluster actors (research institutes, universities, other firms) are integrated into the cluster. This is also a validation for previous analysis in Paper [2] on the role of cluster actors.

Finally, the results assert again the heterogeneity among subsectors of CCIs. For example, while the existence of an advertising cluster encourages advertising firms to locate in the relevant municipality/area, publishing firms do not exploit such locational advantages from publishing clusters. The finding is consistent with those of Heebels and Boschma (2011) who reveal that the Amsterdam cluster of book publishing industry did not function as an attractor for publishing firms. This heterogeneity in the ability of CCIs agglomeration to attract other CCIs is highlighted and reveals that even if the cluster is in the center of Barcelona, it might not have the capacity to absorb and transfer knowledge in a way that attracts similar firms. On the other hand, the findings for media-related clusters in the core of Barcelona are matched

with Cook and Pandit (2012) who found that strong clusters in film and television sectors promote entrepreneurship. Similarly, results for the fashion cluster (in the periphery) encouraging the fashion manufacturer's entry, are in line with Randelli and Lombardi (2014) on the Florence fashion leather cluster which continues to have a positive rate of new firms, and again the Third Italy Industrial District addressed in Paper [2]. Accordingly, designing cluster-oriented policies accounting for heterogeneities among sectors and municipalities is essential. Results on related CCIs conglomeration reveal that the level of technological movement in localized learning might alter the heterogeneity of the cluster, consistent with Maskell and Malmberg (2007), however, the paper cannot provide evidence on that.

The main takeaway is that the resilience and sustainability in the clusters, is driven by various factors, the first being urban resilience "a Barcelona effect" that enhances the capacity to attract and absorb knowledge generated by institutional initiatives and proximity advantages (face to face interactions), but not for all CCIs. Still, the location decisions of firms are not fully driven by big cities *per se*; it can be further explained by related variety for some CCIs sectors, and local particularities of periphery clusters, and both path *dependence* and *interdependence*, which complements the findings of Paper [2] as well.

On a final note, the central district of Barcelona, Eixample, encourages the entry of specific industries, the graphic arts, printing, and publishing firms. Obviously, these firms are art-related and this finding supports literature emphasizing the aptitude of cultural districts to attracting art activities. This is consistent with Murzyn-Kupisz and Działek (2017) who argue that some CCI firms favor locating in inner-city areas (historic quarters) to benefit from social contacts, large flows of customers (mainly tourists) and prestigious image of the city and cultural heritages, while others prefer less prestigious periphery parts of the city, targeting local clients and benefiting from other advantages. This result highlights the importance of cultural heritage in channeling creative networks to an improved place image and creative production opportunities (Miles, 2005; Sacco *et al*., 2018).

The general takeaway is that *place* matters, the role of Barcelona, and other European cities, shall not be diminished, however, policy shall incorporate periphery and rural parts which might have capabilities in contributing either to employment growth or entrepreneurship and new firm entry. Of course, the three papers have quite some limitations and policy implications, both discussed in Chapter Five of this thesis.

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Chapter Two

Cultural and Creative Industries as Drivers of Employment Growth at Local Level in Catalonia

Paper [1] presented in this chapter is coauthored with Josep-Maria Arauzo-Carod. It has already been published in the Working Papers Collection at ECO-SOS, URV (DT 03-2021), and is under review in a journal.

1. Introduction

Do cultural and creative industries (CCIs) fulfill a role as engines for economic growth? This issue has attracted considerable attention among economists and policymakers over the last two decades as governments have started to look for "hard" evidence explaining the dynamics of these industries and their ability to boost economic activity. In the current literature there is a general argument that supports the idea that, by and large, CCIs are vital for encouraging economic growth in urban areas and regions. Theoretically speaking, there is also a debate on whether local growth is boosted by specialization or diversity between and within sectors (i.e. for all sectors) taking into account possible positive externalities and spatial spillovers. Thus, in recent years, the position of CCIs in the development agendas of the European Union has gradually shifted from marginal to more central, with an increasing number of discussions of the economic potential of these industries in terms of local development, economic growth, innovation and resilience capabilities in a post-crisis situation (OECD, 2018; UNCTAD, 2010).

Increasing funding for and investment in CCIs is also the subject of much discussion in Spain, Europe, and worldwide. The main dialogue involves their social and economic contributions and ranges from seeking a clear definition of the sectors to be termed as CCIs to defining the role they play in social and economic cohesion (noting the tangible benefits and intangible values of artistic activities). How does the composition of these economic activities within regions influence the growth of other economic activities and ultimately that of cities and regions? How important are CCIs for regional and local economic development and employment growth? Does "space" in terms of the geographical location of companies, proximity, and accessibility (infrastructures) influence the growth of industries and hide significant spatial spillovers? How can all of the above be quantified to provide a better understanding? These are just a few of the many questions raised by policymakers. As stressed by Higgs and Cunningham (2008) along with other researchers in the field, it is essential for us to accurately evaluate the contribution of CCIs to economic activity to help policymakers reflect on the key findings and then decide on the level and timing of investments, especially since, at the present time, CCIs are on the agendas of the main public administrations and economic organizations.

However, some of the above considerations about CCIs are based mainly on economic intuition and indirect rather than solid empirical evidence (Banks and O'Connor, 2009). The ability to "quantify" and empirically investigate this relationship is still limited, despite significant discussion among researchers in this field on the importance of CCIs and their respective positive impact on various dimensions of local and regional economies. Research on specialization in CCIs and total employment growth at a local level is limited as most of the contributions focus on big urban areas, neglecting smaller and peripheral ones, and this is a serious shortcoming in view of the urgent need to disentangle the economic mechanisms operating in these industries. This is a key point since public investments favoring CCIs are very appealing nowadays (due to the positive spillover effects of these activities in terms of reputation, social cohesion, and the educational level of the population, among other things), but it is not at all clear whether all these investments can be justified or whether they should be focused on more specific areas in which the expected returns could be much higher.

The contribution of this paper to the ongoing discussion is twofold. First, we investigate the impact of specialization in CCIs on total employment growth at the municipality level in Catalonia, using data from 2001 and 2011. This exploration specifically addresses the issues of agglomeration economies from an empirical point of view. Analyzing the Catalan case is of interest not only due to the lack of contributions similar to this one but also because of its geographical and economic structure –small and compact enough to allow close interactions across different regions– and the sizeable share of CCIs in terms of employment and GDP. In addition, focusing on employment growth connects with a major concern for policymakers. Since we want to develop a more complete picture of the effects of CCIs, we focus on what is happening in small- and medium-sized peripheral Catalan municipalities in addition to the capital, Barcelona. Secondly, we investigate whether the effects of local specialization in CCIs are the same across territories and industries, to identify whether there are spatial/sectorial specificities that may intensify/decrease the positive effects of these industries. This is a novel approach, since the empirical literature analyses almost exclusively large cities without considering the mechanisms that may exist in small rural areas. Finally, the role played by CCI subsectors also receives attention in this paper, to explore the existence of heterogeneity in their economic impacts.

The structure of the paper is as follows. Section 2 reviews the literature, addresses the main points raised by scholars discusses agglomeration externalities and their effect on local growth,

while section 3 details the characteristics of the dataset, defines CCIs, describes the variables, and provides some descriptive statistics. Section 4 describes the econometric strategy and discusses the main results and Section 5 concludes and suggests directions for further research.

2. CCIs as Drivers of Economic Growth

CCIs are one of the main contributors to the economy in developed countries (Higgs and Cunningham, 2008) and are considered as part of Smart Specialization Strategies (S3)**.** Their impact on economic growth has attracted considerable attention among economists and especially policymakers, indicating a desire among governments to exploit cultural and creative production in order to foster both employment and economic growth (Kourtit and Nijkamp, 2019). According to the European Commission (2016), CCIs employ, directly and indirectly, 15 million people, which accounts for 7.5% of the EU's employment workforce, subsequently making those sectors the 3rd largest employer in the EU. These figures place CCIs ahead of other industries in the EU, as it employs 2.5 times more people than automotive manufacturers and 5 times more than the chemical industry, in addition to enhancing the quality of life (European Parliament, 2016). More recently, a study conducted by the European Union Intellectual Property Office Observatory (2019) revealed that CCIs generated around EUR 509 billion in 2018, which accumulates for 5.3% of the EU's total GDP. These potentialities of CCIs arise especially from their creative side and their role in economic development (Gouvea and Vora, 2018), from the higher spending on intangibles in CCIs (Scheffel and Thomas, 2011) and their stronger growth capacity compared to other industries, as demonstrated, for instance, by Scheffel and Thomas (2011) for the case of the UK. But how to measure that? Evans (2005) suggested different measurements as increased property values/rents (residential and business), corporate involvement in the local cultural sector (leading to support in cash and in-kind), higher resident and visitor spending arising from cultural activity (arts and cultural tourism), job creation (direct, indirect, induced), enterprise creation (new firms/start-ups, turnover/value-added), retention of graduates in the area (including artists/creatives), creative clusters and quarters, enhanced production chains, joint R&D activities, public-private–voluntary sector partnerships ('mixed economy'), and investment growth (public-private sector leverage). Along similar lines, Potts *et al*. (2008) proposed and tested four models of the relationship between CCIs and the aggregate economy, mainly using data on relative growth rates, employment, entrepreneurship, income, and profit for many countries over the period of a decade. The prevailing arguments among researchers on the potential impacts of CCIs on

economic growth are inter-related and can be grouped into *i)* the role of CCIs as integral parts of local development, *ii)* the creative class, *iii)* the contribution of CCIs to innovation activities, *iv)* their clustering pattern, and *v)* their contribution to employment growth:

i) *CCIs are integral parts of local development:* This argument has made the headlines due to numerous policymaking reports and discussions, including most recently OECD (2018). Creative industries play a significant role in both the social and economic development of nations (UNESCO, 2013; UNCTAD, 2010) and the regeneration of cities and stimulation of fading urban economies (Lee, 2014).

ii) *The creative class*: One way of approaching the creative economy is to consider the creative class, a term coined by Florida (2004) who argues that the creative class is a major driver of urban and regional growth, but this claim is subject to much criticism, mainly concerning the lack of clear empirical evidence (e.g., see Vossen *et al*., 2019, for the German case), in addition to causality concerns.

iii) *The contribution of CCIs to innovation activities:* CCIs generate innovation in different ways. The general argument is that these industries are innovative in themselves and contribute to innovation in other sectors. Florida (2004) was among the first to argue that the presence of a creative class leads to the creation of new ideas and technological advances. One NESTA report by Bakhshi *et al*. (2013) reveals that CCIs can robustly influence development and innovation in the wider economy, in *all* sectors.

iv) *Clustering, positive consumption, and production externalities:* The contribution of CCIs is evident from the positive externalities resulting from their clustering and agglomeration. This translates into the expansion and growth of cultural and creative neighborhoods and districts, the creation of networks of cooperation within the creative sector through creative milieus, the easy exchange of ideas and spillovers to other sectors, and the boosting of entrepreneurial activities. Researchers also argue that workers in CCIs contribute to the growth of the "new" economy involving information technologies and digital developments, the generation of "agglomeration

benefits" (Murzyn-Kupisz and Dzialek, 2017), and the promotion of the relevant areas as tourist attractions and creating a positive image and recognition (Landry, 2008).

v) *Employment growth:* CCIs have a relevant role in generating employment and enhancing well-being (Kemeny *et al*., 2020), although typically causality is not addressed when discussing this point. In this sense, because studies over the last decade have had mixed findings, the economic implications of these industries need to be properly measured and it should be established whether they are shaped by local/regional economic, social and institutional characteristics. Considering both innovation and employment spillovers in the Netherlands, Stam *et al*. (2008) find that firms in creative industries located in urban areas are more innovative than their rural counterparts and that (except for the metropolitan city of Amsterdam) there is no spillover effect of any great size from creative industries. Lee (2014), on the other hand, argues that CCIs are indeed capable of boosting employment growth in the wider economy in the UK. These findings are consistent with the idea that the creative industries help other sectors to grow, but with reservations concerning urban areas. However, when only urban areas are considered, creative industries do drive wage growth but do not increase employment. Other findings regarding the contribution of CCIs reveal that an increase in the number of firms active in the creative industries has a positive effect on regional employment growth (Piergiovanni *et al*., 2012). From a regional employment growth perspective, Mossig (2011) investigate CCIs in the German context and finds that they have a more significant effect on employment growth in urban areas and that rural areas cannot benefit from the growth in CCIs. On the contrary, Lazzeretti *et al.* (2017), for Italy, find that creative industries *cannot* have an impact on employment growth in the wider economy.

In conclusion, the relatively modest set of research findings is both mixed and somewhat inconclusive in examining causal relationships between CCIs and the economy as a whole. As only a small number of empirical works evaluate the impact of specialization in CCIs on employment growth at a local level, this area remains relatively unexplored. Unfortunately, research on the effects of CCIs suffers from extreme heterogeneity of the data sets (i.e., there

is not yet a clear agreement about the industries and activities to be included, as highlighted by Kemeny *et al*., 2020) and geographical areas, the variables used, the specific focus, and demand v. supply effects. As far as data sets and geographical areas are concerned, empirical evidence is provided for many areas in (mainly) capitalist economies, ranging from countries to regions and cities (Lazzeretti, *et al*, 2017; Piergiovanni *et al*., 2012; Mossig, 2011; Potts *et al*., 2008 and Stam *et al*., 2008), and also for a wide typology of economic areas ranging from developed countries such as the US (Americans for the Arts, 2017) and the UK (Lee, 2014; Department of Culture, Media and Sport (DCMS), 2013) to developing countries (Ginsbourgh and Throsby, 2006).

Certainly, since the share of CCIs is stronger for developed countries (and also, therefore, its economic relevance), there are some concerns about causality between the weight of these industries and growth. Another consideration regarding this aspect is that urbanization is conducive to CCI growth (Florida, 2004). However, taking into account the general arguments on the potential of CCI concentration on local development, innovation, and the creation of positive externalities and knowledge spillovers, employment growth may be one of the resulting spillovers that enhance a region's competitiveness. It can be taken as an indicator of competitiveness and economic growth, following studies such as Stam *et al*. (2008). Bearing in mind that the analysis in this study lies at the heart of agglomeration economies, the relevant theories and empirics on urbanization, specialization, diversity, and related variety are briefly reviewed in the following section alongside the economic contribution of CCIs to help understand their "input" to employment generation. The theoretical framework for our empirical analysis is an adaptation of the approach of Glaeser *et al*. (1992) that has been commonly used by many similar studies such as Proost and Thisse (2019), O'Connor *et al*. (2018), Eriksson *et al*. (2017), Bishop and Gripaios (2009) and De Vor and De Groot (2008).

Agglomeration economies can be approached through urbanization economies, localization economies, and Jacobs' externalities. Urbanization economies involve the external factors that affect a firm located in a specific region regardless of the nature of the sector in which it operates. They are mainly reflected in population density, universities, and infrastructures including transport, which facilitate knowledge creation and thus boost innovation (Frenken *et al.*, 2007). Localization economies (also known as MAR externalities) are generated through sectoral specialization, are only available to firms operating in the same sectors, and are associated with high local levels of concentration (De Vor and De Groot, 2008). As for Jacobs'

externalities, these mainly stem from variety and diversity in the local industrial structure within a region (diversification into a bulky mix of sectors) that fosters the creation of new markets, radical innovation, and regional economic growth. A further branched concept, building on Jacobs' hypothesis, is the related variety (RV). This typology, introduced by Frenken *et al*. (2007), differs in the sense that it is not RV *per se* that influences regional and urban growth, but it is the RV between sectors that are technologically interconnected with one another that matters.

The main study that empirically assessed the effects of MAR v. Jacobs' externalities along with other local determinants of regional growth, as measured by employment growth at the city-industry level, was that by Glaeser *et al*. (1992), which was then followed by a wide range of studies that had mixed findings, as Henderson *et al*. (1995). Early findings were later thrown into doubt by Combes (2000) who concluded that Jacobs' externalities are favorable for employment growth in service sectors, while in manufacturing the industrial mix and variety reduce employment growth. De Vor and De Groot (2008) find that, at a site level, specialization slows growth. Further investigations on the impact of spatial externalities in the UK are conducted by Bishop and Gripaios (2009), who find that *i)* specialization has a negative impact on growth, *ii)* the impact of diversity is heterogeneous across sectors, and *iii)* strong local competition has a generally positive impact. Similarly, focusing on the UK's services sector, Johnston and Huggins (2017) argue that diversity and related variety have significant positive implications for regional development.

In short, although it appears complicated to come to any clear-cut conclusions on the nature of the relationship between different externalities and employment growth at a local level, this framework is considered very useful when it comes to investigating the performance of sectors/cities and their trends and economies, which will form the basis of the methodology in this study. Even if some of the previous results might be considered contradictory, this is not true if it is assumed that knowledge generation and transmission vary across industries and, therefore, the effects of spatial agglomeration (i.e., specialization vs. diversification) may also depend on industries and spatial areas considered.[12]

[12] Chung and Hewings (2019) show differences reported when analysis is conducted using US state level data or when using US county level data.

Accordingly, based on preceding literature and the aim of our analysis we put forward the following hypotheses:

Hypothesis 1 Specialization in CCIs has a positive impact on total employment growth in Catalan municipalities between 2001 and 2011, and its effect varies at their sectoral level.

Hypothesis 2 The impact of specialization in CCIs on employment growth is different between urban and rural areas of Catalonia.

3. Methodology

3.1 Definition of CCIs

Despite growing efforts to fix a widely-accepted classification of CCIs, heterogeneities are still important. Creative industries were initially defined as "those industries which have their origin in individual creativity, skill, and talent and which have the potential for wealth and job creation through the generation and exploitation of intellectual property" (DCMS, 2001, p.4). Generally speaking, most definitions follow the structure provided by the UK DCMS model (2001) and then those from the OECD (2007), UNCTAD (2008), and the European Commission (2012), but there are still controversies. Bakhshi *et al*. (2013), for example, criticized the DCMS model and called for the inclusion of a major creative sector in the shape of software design, while Lazzeretti *et al*. (2008) and Coll-Martínez and Arauzo-Carod (2017) further developed the definition, with Lazzeretti *et al*. (2017) using a narrower definition by focusing on "core creative industries." In this paper, we try to accommodate previous studies and policy-oriented reports with the nature of the Catalan context and the intensity of creative occupations in certain industries. Consequently, we consider the following cultural and creative activities[13]: fashion, publishing, graphic arts, printing, jewelry, musical instruments, toys, software, videogames, research and development, architecture and engineering, advertising, photography, design, cinema, video, music, TV, radio, writers, performing arts, visual arts, crafts, and heritage-related activities.

3.2 Geographical scope of the data

In the literature on employment growth, most studies take a regional or national-level approach (e.g., O'Connor *et al*., 2018, for Ireland; Eriksson *et al*., 2017, for Denmark and Sweden), or

[13] See Table A.1 in the Appendix.

consider county levels, looking at both metropolitan and non-metropolitan counties (e.g., Fallah *et al*., 2013, for the US), or city levels focusing on urban areas alone (e.g., Illy *et al*., 2011, for Germany). In addition to these papers, there is a branch of the literature that assumes that employment growth processes are strongly driven by agglomeration economies, which operate at shorter distances such as in counties, metropolitan areas, or municipalities.

The data in this paper refer to municipalities[14] in Catalonia[15], an autonomous region in north-eastern Spain whose capital is Barcelona. Catalan municipalities are quite heterogeneous in terms of population, employment, and urbanization, especially when compared to Barcelona. The local spatial scale has been selected due to that heterogeneity (e.g., the size of municipalities ranges from 27 inhabitants to 1.5 million) in order to capture different trends regarding the effects of CCIs over employment growth. The dependent variable measures local employment growth (in logs) between 2001 and 2011, while the independent variables refer to a number of local characteristics (measured in 2001) hypothesized to explain that process. In order to select these variables, numerous factors have been taken into account, such as the variables used in previous studies (see Table 1), the scope of this paper, data availability, and data characteristics (e.g., correlations between variables, goodness-of-fit tests, etc.).

[14]The current number of Catalan municipalities is 948, but we omitted 5 of them due to lack of data.
[15]Catalonia has about 7.5 million inhabitants (15 per cent of Spain's population) and covers an area of 31,895 km2. It accounts for 19 per cent of Spanish GDP.

Table 1. Variables used in the Previous Literature on Agglomeration Economies

Variables	Dependent Variable	Sector Specialization		Emp. Concentration	Diversity		Unrelated Variety	Competition	Urbanization Economies		Spatial Heterogeneity	Level of Human Capital		Income Distribution
	Employment Growth	LQ	Specialization Index	LQ	Other sectors' emp	Inverse HHI	Entropy	% firms/worker	Population Density	Reg/Pop Dummies	Regional Dummies	Residence/Work Ratio	High Education	Gini Coefficient
Glaeser *et al.* (1992)	✓		✓		✓			✓			✓			
Henderson *et al.* (1995)	✓		✓			✓							✓	
Combes (2000)	✓		✓			✓			✓		✓			
Bishop and Griupaios (2009)		✓					✓	✓	✓		✓			
Eriksson *et al.* (2017)	✓			✓	✓			✓		✓		✓	✓	✓
Ribeiro *et al.* (2017)	✓	✓	✓		✓				✓					
Wang *et al.* (2016)	✓			✓	✓		✓	✓						

Notes: "Employment Growth" indicates the change in the log of employment in a sector in a particular area over a period of time; "LQ" indicates the proportion of local employment accounted for by a sector in a specific locality divided by the proportion of employment accounted for by the sector nationally; "Other sectors' emp" measures the logarithmic value of total employment minus the industry class in question; "Inverse HHI" indicates the inverse of a Herfindahl index of sectoral concentration based on the share of all sectors, except the one considered; "Population Density" measures population per square kilometer; "Residence/Work Ratio" controls for the differences in qualitative functionality of municipalities (residential municipalities v. employment municipalities); and "High Education" measures the share of workers with at least a Bachelor's degree.

Source: Authors' own elaboration.

The data (see Table 2 for a description) were collected from different sources: the general employment data were obtained from the IDESCAT (Catalan Statistical Institute) and the Census of Population and Housing for 2001 and 2011 from the INE (Spanish Institute of Statistics).

Table 2. Variables: Data Sources and Descriptive Statistics

Variable	Definition	Year	Source	Mean	SD	Min	Max
Code	Municipality Code		IDESCAT				
Name	Municipality Name		IDESCAT				
Emp Growth	Employment Growth	2001 - 2011	Own calculation (based on employment data for 2001 and 2011 from the Census of Population and Housing by INE)	43.33	100.02	-78.06	1800
LQCCIs2001	Location quotient in CCIs	2001	Own calculation	0.67	0.75	0	8.08
Entropy	Diversity index	2001	Own calculation using the Geo-Segregation Analyzer (Apparicio *et al.,* 2014)	0.57	0.14	0.05	0.81
Dist_cap	Mean distance to four provincial capitals (minutes)	2001	Own calculation	86.92	23.9	0	190
University	Intermediate and advanced university degree (% of workers)	2001	Own calculation from IDESCAT	16.34	6.17	2.32	50
Smallfirms	Jobs in firms with 0 to 50 employees (%)	2001	Own calculation	83.72	23.66	0	100
Popdensity	Population density	2001	IDESCAT	380.39	1522.4	0	21020

Source: Author's own elaboration.

As we aim to estimate the local employment change as a function of local specific characteristics described below (as well as spatially weighted factors):

$$y = \beta X + \varepsilon$$

where y is the dependent variable (employment growth in general terms), X is a matrix containing all independent variables plus an intercept, and ε is the error term. The fact that the main covariate has some degree of spatial dependence renders the inclusion of spatially lagged variables since the assumption of non-dependence between cross-sectional observations is presumably not satisfied. Therefore, although most articles dealing with job creation have neglected such spatial issues, we consider that they have to be tackled.

In order to account for the spatial dependence of specialization in CCIs we need to define the spatial range of the existing interactions among municipalities. In this regard, we use a row-standardized spatial-neighbor matrix (*W*).[16] Among the various approaches that can be used – distance-based neighbors or *k*-nearest neighbours among others (Getis and Aldstat, 2004) – we assume a contiguity criterion (i.e., two municipalities are neighbors if they share a common border), but it is important to note that our results were quite robust to alternative formulations of *W* matrices. Once *W* is identified, we calculate the spatial lagged LQCCIs, and then the spatially lagged variable for each of the LQ at the subsector level (i.e., WLQ-Fashion, WLQ-Advertising, etc.). Formally, for observation *i*, the spatial lag of x_i, referred to as $[Wx]_i$ (variable Wx observed for location *i* is:

$$[Wx]_i = w_{i1}x_1 + w_{i2}x_2 + \cdots + w_{in}x_n$$

$$[Wx]_i = \sum_{j=1}^{n} W_{ij}x_j$$

Where the W_{ij} consist of the elements of the *i*-th row of the matrix *W*, matched up with the corresponding elements of the vector *x.*

Given that we assume that specialization in creative industries is a key driver of employment growth, we will first focus our analysis on several indicators of that specialization. Also, and in line with the previous literature, the econometric specifications include different vectors of variables referring to a combination of social, economic, geographical, and infrastructural factors that are hypothesized to influence employment growth. Consequently, these variables include several vectors related to *i)* agglomeration economies, *ii)* transport infrastructures, *iii)* human capital, and *iv)* market structures.

For agglomeration economies and sector specialization, we use the *Location Quotient* of CCIs (*LQCCIs*) as well as its spatial lagged version (*WLQCCIs*)[17]. We hence try to capture the spatial spillover effects, knowing that the latter is likely to be more significant as we move to smaller geographical scales as municipalities, the ones used in this paper (Chung and Hewings, 2019). The approach by Glaeser *et al*. (1992) and Henderson *et al*. (1995) was recently revisited by Francasso and Vittucci Marzetti (2018), who examine the confusion surrounding the definition

[16] Using both highly disaggregate spatial units and spatial lagged variables help to tackle potential endogeneity problems.
[17] Queen contiguity weight matrix (alternatives *W* matrices were also tested).

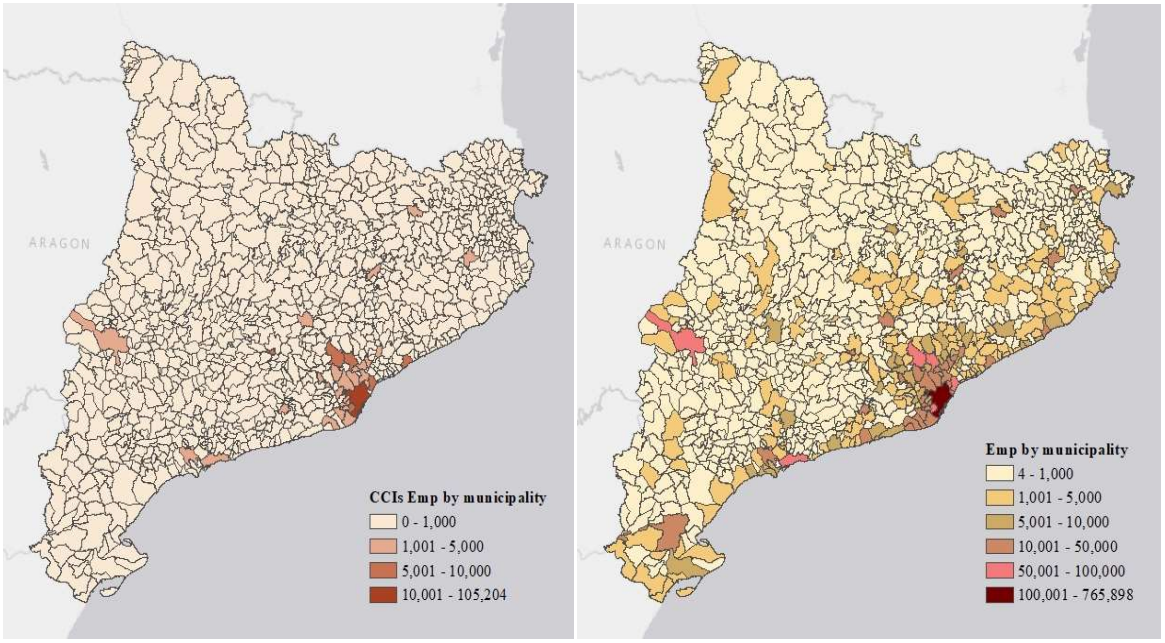
and estimation of localization economies in empirical work. Therefore, we follow their suggestion that applied researchers can "select between the size of the local industry, the specialization index and the location quotient to proxy for these externalities as far as they also encompass a correct proxy for the size of the local economy." Population density provides a proxy for the degree of urbanization and may be relevant for some activities requiring a high degree of potential interactions between firms and clients.

Transport infrastructures are proxied using the mean travelling time to the four Catalan provincial capitals (*Dist_cap*). Proximity to administrative and economic cores is needed in order to access the higher-level services mainly provided there rather than elsewhere (Guimarães *et al*., 2000) and also because the main markets tend to be there. Human capital is proxied through the percentage of workers holding university degrees (*University*); this is a key location factor regardless of the industry to which a firm belongs, since firms need a skilled workforce. Finally, market structures are proxied by using the entropy index (*Entropy*) and the percentage of workforce in firms with up to 50 employees (*Smallfirms*). The entropy index makes it possible to identify whether a municipality is homogeneous or diverse in terms of its sectoral structure (the higher the value of the index, the greater the diversity). In this regard, although there is lively debate as to whether specialization (MAR externalities) or diversification (Jacobs' externalities) is more important in terms of fostering employment growth; it seems that diversified economies may benefit from knowledge spillovers boosting economic activity, with these spillovers being quite important for skilled activities like CCIs. Company structure in terms of size also matters because areas in which SMEs predominate are more likely to see the creation of new firms and then increased employment levels (Arauzo-Carod, 2008). The correlation matrix (see table A.3.) shows that there are no major problems among variables, as the stronger significant correlations are only 0.37.[18]

In terms of the spatial distribution of these variables, figures 1 and 2 provide a clear insight into the aforementioned heterogeneities among Catalan municipalities. Figure 1 shows the spatial distribution of employment both in CCIs and in all activities; they are clearly agglomerated around the metropolitan area of Barcelona and in some other major urban areas, as is all economic activity.

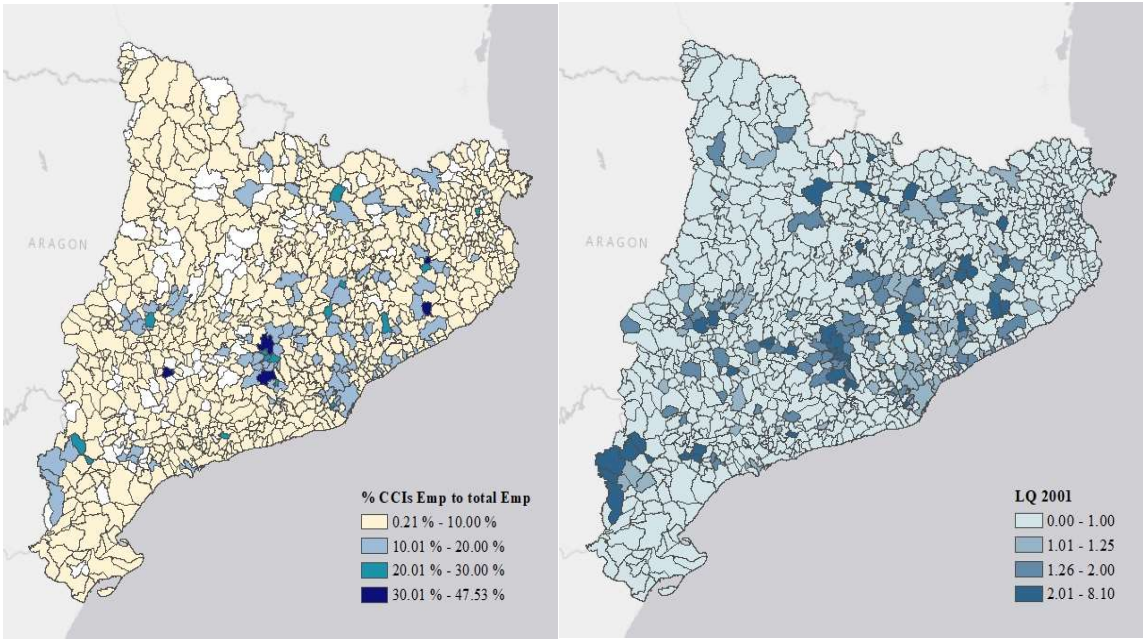
[18] Independent variables with high significant correlation among them have been removed from the specification.

Figure 1. CCIs Employment by Municipality in 2001



Source: Authors' own elaboration.

Figure 2. Degree of Specialization in CCIs in 2001



Source: Authors' own elaboration.

In view of this huge agglomeration in the Barcelona area, it would be better to focus on relative measures of employment distribution. Figure 2 shows the weight of CCIs at local level in terms of employment and also the CCIs location quotients (LQ) calculated related to employment in Catalonia. This provides a broad overview of the location patterns of employment in CCIs,

although it covers all the CCIs analyzed in this paper together, including very different industries.

4. Econometric Strategy and Main Results

The econometric strategy consists of three stages: first, a baseline OLS specification is estimated separately for i) all municipalities, ii) all municipalities except outliers, and iii) outliers; secondly, an OLS specification focusing on sectoral LQ (instead of overall LQ) is estimated; and thirdly, a quantile regression (QR) model and an interquantile (IQR) model are estimated.[19]

The use of QR is justified when trying to analyze the determinants of employment growth rates at a local level when there are enormous heterogeneities among the local units (i.e., the Catalan municipalities). QR overcomes some of the disadvantages of OLS estimations (Koenker and Bassett, 1978), since it allows for different conditional distributions to be analyzed instead of only the mean, as in the case of OLS. This strategy provides much more comprehensive results since the heterogeneity among municipalities is not captured by explanatory variables. The QR procedure divides the population into *n* parts (quantiles) with equal proportions in each of them, and this enables the relationship between independent and dependent variables inside each quantile to be analyzed rather than just the mean. In order to do this, we have estimated the results for quantiles θ = 0.25, 0.50, 0.75, and 0.90, obtaining the complete distribution of y conditional on x.

The analysis of employment growth shows very different patterns (see table 3), with small municipalities (especially those below 1,000 inhabitants) showing immense employment dynamism in relative terms while changes, albeit positive, are much smaller for larger municipalities, such as those with between 20,000 and 50,000 inhabitants, those with between 100,000 and 1,000,000 inhabitants, and the city of Barcelona. Nevertheless, the pattern is not strictly linear in terms of lower growth rates when the population increases, so there are obviously additional factors at work that help to explain this asymmetric behavior.

[19]The variance inflation factor (VIF) was measured to check for multicollinearity and all scores for the specifications and variables were below 1.25.

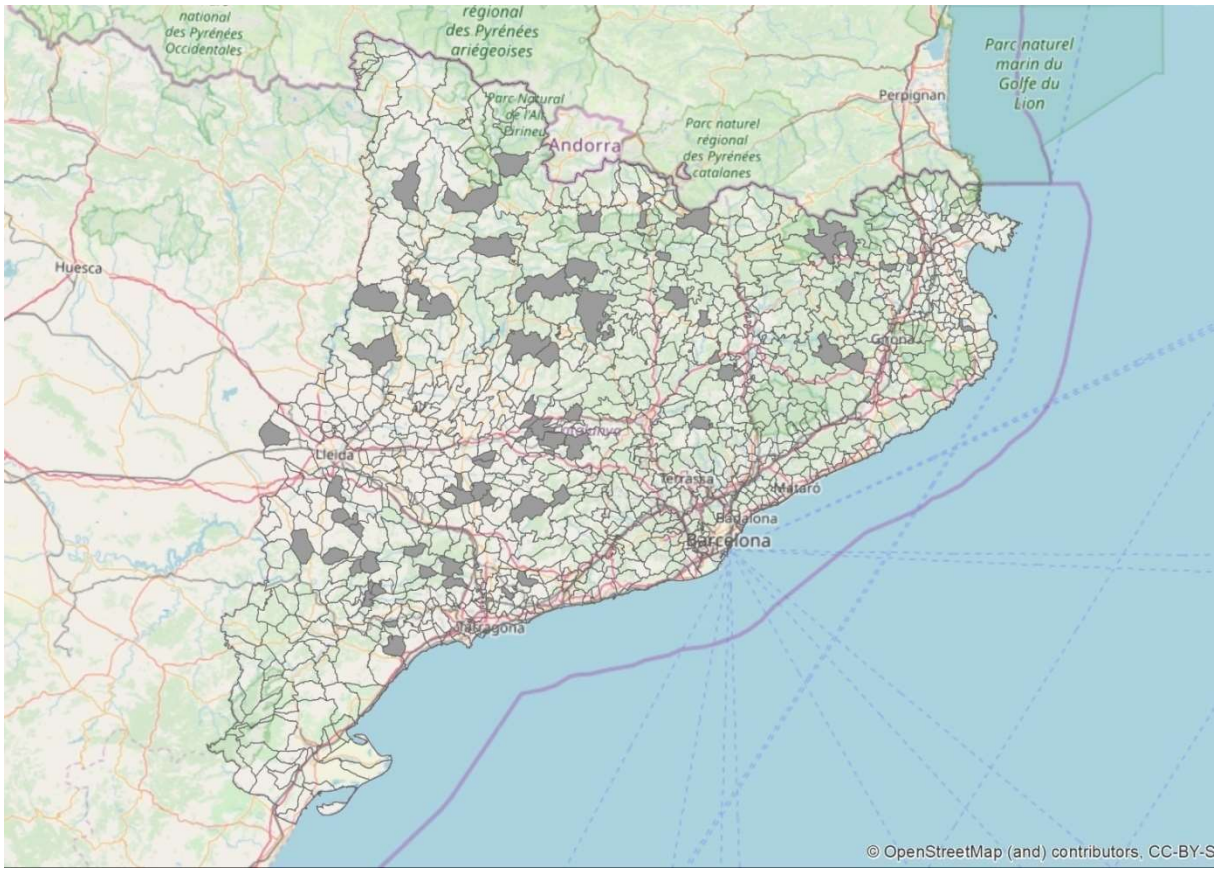
Table 3. Employment Growth and Municipality Size

	Employment growth 2001-2011 (%)	
Population	Mean	StdDev
< 1,000	65.30	127.35
≥ 1,000 &< 20,000	18.41	34.32
≥ 20,000 &< 50,000	.42	11.72
≥ 50,000 &< 100,000	6.81	19.34
≥ 100,000 &< 1,000,000	.15	13.34
≥ 1,000,000	2.08	-
Total	43.35	100.07

Source: Authors' elaboration

An initial strategy used to control for these heterogeneities is to separately regress all municipalities, all municipalities except outliers (filtered) and outliers. At this point, it is important to correctly identify the profile of those municipalities considered as outliers (see table A.3.) – they are smaller in size, covering an area ranging from 5.2 km^2 to a maximum of 145.6 km^2, with a population of 35 inhabitants being the minimum and 1,066 the maximum, with a mean of 227. Size is quite relevant in terms of explaining employment growth in relative terms because it is easier to achieve high growth rates when starting from very low levels.

Figure 3. Geographical Distribution of Outliers



Source: Authors' elaboration using an OpenStreetMap layer.

In terms of geographical distribution, Figure 3 shows that the outliers are inland municipalities spread all over Catalonia, but all of them far in distance from metropolitan Barcelona and other major urban areas. This geographical remoteness restricts the potential growth of these areas, making it more difficult to benefit from the agglomeration economies generated in the main urban areas, but at the same time this makes production costs lower, enhancing the potential for growth.

The results of the baseline OLS specification (see Table 4) show that local specialization in CCIs (*LQCCIs*) plays a different role depending on the relative local employment growth.

Specifically, when considering all municipalities, the *LQCCI* has a (small) positive and significant effect on employment growth. In contrast, the spatial lagged version of *LQCCI* has a negative effect, suggesting that there is not a clustering of municipalities where specialization in CCIs boosts total employment. The estimation for outliers corroborates this finding, as

LQCCI retains this positive and significant effect, but now *WLQCCI* becomes insignificant. Overall, these results suggest a spatially discontinuous pattern of municipalities whose employment growth is fostered by CCIs. In addition, this effect completely disappears when regressing without outliers,[20] as the *LQCCI* (and also its spatial lagged version) becomes insignificant. An interpretation of these differences highlights the existence of different growth mechanisms, suggesting that specialization in CCIs is positive for employment growth, but only in certain circumstances.

In this regard we might advance the idea of there being certain thresholds above which CCIs lead to job creation. Our results corroborate those of Lee (2014) in the UK, as the author finds that creative industries drive employment growth in other sectors; however, when only urban areas are considered, CCIs do not increase employment. Lee (2014) argues that CCIs help other sectors to grow, but may force out declining industries from urban areas. However, it is essential to recognize difference in spatial scales, as in Lee (2014) travel-to-work-areas are used, which are quite larger than the ones used in this paper, although both cover urban and rural areas.

Table 4. Baseline OLS specification

	(1)		**(2)**		**(3)**	
	All Municipalities		**Filtered**		**Outliers**	
Dependent Variable	**Employment Growth 2001-2011**					
	Coeff	**Robust Std Err**	**Coeff**	**Robust Std Err**	**Coeff**	**Robust Std Err**
Constant	**1.04*** **	(0.118)	**0.44*** **	(0.089)	**1.64*** **	(0.247)
LQCCIs	**0.06***	(0.031)	0.002	(0.018)	**0.125***	(0.048)
WLQCCIs	**-0.09***	(0.035)	-0.04	(0.027)	0.01	(0.162)
Entropy	**-1.34*** **	(0.126)	**-0.62*** **	(0.097)	**-0.99***	(0.468)
University	**0.01****	(0.002)	**0.007*** **	(0.002)	0.01	(0.009)
Popdensity	0.00	(0.000)	-0.00	(0.000)	0.00	(0.000)
Dist_cap	**-0.002****	(0.001)	-0.000	(0.001)	**-0.004*** **	(0.001)
Smallfirms	0.001	(0.001)	0.000	(0.000)	0.00	(0.001)
R-Squared	0.1990		0.0822		0.3602	
R2-A	0.1930		0.0764		0.2816	
Number of Observations	943		878		65	

Significance codes: * p<0.05; ** p<0.01; *** p<0.001.

Source: Authors' own elaboration.

[20] Outlier municipalities are defined as those where percentage employment growth between 2001 and 2011 was greater than 145%.

In general terms, the literature shows two types of results regarding the effect of CCIs on employment growth. The first argue that these industries act positively on the economy as a whole, while the second identify certain heterogeneous effects depending on urban/rural profiles. Regarding the first type of results, Piergiovanni *et al*. (2012) found an overall positive effect on regional employment growth in the case of Italy. The results of this paper fit with the second group of contributions, such as those from Lazzeretti *et al*. (2017), again for Italy, that limit the positive effects of CCIs to certain industries; from Sörvik *et al*. (2019) about CCIs as part of S3 priorities of less populated and remote areas; and from Lee (2014), for the UK. Concretely, Lee (2014) finds that creative industries drive employment growth and help other sectors grow, especially in rural areas, but with reservations concerning urban areas. Further insights are provided by Mossig (2011), for Germany, who argues that CCIs have a more significant effect on employment growth in urban areas and that rural areas cannot benefit as much. Specific geographic effects are also found by Stam *et al*. (2008) for the Netherlands, but in the opposite direction to Lee (2014), since they identify the spillover effects from creative industries occur only in the metropolitan area of Amsterdam.

Table 5. Baseline Model at Subsector Level

Models		(1) All Municipalities		(2) Filtered		(3) Outliers	
	Dependent Variable	**Employment Growth 2001-2011**					
		Coeff	**Robust Std Err**	**Coeff**	**Robust Std Err**	**Coeff**	**Robust Std Err**
(A)	Constant	**1.08*****	(0.122)	**0.47*****	(0.09)	**1.60*****	(0.261)
	LQ Fashion	-0.02	(0.012)	**-0.002***	(0.01)	0.12	(0.06)
	WLQFashion	-0.01	(0.015)	-0.00	(0.013)	-0.04	(0.046)
(B)	Constant	**1.02*****	(0.117)	**0.42*****	(0.088)	**1.51*****	(0.234)
	LQ Publishing	-0.00	(0.01)	0.00	(0.009)	-0.02	(0.027)
	WLQPublishing	-0.03	(0.025)	-0.03	(0.024)	0.22	(0.141)
(C)	Constant	**1.03*****	(0.119)	**0.42*****	(0.09)	**1.60*****	(0.230)
	LQ Graphic Arts and Printing	-0.16	(0.018)	-0.00	(0.015)	0.11	(0.085)
	WLQGraphic Arts	-0.00	(0.028)	-0.02	(0.025)	0.05	(0.133)
(D)	Constant	**1.04*****	(0.117)	**0.43*****	(0.088)	**1.54*****	(0.26)
	LQ Jewelry, Musical Instruments and Toys	-0.01	(0.012)	**-0.02****	(0.007)	-0.00	(0.003)
	WLQ Jewelry	-0.007	(0.011)	0.001	(0.009)	0.37	(0.085)
(E)	Constant	**1.00*****	(0.118)	**0.41*****	(0.088)	**1.58*****	(0.205)
	LQ Software and Videogames	0.03	(0.036)	-0.01	(0.021)	0.04	(0.091)
	WLQ Software	0.06	(0.048)	0.03	(0.040)	0.07	(0.126)
(F)	Constant	**1.04*****	(0.117)	**0.42*****	(0.089)	**1.59*****	(0.238)
	LQ Research and Development	0.00	(0.005)	-0.00	(0.003)	-0.00	(0.012)
	WLQ R&D	-0.1	(0.009)	-0.00	(0.008)	-0.00	(0.026)
(G)	Constant	**1.01*****	(0.114)	**0.42*****	(0.089)	**1.41*****	(0.245)
	LQ Architecture and Engineering	0.03	(0.022)	-0.00	(0.019)	0.04	(0.019)
	WLQ Arch&Eng	0.00	(0.032)	-0.03	(0.026)	0.12	(0.149)
(H)	Constant	**1.028*****	(0.117)	**0.42*****	(0.088)	**1.63*****	(0.261)
	LQ Advertising	-0.01	(0.013)	-0.00	(0.011)	0.01	(0.042)
	WLQ Advertising	-0.03	(0.023)	-0.02	(0.021)	-0.11	(0.152)
(I)	Constant	**1.02*****	(0.117)	**0.41*****	(0.088)	**1.57*****	(0.229)
	LQ Interior Design	0.01	(0.022)	-0.01	(0.018)	**0.03***	(0.012)
	WLQ Int Design	-0.00	(0.032)	-0.02	(0.023)	0.00	(0.085)
(J)	Constant	**1.02*****	(0.117)	**0.41*****	(0.088)	**1.63*****	(0.249)
	LQ Cinema, Video, Music, TV and Radio	-0.01	(0.025)	-0.01	(0.02)	**-0.09***	(0.041)
	WLQ Cinema	0.01	(0.043)	-0.01	(0.036)	-0.11	(0.212)

Cont. Table 5. Baseline Model at Subsector Level

(K)	Constant	**1.02*** **	(0.117)	**0.41*** **	(0.088)	**1.553*** **	(0.232)
	LQ Writers and Crafts	0.00	(0.01)	0.00	(0.001)	0.01	(0.232)
	WLQ Writers	0.01	(0.015)	-0.00	(0.013)	-0.03	(0.044)
(L)	Constant	**1.02*** **	(0.117)	**0.42*** **	(0.089)	**1.54*** **	(0.257)
	LQ Heritage	0.01	(0.004)	0.00	(0.004)	0.01	(0.009)
	WLQ Heritage	0.00	(0.012)	0.00	(0.009)	0.02	(0.032)
Number of Observations		943		878		65	

Significance codes: * p<0.05; ** p<0.01; *** p<0.001
Note: there is only one independent variable for each of these regressions.
Source: Authors' elaboration.

The results from the OLS specification focusing on sectoral LQ (see table 5) show that the role played by local specialization in CCIs is asymmetric and relies heavily on certain industries and typologies of municipalities; most of these municipalities do not really have the capacity to promote employment growth. In this regard, when considering only the effects for outliers (i.e., municipalities with great dynamism in terms of employment growth), the positive effects point solely to interior design sector while the effects for other industries are not significant at all or negative (i.e., cinema, video, music, TV and radio). Local specialization in these specific CCIs has no effect on employment growth for all municipalities; thus, the specialization positive effects appear to be driven solely by outliers.

Regarding the rest of industries, when considering all municipalities and excluding outliers, surprisingly there is a negative effect for all subsectors, except publishing, activities related to heritage, writers, performing arts, visual arts and crafts, although only significant for fashion, jewelry, musical instruments and toys. Nevertheless, judging by the previous results shown in table 4 we can suggest that there is a similar mechanism to explain these differences, such as the role played by local specialization in certain CCIs possibly varying depending on local patterns of employment growth. This is consistent with the arguments made by Combes (2000) and Johnston and Huggins (2017) on the need to distinguish between industries in order to better decode the effect of specialization. This will be addressed next investigating CCIs and noting their significant sectoral and spatial heterogeneity. Hence, aiming at more comprehensive findings given the heterogeneity in the municipalities, we have estimated as well a quantile regression model

Table 6. Quantile Regression Model

Θ	**0.25**	**0.50**	**0.75**	**0.90**
Constant	**0.43*****	**0.91*****	**1.32*****	**2.15*****
	(0.108)	(0.098)	(0.128)	(0.174)
LQCCIs	-0.01	-0.00	**0.06****	**0.12*****
	(0.019)	(0.017)	(0.022)	(0.031)
Entropy	**-0.76*****	**-1.32*****	**-1.70*****	**-2.47*****
	(0.11)	(0.097)	(0.126)	(0.173)
University	**0.01*****	**0.01****	**0.01***	0.00
	(0.002)	(0.002)	(0.002)	(0.004)
Popdensity	**-0.00****	0.00	-0.00	0.00
	(0.000)	(0.00)	(0.000)	(0.000)
Dist_cap	-0.00	-0.00	-0000	**-0.003****
	(0.000)	(0.000)	(0.000)	(0.001)
Smallfirms	-0.00	0.00	0.00	0.00
	(0.000)	(0.000)	(0.000)	(0.000)
Number of Observations	943	943	943	943
Pseudo R2	0.0554	0.1348	0.1978	0.2667

Significance codes: * p<0.05; ** p<0.01; *** p<0.001

Source: Authors' elaboration.

The results of the quantile regression model (see table 6)[21] corroborate previous economic intuition, such as the effect of *LQCCI* being significant and positive only for upper quantiles (i.e. from 0.75). This finding also suggests that although local specialization in CCIs is positive for local employment growth, the relationship is restricted to more dynamic areas in terms of job creation, which are predominantly small municipalities. As the dependent variable is measured in relative terms, the upper levels of employment growth (tend to) correspond with areas that have initially low levels of employment thereby resulting in relatively high growth spurts. From these results, therefore, it seems that specialization in CCIs has effects only for small municipalities, but not for large municipalities or urban areas. Nevertheless, these results refer to CCIs as a whole, since table 5 reports specificities at an industry level.

[21] Interquantile regressions are shown at table A.4 at the appendix.

Figure 4. OLS and Quantile Regression Coefficients

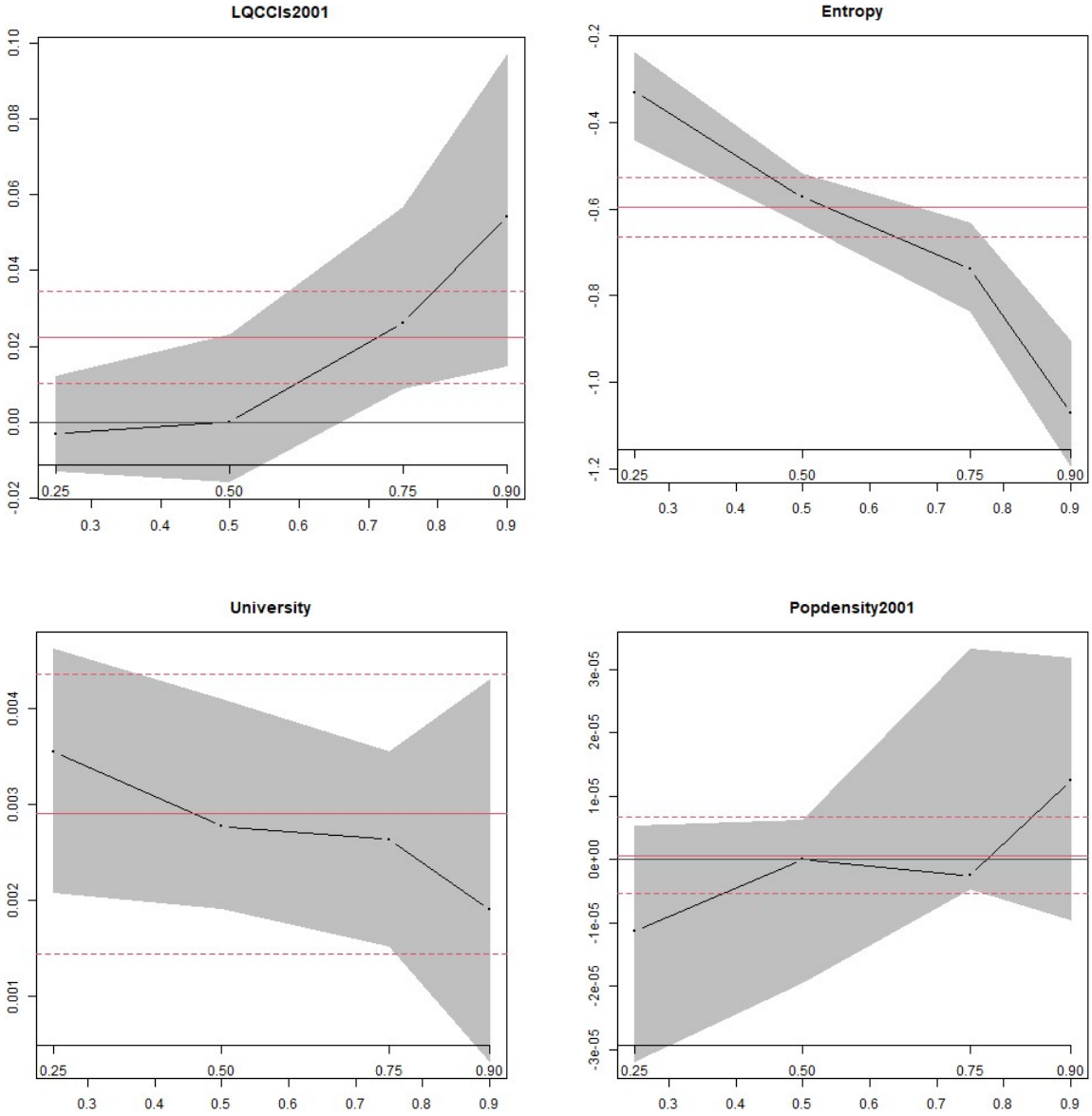
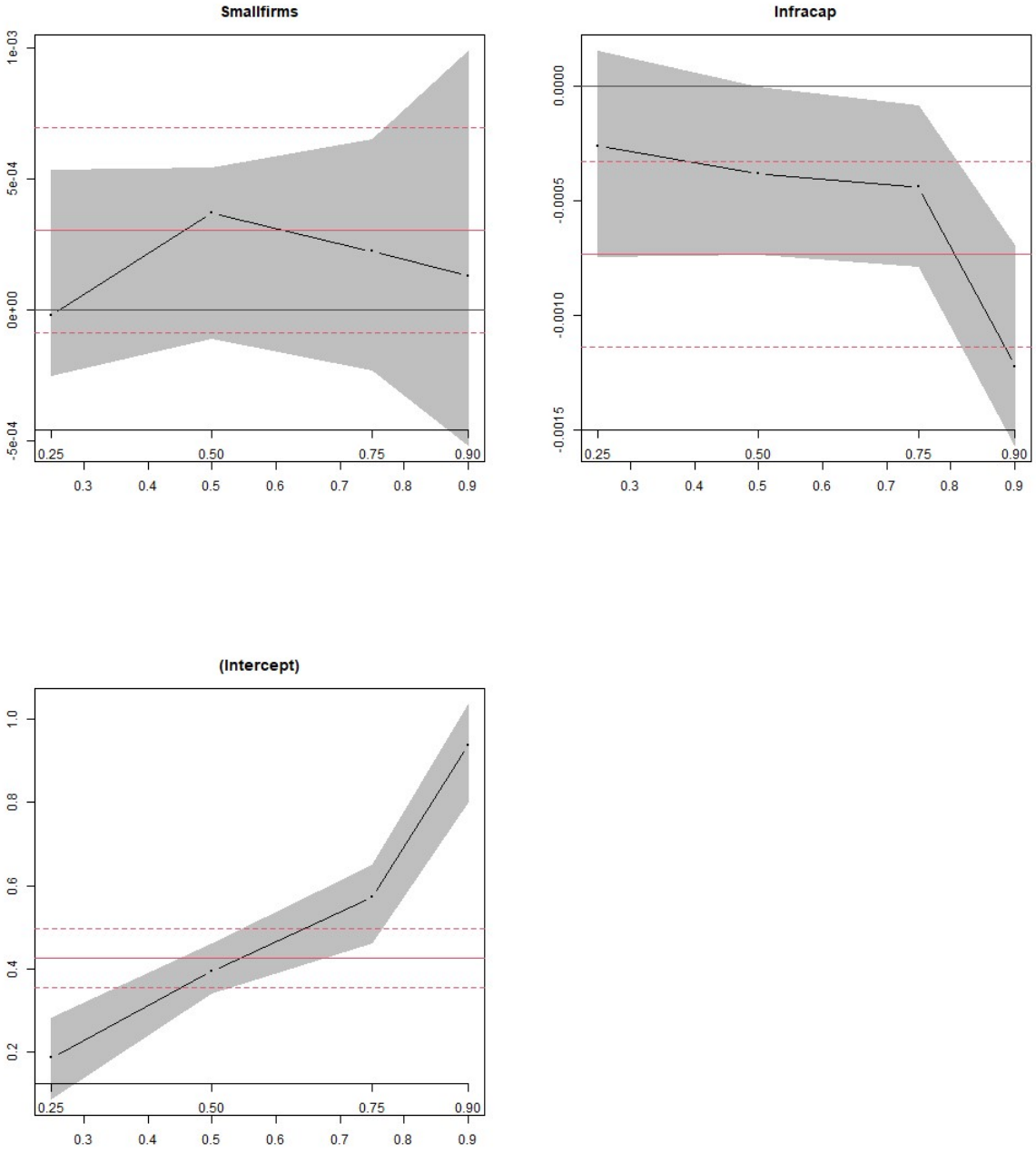


Figure 4. OLS and Quantile Regression Coefficients (cont.)



Source: Authors' elaboration.

The asymmetric roles of municipalities are easier to observe in the following figures (see Figure 4), in which both quantile and OLS coefficients are reported.[22] The interpretation of these figures (where the horizontal axis portrays quantiles and the vertical axis portrays regression coefficients) is as follows: the solid black line with dots shows estimates of the

[22] Figure 4 portrays the results of both estimation (1) in Table 4 and the estimation in Table 6.

regression coefficients for each quantile while the grey areas are the confidence intervals at 95%, and the solid red line (parallel to the horizontal axis) shows estimates of the OLS coefficient, while the red dotted lines are the confidence intervals at 95%.

The solid black line is the zero line, the reference whereby the significance of the coefficients can be appreciated as follows: given that *none* of the confidence intervals overlap with the solid black line, then this reflects a significant effect and vice versa. If we focus on the LQ variable, it is easy to see that the OLS coefficients and quantile coefficients differ greatly, especially for the lower quantiles. These findings support the use of a quantile regression strategy rather than focusing only on a specific part of the distribution. Specifically, the first graph shows that the effect of local specialization in CCIs – the *LQCCI*– increases with employment growth and that the effect is only significant for the upper quantiles (0.75) and (0.90),while for the other quantiles (0.25 and 0.50) the confidence intervals overlap with the zero line, depicting a non-significant effect. The significant positive effects in the upper quantiles may be due to the characteristics of the municipalities. As for the entropy variable, the effect is significantly negative across all four quantiles. For the rest of the variables, there is a similar effect in terms of the dissimilarity of the effect of covariates on the dependent variable depending on its distribution. The quantile regression model justifiably outperforms the linear regression in these findings, since the latter fails to capture variations in the impact of specialization and other variables relative to the characteristics of the municipalities.

Glaeser *et al*. (1992) argue that at the city-industry level, specialization hurts and diversity boosts employment growth. On the basis of our findings, we cannot completely agree with this as it applies to CCIs in Catalan municipalities for 2001-2011. As we have already mentioned, specialization in CCIs does have a positive yet heterogeneous effect among sectors and municipalities, while diversity has a negative effect. Clear examples of this include the decreasing (negative) effect of entropy, which indicates that industrial diversity (typically correlated with urban size) has a negative (and increasing) effect on employment growth that is significant for all quantiles. While a wide range of the literature finds diversity to be important for employment growth (Glaeser *et al*., 1992; Frenken *et al*., 2007; Bishop and Gripaios, 2009; Johnston and Huggins, 2017; O'Connor *et al*., 2018), our findings are in contrast to this argument, but the profile of local units (i.e., smaller) is different to previous

one. Given the Catalan context and our data timeframe,[23] Jacobs' externalities (diversification among all sectors) are not found to be capable of generating employment growth at a local level. Similarly, for urbanization economies, population density is only significant for the first quantile and *Dist_cap* is only significant for the upper quantile. According to the above results, we can conclude that Hypothesis 1 is partly supported by the empirical evidence, while there is total support for Hypothesis 2. Firstly, the econometric results indicate that specialization in CCIs does not boost employment growth in all circumstances, but only for high-growth employment areas. In addition, when looking at industry-specific location quotients, the results show asymmetric effects among different CCIs. Secondly, the econometric and (especially) the descriptive results show an unequal spatial distribution of the effect of specialization on employment growth, since significant effects were identified mainly for high-growth areas located away from the main urban cores, suggesting that CCIs may play also a role at rural and peripheral areas, which is a novelty in view of lack of analyses about that profile of municipalities.

5. Conclusions

This paper has provided some insights on the role played by CCIs in local employment growth using data for Catalan municipalities between 2001 and 2011. We have analyzed whether local specialization in CCIs might boost total employment growth. Our interest in CCIs comes from their increasing importance in developed countries, the existence of positive externalities that may arise from them and reach other economic activities, the large number of contributions that highlight the enormous potential of these industries for advanced economies, and the increasing efforts devoted by public administrations to stimulate these industries, both in urban and rural areas (Sörvik *et al*., 2019). All these analyses must be presented with the caveat that there is still some skepticism regarding the measurement of CCI effects. For all these reasons, additional research is needed in order to corroborate previous (potential) positive effects.

The main conclusion of this paper suggests that the role of CCIs is still unclear and merits additional analysis since, on the one hand, there is widespread empirical evidence pointing to its positive effects on economic growth, job creation and knowledge generation, but on the

[23] It is important to take into account that the time period includes an important economic crisis (i.e., from 2008) that may have affected employment creation and destruction in an heterogeneous way depending on each municipality.

other hand, there is also evidence indicating that their weight and influence is still small. It might be suggested that a potential explanation of this apparent contradiction depends on industry and municipality profiles, and we have tried to disentangle earlier ambiguous results by considering both detailed CCIs as well as different typologies of municipalities. In this regard, our results corroborate the initial hypothesis that the effects of CCIs vary considerably across heterogeneous areas, implying that public administrations should take care when choosing where and how to promote these activities.

While there are some demonstrable conclusions, it is clear that more work needs to be done. This paper has used data on small and medium-sized municipalities, whilst most of literature focuses on what happens in big urban areas (e.g., London or New York) not considering the rest of territories. Nevertheless, as it is also true that municipalities are quite small and that spatial range of labor markets may be larger than municipality boundaries, alternative spatial aggregation levels such as counties or local labor markets should therefore also be tested in order to corroborate previous findings.

In general terms, our results have important implications for policy measures, since the potentialities of CCIs should be carefully analyzed by taking into account specific industries and spatial units, given that the expected effects are quite heterogeneous in the combined industry/space dimension. It is important to clarify that we are not diminishing the potential effects of CCIs, but trying to precisely specify the conditions under which these positive effects can be demonstrated. Smart specialization in CCIs, and relative subsectors, shall be more emphasized in policy-making, since it is clear that *place* matters. In this sense, as highlighted by McCann and Ortega-Argilés (2019), smart specialization is aimed at transforming policy-thinking from traditional top-down and predominantly sectoral-led approaches to a more local, bottom-up innovation led approach.

Finally, regarding future research directions, additionally to consider alternative spatial settings (i.e., counties or local labor markets, for instance), in order to disentangle the potentially restrictive effects caused by the economic crisis starting in 2008, we intend to explore whether the results hold for alternative periods.

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Appendix

Table A.1. Cultural and Creative Industries Definition

Fashion		**Research and Development**	
17710	Manufacture of knitted and crocheted hosiery	73100	Research and experimental development in natural sciences and engineering
17720	Manufacture of other articles with knitted fabrics	73200	Research and experimental development in social sciences and humanities
18100	Manufacture of leather garments	**Architecture and Engineering**	
18210	Manufacture of workwear	74201	Architectural technical services
18221	Manufacture of industrial clothing	74202	Engineering technical services
18222	Tailor-made clothing	74203	Mapping and surveying technical services (Cartography and Topography)
18231	Manufacture of men's underwear	**Advertising**	
18232	Manufacture of female lingerie	74401	Advertising agencies and consultants
18241	Manufacture of babies' garments	74402	Advertising media management
18242	Manufacture of sportswear	**Photography**	
18243	Manufacture of other types of clothing and accessories	74811	Development laboratories, printing and photographic enlargement
18301	Preparation, tanning and dyeing of fur	74812	Photographic studies and other photography activities
18302	Manufacture of articles of fur	**Design**	
19100	Preparation, tanning and finishing of leather	74841	Non-industrial design and interior decoration
19201	Manufacture of leather goods and luggage	**Cinema, video, music, TV and Radio**	
19202	Manufacture of other articles of leather	22310	Reproduction of sound-recorded media
19300	Manufacture of footwear	22320	Reproduction of video-recorded media
Publishing		22330	Reproduction of data-recording
22110	Publishing of books	92111	Production of films
22120	Publishing of newspapers	92112	Assistance activities to cinematographic and video production
22130	Magazine publishing	92121	Distribution of cinematographic films and videotapes
22140	Publishing of sound recordings	92122	Distribution of films on videotape
22150	Other publishing activities	92130	Film showings
Graphic Arts and Printing		92201	Radio activities
22210	Printing of newspapers	92202	Production and distribution of television
22220	Other printing activities	92203	Broadcasting of TV programs
22230	Binding and finishing	64200	Telecommunications
22240	Composition and photoengraving	**Writers, performing arts, visual arts and crafts**	
22250	Other graphic activities	92311	Artistic and literary creation, interpretation of dramatic art, music and similar activities
Jewelry, Musical Instruments and Toys		92312	Production of entertainment shows
36221	Manufacture of jewelry items	92313	Other activities related to entertainment shows
36222	Manufacture of articles of gold and silverware	92320	Management of entertainment venues
36300	Manufacture of musical instruments	92330	Activities of amusement and theme parks
36500	Manufacture of games and toys	92341	Dance halls, discotheques and similar activities
36610	Manufacture of customized jewelry	92342	Bullfighting shows and activities
Software and Videogames		92343	Other entertainment activities
72100	Activities of computer consultancy	**Activities related to Heritage**	
72200	Software consultancy and supply of computer applications and programs	92510	Library and archive activities
		92521	Museum activities
		92522	Conservation of historical sites and buildings
		92530	Activities of botanical and zoological gardens, nature reserves and national parks

Source: Own elaboration based on Sánchez-Serra (2016), DCMS (2013), Lazzeretti *et al*. (2008), UNCTAD (2010).

Table A.2. Correlation Matrix

	EmpGrowth	LQCCIs2001	Entropy	University	Popdensity 2001	Dist_cap	Smallfirms
EmpGrowth	1	0.11	-0.37*	0.08*	0.12*	-0.02	-0.03
LQCCIs	0.11	1	0.19*	0	-0.07	-0.21	0.03
Entropy	-0.37	0.19	1	0	-0.21	-0.33	0.18
University	0.08	0	0	1	0	0.04	0.02
Popdensity2001	0.12	-0.07*	-0.21*	0	1	0.01	-0.19
Dist_cap	-0.02	-0.21*	-0.33*	0.04	0.01	1	-0.01
Smallfirms	-0.03	0.03	0.18*	0.02	-0.19*	-0.01	1

Significance level (p<0.05).

Table A.3. Profile of Outlier Municipalities: Filtered (878) v. Outliers (65)

	Mean		**Median**		**SD**		**Min**		**Max**		**Sum**	
	Filtered	**Outliers**	**F**	**O**	**F**	**O**	**F**	**O**	**F**	**O**	**F**	**O**
Employment 2001	3,137.94	26.91	262.50	17	32,589.61	35.57	3	0	946,119	221	2,755,110	1,749
Employment 2011	3,275.44	84.40	311	54	33,301.23	104.86	4	5	965,810	662	2,875,834	5,486
%Emp. Growth	25.29	284.10	18.93	204	38.25	251.87	78.36	12.12	143.42	1,800	22,202	18,466.67
Emp. in CCIs 2001	293.01	1.63	12	1	3,601.37	2.75	0	0	105,204	13	257,266	106
LQ-CCIs 2001	0.66	0.78	0.48	0.30	0.70	1.25	0	0	8.09	6.55	577.76	50.71
Dist_cap	86.83	88.32	82	85	23.57	28.32	0	0	190	152	76,234	5,741
Pop 2001	7,203.16	226.83	919	165	53,646.28	191.75	26	35	1,503,884	1,066	6,324,373	14,744

Source: Authors' elaboration.

Table A.4. Interquantile Regression Models

Θ	**0.25-0.50**	**0.50-0.75**	**0.75-0.90**
Constant	**0.48*****	**0.41*****	**0.84*****
	(0.102)	(0.135)	(0.197)
LQCCIs	0.01	**0.06***	0.06
	(0.22)	(0.039)	(0.041)
Entropy	**-0.56*****	**-0.38****	**-0.77*****
	(0.109)	(0.167)	(0.246)
University	-0.00	-0.00	-0.00
	(0.002)	(0.002)	(0.002)
Popdensity	0.00	-0.00	0.00
	(0.000)	(0.000)	(0.000)
Dist_cap	-0.00	-0.00	**-0.00****
	(0.000)	(0.001)	(0.000)
Smallfirms	0.00	-0.00	-0.00
	(0.000)	(0.135)	(0.000)
Number of Observations	943	943	943
Pseudo R2	"0.50": 0.1348 "0.25": 0.0554	"0.75": 0.1978 "0.50": 0.1348	"0.90": 0.2667 "0.75": 0.1978

Significance codes: * p<0.05; ** p<0.01; *** p<0.001.
Bootstrap (20) Standard Errors
Source: Authors' elaboration.

Chapter Three

Detection of Geographical Clustering: Cultural and Creative Industries in Barcelona

Paper [2] presented in this chapter is coauthored with Josep-Maria Arauzo-Carod and Fernando López Hernández. It has been published in the Working Papers Collection at ECO-SOS, URV (DT 04-2021), and is under review in a journal.

1. Introduction

Given the recent focus on the importance of Cultural and Creative Industries (CCIs) clusters, understanding the detailed dynamics of firms located in these clusters is essential. While many previous studies have been concerned with CCIs agglomeration in general terms, we specifically look into significant clustering and its urban evolution of over a period of time. This paper therefore addresses the current emphasis on smart specialization tools for economic transformation and policymakers' initiatives (mainly in the EU and OECD countries) to successfully tap the regional potential of creative clusters "as a way to promote socio-economic development, including the use of EU Structural Funds" (European Commission, 2012, p. 3). Concretely, we aim to provide an improved understanding of CCIs clusters in the Functional Urban Area of Barcelona (FUAB).

Research in the area of spatial distribution of economic activities begins by identifying certain spatial patterns in order to provide a range of rationalizations about their determinants or implications. CCIs have important direct, indirect, and induced roles in the economy, ranging from stimulating innovation (Jones *et al.,* 2016), boosting GDP growth (De-Miguel-Molina *et al.,* 2012), and catalysing urban economic expansion (Higgs and Cunningham, 2008). They also play a role in endorsing economic resilience through fostering efficiency and stability in times of economic uncertainty (Mitkus and Maditinos, 2017), mainly because these industries depend on local knowledge and are quite place-specific (Comunian and England, 2018). But literature about CCIs has unclear boundaries since their standard classification has only recently been provided (DCMS, 1998) and followed up with the policy-making definitions of cultural employment and occupations (Eurostat, 2018): *creative economy* (OECD, 2007), *creative class* (Florida, 2002), *creative cities* (UNESCO, 2012) and, more recently, *creative clusters* (Lazzeretti *et al.,* 2012; Boix *et al*., 2012; Mommaas, 2004). The latter is the focus of this study.

Boix *et al.* (2012) consider that the geography of creative industries is *diverse*, *heterogeneous,* and *complex*. Understanding creative clusters is fundamental for the design and implementation of policy-making (Boix *et al*., 2012) and entry strategies for creative firms. Therefore, CCIs are of noticeable importance in economic terms, and they tend to cluster in a different way than other industries. In the last decade, there has been a growing realization that CCIs, such as

music, fashion, publishing, film, media, research and development, and software design, are significant economic contributors to developed countries in terms of innovation, local development, and employment growth (OECD, 2018). There has been increased attention to developing and sustaining the cluster approach in these countries, mainly through the use of smart specialization strategies as tools for regional and local development. This has been made evident by the recent initiatives carried out by the European Commission and the OECD to foster better innovation strategies based on clustering patterns and smart specialization, with the aim of creating new economically productive and innovative urban locations. Due to the growth of the creative economy in major European cities ranging from fashion and design to software and innovative research and the challenges confronting urban policy on supporting these industries, economic geographers have been called on to address the formation, growth, and decline of creative clusters.

With CCIs cluster planning, CCIs are moving more to the forefront in policy-making agendas. The objective of this paper is to contribute to this area of research, focusing on the FUAB as a major European hub where CCIs play an important role in positive economic and social externalities. We aim to interpret the spatial distribution of cultural and creative firms and uncover their clustering patterns, both in general terms (for all the CCIs) and at the industry level, using geo-located firm data from the SABI database (Mercantile Register). This study is exploratory in nature, and we answer the following research questions by proposing the application of an innovative methodology, SaTScan (Software for spatial, temporal, and space-time scan statistics): Do cultural and creative industries cluster in the core or in the periphery of the FUAB? And if any preference exists, is it shared by all sectors or are there different spatial patterns? Do these patterns evolve over time? Is there a specific urban resilience encouraging core CCIs clusters given the characteristics of cluster lifecycles and urban amenities?

The structure of this paper is the following. The second section reviews the literature and addresses the main points raised by scholars on cultural and creative industries, their spatial distribution and clustering patterns. The third section details the characteristics of the dataset and the methodology used to identify clusters. The fourth section discusses the main results. Finally, the fifth section concludes and indicates directions of further analyses.

2. Spatial Distribution of Cultural and Creative Firms

2.1 Clusters: Characteristics and Lifecycle

There exists a common census in literature that firms within a cluster grow more powerfully and have a faster innovation capacity than non-clustered firms, in addition to clusters being able to encourage entrepreneurship and attract firms or more than non-clustered regions general (Menzel and Fornahl, 2009; Klepper, 2007). Given the particular focus in the recent decade on the importance of creative clusters, understanding their lifecycle becomes essential. Andersson *et al.* (2004) have established a clear categorization of cluster lifecycle starting from agglomeration of firms to mature clusters and transformation and show that, theoretically, mature clusters are said to have profound cluster actors (firms, research community, government, public institutions, financial sectors, and other institutions for collaboration), and are characterized by developed relationships within and outside the cluster with internal innovation and dynamic capabilities of new firm creation and spinoffs. Transformation, on a more developed level, leads the cluster to more innovation in terms of production and development of new clusters that focus around other activities (Andersson *et al.,* 2004). Menzel and Fornahl (2009) suggested two dimensions through which one can identify the stage of the cluster lifecycle: (1) *quantitative* dimension that can be assessed through the size of a cluster (number of firms, number of employees, cluster actors) and (2) *qualitative* dimension that is evaluated via the utilization of diversity (knowledge and competencies). Based on that the authors identified four phases of a cluster lifecycle: emerging, growing, sustaining and declining. As well, preceding literature further distinguished between spatial clustering and functional clustering (Menzel and Fornahl, 2009, and Zheng and Chan, 2014), based on the capacity of a cluster to utilize its capabilities.

2.2 Clusters and Competitive Advantage

Recent literature has emphasized the importance of clustering and its ability to generate numerous gains for firms, cities, and rural/periphery areas by encouraging the regeneration of underprivileged localities, enhancing productivity and competitiveness, stimulating entrepreneurship, boosting economic growth through employment, and innovation, among other positive knowledge spillover effects (Boix *et al.,* 2012; Porter, 2008; Mommaas, 2004). This makes the concept of creative cluster development vital within economic strategies for

local and regional development in EU countries and other developed nations. Principally, the chief argument is that creative industries are spatially concentrated (Boix *et al.,* 2012; De Vaan *et al.,* 2012; Lazeretti *et al.,* 2008).

2.3 Creative Clusters: Geographical Locations and Related Determinants

The literature in the field of firm spatial distribution, clustering, and location patterns has expanded considerably in recent years, emphasizing the notion that "place" matters. Within this strand, analyses about CCIs have also grown considerably (given their social and economic weight in developed economies), using a wide range of methods and geographical contents.

Among the contributions using qualitative research, we highlight Asheim *et al.* (2017) about the New Media Cluster (Sweden / Norway); Martins (2016) about the role of urban design in the development of creative production in Shoreditch (East London); Dyba *et al.* (2019) about a furniture clustering comparison between Italy and Poland; Lin (2017) about the design and music industry cluster in Taipei; and Kiroff (2017), who examined the spatial distribution of firms in three creative design subsectors (architecture, specialized design, and advertising) in Auckland (New Zealand). Among quantitative approaches, there are those by Polèse *et al.* (2007), on the location of economic activity in Spain focusing on the role of distance to metropolitan areas and city size; Coll-Martínez *et al.* (2019), using firm-level geo-located data to calculate distance-based *M* and *m* functions of CI agglomeration and co-agglomeration in the metropolitan area of Barcelona; and Méndez-Ortega and Arauzo-Carod (2019), using the Nearest Neighbor Index (NNI), *M*-functions and local spatial autocorrelation indicators to analyze the location patterns of software, videogames, and electronic editing firms in the Metropolitan Area of Barcelona. In a larger, European urban context, Boix *et al.* (2015) avoid the limitations of methodologies using administrative data by using geo-referenced micro-data and a nearest neighbor hierarchical clustering algorithm (NNHC).

Following previous contributions, this paper fills the gap in terms of lack of spatially disaggregated analyses of clusters in CCIs at the sub-industry level, applying innovative methodology and using geo-referenced micro-data to identify statistically significant clusters. The usage of spatial scan statistics applied to CCIs clusters is novel and has only recently been applied to other industries (e.g., López and Páez, 2017). In spite of the advantages of the preceding approaches, this method uniquely admits the identification of statistically significant

clusters, Most-Likely Cluster (MLC), and secondary clusters, which provides a clearer picture of the clustering of economic activity instead of just identifying clusters in a binary way (i.e., clustered vs. non-clustered areas). Although this approach is similar to Boix *et al.* (2015), we exploit the capabilities of Scan-test methodology to detect significant industrial clusters and identify their spatial boundaries. The major advantage of Scan-test methodology is that the reference used is not the distance between firms in CCIs, but rather the geographic concentration of CCIs firms in a specific location or area.

Why firms in the creative industry do cluster is a question that has been asked by a number of researchers in different countries and various scopes of analysis. Creative industries are varied in their nature, and they cluster and prosper in response to the distinctive knowledge bases and characteristics of each community (Wu, 2005). On a general note, the common determinants in the formation of clusters, as derived from the literature, are the following:

1. Cultural heritage including historical place, monuments, ruins (Lazzeretti *et al.,* 2012; Cooke and Lazzeretti, 2008; Mommaas, 2004)
2. Universities and knowledge transfer (Wu, 2005)
3. Localization externalities (Lazzeretti *et al.,* 2012)
4. Urbanization economies (Gong and Hassink, 2017; Lorenzen and Frederikson, 2008)
5. Creative Class (Florida, 2002)
6. Spin-off dynamics (Gong and Hassink, 2017)
7. Public intervention and supporting institutional *milieu* (Foord, 2009); governmental regulation in the form of local, regional, and national frameworks which affect spatial patterns of creative firms (Wu, 2005; Turok, 2003)

The complementary needs of interrelated sectors within CCIs along with the benefits from technological spillovers are factors that facilitate the long–term growth of creative clusters in certain areas and encourage their stability and innovative capacity (De Propris *et al.,* 2009). Many of the findings in the literature link cultural and creative clusters to urban areas. The concentration is most common in big cities, leading to the formation of hubs. By ranking, the most visible creative clusters are formed in London, Paris, Madrid, Milan, Barcelona, and Rome, with differences in concentration levels among the cities, while medium-sized cities also feature some form of concentration of local creative systems (Boix *et al.,* 2012). Likewise,

Hutton (2004) finds that creative clusters concentrate in inner-city areas because of the innovative *milieu* that the city provides, in addition to the cultural heritage, parks, and tourist attractions that make the core of cities very attractive. However, recently, this notion has been challenged as some researchers have started to address the "suburbanization" of creative clusters as suburbs are shifting from pure residential areas to culturally and economically intricate and active ones. One example is the argument of Bain (2016) that creative clusters are also flourishing outside the core of cities, and these areas are no longer necessarily "uncreative zones".

In a detailed contribution to the economic geography of creative industries, Gong and Hassink (2017) present a systematic literature review of the role of agglomeration economies in CCIs. In terms of the role played by cities, large ones commonly provide urban amenities that are attractive to the creative class (Florida, 2002), whilst Lazzeretti *et al.* (2012) find a significant impact of urbanization economies on the clustering of CCIs in Spain and a less important effect in the Italian context.

Gong and Hassink (2017) also discuss the role of "spin-off" activities, which we can interpret as by-products and by-services resulting from universities and parent companies. Examples can be seen in knowledge transferring among personal networks and employees of creative firms (De Vaan *et al.,* 2012), university research centers (software design companies near universities with active computer science engineering faculty), as well as corporate subsidiaries agglomerating near parent firms. Wu (2005) presents other examples of how academia and local creative firms can interrelate: *i)* Boston's Research Row (MIT, Harvard, and other local universities) playing a role in the growing concentration of start-ups and R&D firms providing cutting-edge research and innovative solutions for many consumer problems throughout the world; and *ii)* fashion clusters in New York, where he found considerable local impact on university-based innovation and entrepreneurship in the city.

Predictably, a third core factor that influences the location decisions of creative firms are institutions and urban, regional, and local policies (Gong and Hassink, 2017). This is an argument previously validated by Turok (2003), who emphasizes the role of institutions in the development of creative clusters, arguing that it is not a story of localized networks or clusters of small knowledge-intensive firms generating regional growth through an endogenous

process, contrary to the image conveyed by policy-makers and advisers. Similarly, Foord (2009) investigates the cases of Barcelona, Berlin, and London and finds that public and private institutions play an important role in developing creative clusters.

Another branch of the literature that should not be left out is that dealing with cluster *building*. Based on three case studies in Sweden (music, information and content design, and film), Power and Hellencreutz (2005) outline major common factors essential for building clusters. The first one is the existence of a regional competitive advantage, not necessarily starting from a large agglomeration of firms (an argument in line with the findings by Lazzeretti *et al.* (2012) in the case of creative clusters in Italy). The second one is the intervention of the public sector in financing educational programs and vocational training and infrastructure to stimulate clusters; particularly focusing on place-marketing and cluster-branding in order to better attract investments, public funding, and entrepreneurs. The third one is the existence of places, such as temporary sites and festivals, or permanent ones, such as universities, to provide meeting places where knowledge can be exchanged in addition to creating entertaining social contexts and a better quality of life to attract creative people.

On a final note, creative clusters differ in their spatial patterns in the same way that CCIs differ from other industries in their structure and characteristics (Mommaas, 2004). The differences could be in their orientation from productive creative firms to consumption-leading creative firms, their financing, spatial position within wider urban infrastructures, and policy intervention strategic plans. Different cluster and location tendencies for different sectors of creative and cultural industries can also result from the different stages of the CCIs value chain. While production and manufacturing activities are the most regionally concentrated, consumer/end-user-oriented activities are the least regionally concentrated (Europe INNOVA, 2011). Clustering is evident among creative firms specialized in manufacturing or publishing (games publishing, recorded media and film and television activities, software and music publishing, news agencies, and musical instrument manufacturing), as well as institutions related to cultural heritage. Thus, it is essential to consider the specificity, interconnections between different drivers, external linkages among creative firms, and comparisons between different locations of each creative sector to better understand and explain the clustering of creative firms.

To sum up, CCIs have been identified as major actors in the economic growth of urban areas where these industries tend to cluster. Unfortunately, less is known about the way in which specific CCIs cluster and their preferences for locating in the core or the periphery of these urban areas, which is precisely the main aim of this paper. Nevertheless, as we want to focus on cluster identification, the econometric analysis of cluster determinants has been left for future research.

3. Data and Methodology

3.1 Data

The source of the data is the SABI database (acronym for Iberian Balance Analysis System) that collects economic information on an extensive list of businesses in Spain. SABI collects data from the Spanish Mercantile Registry, where firms are obliged to deposit their balance sheets on an annual basis[24]. SABI is not a census and coverage is uneven for different Spanish regions, but approximately 40% of all Spanish businesses are listed in this data bank. The biggest advantage SABI has is that individual firms are geo-referenced at their latitudinal and longitudinal coordinates. Our dataset covers the number of firms in the Functional Urban Area of Barcelona (FUAB). In this paper we include two years, 2009 and 2017. The first one is just after the economic downturn (2007) that pushed thousands of firms out of markets, whilst the second one, belongs to the beginning of the economic recovery, although the number of firms was still lower than at the beginning of the period: 130,313 total firms were located in FUAB in 2009, among which 10,635 are firms in the cultural and creative industries (8.16%), compared to 98,422 total firms located in the same area in 2017, among which 8,775 belong to CCIs (8.94%).

3.2 CCIs: Definition of Industries

Providing a definition for cultural and creative industries is not an end in itself for this paper, nonetheless, it is necessary to first define the sectors involved. Following previous studies (see, among others, Lazzeretti *et al.,* 2008), we build on the prevalent definition of the twelve CCIs subgroups: Advertising; Architecture and Engineering (hereafter Architecture); Cinema,

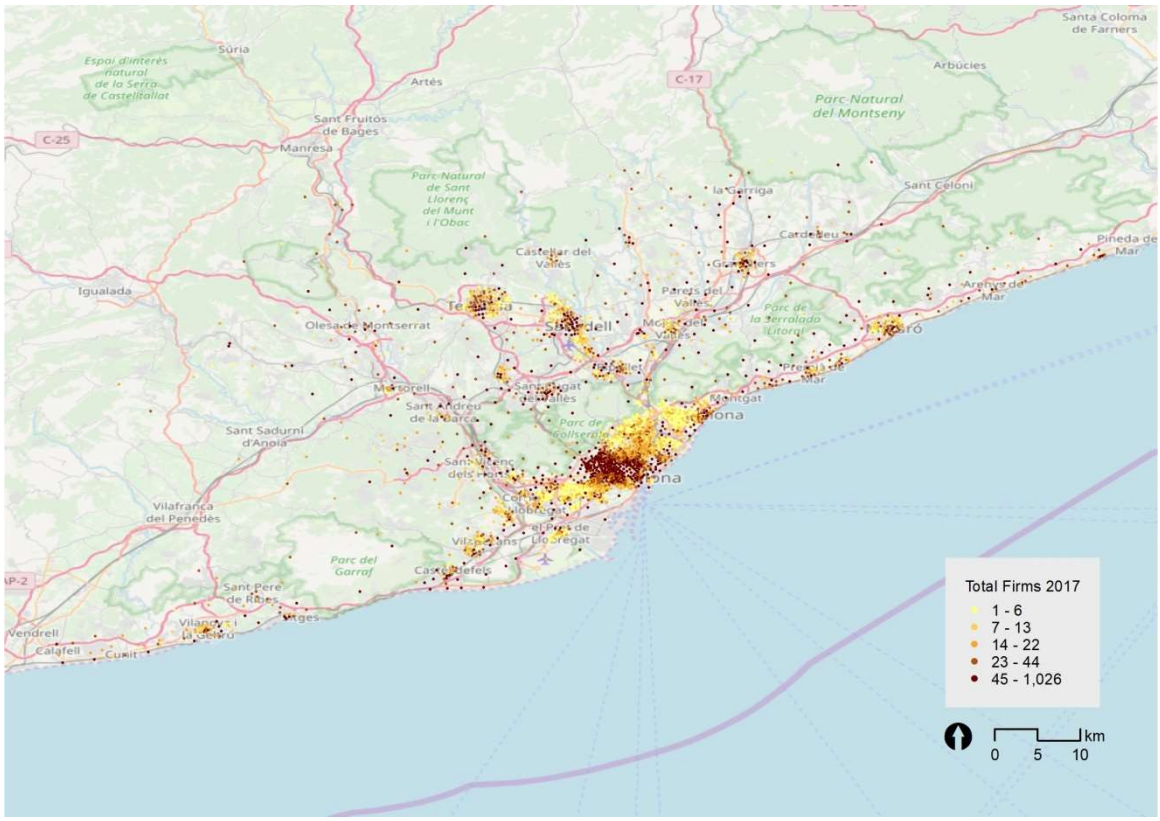
[24] SABI is the most common database to analyze firms' location distribution for the Spanish case, although it has some limitations, such as size coverage (i.e., it focuses mainly on medium-sized and large firms) and the profile of firms (i.e., it is about firms, not about firms' establishments).

Music, TV and Radio (hereafter Audio-Visual); Fashion; Graphic Arts and Printing (hereafter Graphic); Jewellery, Musical Instruments and Toys (hereafter Jewellery); Photography; Publishing; Research and Development (hereafter R+D); Software and Video-games (hereafter Software); Writing, Performing Arts, Visual Art and Crafts (hereafter Arts); and Activities Related to Heritage (hereafter Heritage). Details on CCIs along with their CNAE 2009 and CNAE 93 equivalence (adapted from the Spanish Statistical Office) are presented in Appendix 1.

3.3 Area under Study: Functional Urban Area of Barcelona

The area under study in this paper is the Functional Urban Area of Barcelona FUAB (Spain). This FUAB has a resident population of 4,991,133 inhabitants (2018), with the municipality of Barcelona totalling around 1.5 million inhabitants. The economic activity rate in FUAB was 59.51% in 2019, and the ratio of the employed to economically active population was 89.09% for the same year. Barcelona city, the core of the FUAB, is the second largest city in Spain and is a major cultural center for heritage, music, architecture, design and, recently, innovation. According to its size, attractiveness, specialization in CCIs, and economic importance in general terms, the city of Barcelona can be considered the core of the FUAB, and the rest of the 134 municipalities, are its periphery. Nevertheless, i) as some CCIs have suburbanized in recent years, this core-periphery distinction only holds true when discussing CCIs as a whole, and ii) inside Barcelona, is it also possible to identify specific areas acting as cores for specific CCIs.

Figure 1. Spatial Distribution of Firms in the Functional Urban Area of Barcelona



Source: own elaboration.

In this research, the unit of analysis is the census tract[25]. The FUA of Barcelona is divided into 3,050 census tracts and using SIG software, the total number of firms in each census tract is calculated, as well as the number of firms in CCIs. Figure 1 shows the spatial distribution of all the firms (aggregated by census tract) in the FUA. Each point in the figure is the centroid of a census tract. The centroids of census tracts are used to identify the clusters.

3.4 Cluster Identification: Scan-test Methodology

There has been a large amount of research in recent years into statistical methods for identifying localized clustering. The Scan-test (Kulldorff, 1997)[26] is probably the most frequently used test in epidemiology to identify clusters of diseases, but it has been used in many other areas aiming

[25] Census tract (CT), *"Secciones Censales"*, represents the smallest territorial unit for which population data are available in Spain. The number of inhabitants of each CT ranges from between 1,000 and 2,500 inhabitants. We consider this spatial unit as a reference to identify spatial clusters. Latitudinal and longitudinal coordinates (centroids) were assigned to each CT and the distance between two CTs was defined as the distance between centroids.

[26] The SaTScan software: http://satscan.org is available for computing.

to identify firm clusters (Kang, 2010; López and Páez, 2017; Murray *et al.,* 2014; Chasco *et al.,* 2020). Additionally, there are other specific approaches used to identify CCIs clusters, such as those by Boix *et al.* (2015), using nearest neighbor methods and Lazzeretti *et al.* (2008), using location quotients.

For our propose, we consider that the Scan-test methodology is relevant for three reasons. In the first place, the Scan-test evaluates the null hypothesis of independence. In the second place, if the null is rejected, the test gives valuable information, geographically identifying the area with a differential and quantifying said differential. Lastly, the test can geographically identify one, or perhaps multiple, non-overlapping clusters with high/low levels of CCIs. The final output of the test is both a statistic value with a level of significance for each cluster and a map showing where the clusters are located. This map can to help to confirm or refute the hypothesis about why the clusters are located in those specific areas and not in others.

The procedure of the Scan-test consists of imposing a set of windows on a map and moving their centers over each point location until each window includes different sets of neighboring points at different positions. By adjusting the central location and its shape, this test generates a large number of differing windows, each one with a different set of neighboring points. At each point location, the size of the window continuously increases from '0' to a user-defined maximum size (lower than 50% of the total population[27]). The Scan-test looks for the windows where there is a maximum difference between inside and outside the window. In the case of our research, the null hypothesis is that in all locations (i.e., census tracts in FUAB), the probability of finding a CCIs firm is the same, whilst the alternative hypothesis is that there is a window Z (a set of connected census tracts), so that the probability of finding a CCIs firm is higher inside Z than outside Z.

3.4.1 Technical Details of the Scan-test

In this subsection we briefly present the formal construction of the test. More complete details about the construction of the test can be found in Kulldorff (1997). Let *N* be the total number of firms observed in FUAB, which we consider divided into discrete areas (census tracts). Let

[27] We decided to use a smaller threshold (10% of the population) in our research. This tuning parameter must be chosen before launching the test in order to avoid problems of multiple comparisons. The selection of this parameter is not relevant to the testing of the null hypothesis of independence, but is relevant to geographically identifying clusters. High values of this parameter could identify one cluster formed of several small clusters. Low values allow the identification of more complex forms (e.g., a cluster with an 'S' form). The value of 10% is usually selected in the literature.

N_i represent the total number of firms in the census tract *"i"*. Similarly, *n* and n_i denote the total number of CCIs in the FUAB *(n)* and in the census tract *'i' (n_i),* respectively. We assume that the number of CCIs in the census tract *'i',* namely X_i, follows a binomial $B(n_i,p_i)$ distribution that we can approximate to a Poisson $P(\lambda_i)$ with $\lambda_i=n_ip_i$. Under the null we assume that the distributions in census tracts are independent. Under the alternative hypothesis we assume that there is a set of census tracts, named *Z*, where the probability of finding a CCIs firm is different (higher or lower). Formally, the test is constructed under the hypothesis:

$H_0: \lambda_i = \lambda(\forall i)$ and X_i are iid

$H_A: \exists Z \in \Theta$ where $\lambda_i = \lambda_Z$ if i∈Z; $\lambda_i = \lambda_{\bar{Z}}$ $if\ i \in \bar{Z}\ (with\ \lambda_Z \neq \lambda_{\bar{Z}})$

The likelihood function of the spatial process is obtained for the null (L_0) and for the alternative hypothesis ($L_A(Z)$), and the likelihood ratio (named λ_Z) is calculated. After a few calculations, the expression for the likelihood ratio is,

$$\lambda_Z = \frac{L_A(Z)}{L_0} = \left(\frac{N_Z}{E_Z}\right)^{N_Z} \left(\frac{N - N_Z}{N - E_Z}\right)^{N - N_Z}$$

Where N_Z is the total number of firms in the set *Z,* and E_Z is the expected number of CCIs firms under the null. Note that the likelihood ratio depends of the set Z, and, therefore, a ratio must be calculated for each proposed cluster Z. The Scan-test looks for the set *Z*, where the likelihood ratio is maximum.

Therefore, the Scan-statistic Λ is defined as,

$$\Lambda = \sup_{Z\epsilon} \left\{ \lambda_Z\ I\left(\frac{N_Z}{E_Z} > \frac{N - N_Z}{N - E_Z}\right) \right\}$$

Where *I(x)* is an indicator function to look for clusters Z, where the number of firms is higher than expected. This indicator function can be changed if the objective is to look for a cluster of under-expected CCIs firms (changing '>' to '<') or it can be deleted if no assumption is considered. Θ is the set of all possible connected regions which could be considered in the study area. Typically, this set Θ is reduced to only circular and/or elliptic shapes[28], although it is also possible to work with spatial clusters of flexible shapes (Tango and Takahashi, 2005).

[28] In this study we use elliptic clusters. The relevance of the test using elliptic or circular windows is similar, but selecting elliptic windows allows the test to identify the differential region with more precision than with circular clusters.

The region *Z*,* where the likelihood ratio reaches the maximum, is named Most Likely Cluster (MLC).

As the theoretical distribution of the Scan-statistic under the null hypothesis is not known, its significance is empirically evaluated by simulating neutral landscapes (obtained by means of a random spatial process) and comparing the empirically computed statistic against the frequency of values obtained from the neutral landscapes. Hence, a *p*-value is obtained through the Monte Carlo hypothesis testing method by comparing the ratings of the maximum likelihood functions of the real dataset with those of the random data sets, with a number *B* of replications. If the MLC Z* is significant, the process is repeated looking for secondary clusters non-overlapping with the MLC.

3.4.2 Secondary Clusters

If the test rejects the null hypothesis and identifies a significant cluster, a natural question would be to ask if there is another cluster (not overlapping the most likely cluster) whose variance is significantly different from the rest. These clusters are the so-called secondary clusters. Zhang *et al.* (2010) suggest an iterative method based on eliminating the observations included in the MLC from the sample and re-obtaining the value of the statistic with this subsample, as this procedure is capable of identifying secondary clusters (i.e., the method used in this paper).

4. Results

4.1 Descriptive Statistics

Table 1 shows how the distribution of CCIs firms according to industries for 2009 and 2017 is quite similar. Although the Fashion industry share decreases quite a lot, other industries show an expanding trend (i.e., R+D, Architecture, and Software). The table also shows the distribution of firms in terms of census tracts, with the maximum number of firms in one census tract belonging to Fashion firms in 2017 (34), followed by Advertising firms for the same year (30), and then Graphic firms (27).

Table 1: Descriptive Statistics: Number of firms in the Functional Urban Area of Barcelona (2009 and 2017)/ Distribution by census tract

		Number of Firms	% of CCIs	Mean	Min	Max	SD
Advertising	2009	1769	16.6	0.57	0	31	1.56
	2017	1412	16.1	0.46	0	30	1.55
Architecture and Engineering	2009	2239	21.1	0.73	0	23	1.61
	2017	2215	25.2	0.73	0	19	1.63
Cinema, Music, TV and Radio	2009	865	8.1	0.28	0	23	0.98
	2017	693	8.0	0.23	0	18	0.82
Fashion	2009	1068	10.0	0.35	0	31	1.12
	2017	526	6.0	0.17	0	34	1.06
Graphic Arts and Printing	2009	1565	14.7	0.51	0	32	1.01
	2017	1106	12.6	0.36	0	27	0.02
Jewellery, Music Instruments and Toys	2009	377	3.5	0.12	0	8	0.42
	2017	279	3.2	0.09	0	6	0.37
Photography	2009	271	2.5	0.09	0	5	0.34
	2017	181	2.1	0.06	0	7	0.29
Publishing	2009	854	8.0	0.28	0	14	0.85
	2017	588	6.7	0.19	0	14	0.58
Research and Development	2009	147	1.4	0.05	0	5	0.25
	2017	223	2.5	0.07	0	17	0.82
Software and Video-games	2009	976	9.2	0.32	0	13	0.93
	2017	1123	12.7	0.37	0	23	1.23
Writing, Performance Arts, Visual Arts and Craft	2009	461	4.3	0.15	0	9	0.52
	2017	396	4.5	0.13	0	6	0.45
Activities Related to Heritage	2009	44	0.4	0.01	0	3	0.13
	2017	33	0.4	0.01	0	2	0.11
Total CCIs	2009	10635	100	3.5	0	111	7.21
	2017	8775	100	2.88	0	110	6.39
Total Firms	2009	130313		42.25	1	106	75.5
	2017	98422		32.28	1	1026	60.48
%CCIs from Total Firms	2009	8.16					
	2017	8.94					

Source: own elaboration.

4.2 Cluster Identification

The analysis is conducted for 2009 (Table 2) and 2017 (Table 3) in order to control for *i)* the temporal continuity of the clusters and *ii)* the potential bias caused by fluctuations in business cycles due to the economic downturn between 2007 and 2014. Concretely, we show data about

number, size (the number of firms) and the significance of the clusters (scan-statistic), taking into account that only significant clusters (with p-values <0.05) are included. The figures show the graphic location of the clusters.

Table 2: Cultural & Creative Industries (Clusters-Elliptic at 10%). Year 2009

Industry	Nb	Size	Nz	Nf	ENf	Nf/ENf	Λ	p-value
Total Cultural & Creative Industries	1	8	1,229	248	101.8	2.4	75.7	<0.001
	2	124	12,944	1,345	1072.0	1.3	34.0	<0.001
Advertising	1	131	12,971	297	176.1	1.7	38.3	<0.001
	2	156	10,818	216	146.9	1.5	15.7	<0.001
Architecture & Engineering	1	237	11,584	288	199.0	1.4	16.8	<0.001
Cinema, Music and TV	1	118	13,004	173	86.3	2.0	36.4	<0.001
	2	6	1,386	45	9.2	4.9	34.3	<0.001
Fashion	1	94	3,920	130	32.1	4.0	88.6	<0.001
	2	1	168	28	1.4	20.3	58.1	<0.001
	3	5	568	20	4.7	4.3	13.6	0.005
Graphic Arts & Printing	1	32	1,168	51	14.0	3.6	28.7	<0.001
	2	388	12,378	239	148.7	1.6	24.6	<0.001
	3	6	1,124	40	13.5	3.0	16.8	<0.001
	4	147	6,349	127	76.2	1.7	11.1	0.045
Jewellery, Music Instruments & Toys	1	16	1,543	20	4.5	4.5	12.8	0.011
Publishing	1	1	153	14	1.0	14.0	24.0	<0.001
	2	86	7,746	103	50.8	2.0	21.9	<0.001
	3	37	4,151	68	27.2	2.5	19.5	<0.001
Software and Video-games	1	43	3,012	57	22.6	2.5	17.9	<0.001
	2	215	12,799	162	95.9	1.7	16.0	<0.001
Writing, Performing Arts, Visual Arts and Crafts	1	175	10,546	94	37.3	2.5	29.6	<0.001

Nb = number of significant clusters; Size = number of locations that form the cluster; Nz = number of firms in the cluster; Nf = number of firms in the specified sector (cultural and creative industries); ENf = Expected number of firms in the specified sector (cultural and creative industries); T-stat = statistic value; P-value = p-value indicates significant level

Source: own elaboration.

For 2009 we have identified 2 clusters for total amount of CCIs with, respectively, 248 and 1,345 firms, and 19 clusters at the subsector level that are distributed in the following way: Advertising (2 clusters); Architecture (1); Audio-Visual (2); Fashion (3); Graphic (4); Jewellery (1); Publishing (3); Software (2); and Arts (1).

Table 3: Cultural & Creative Industries (Clusters-Elliptic at 10%). Year 2017

Industry	Nb	Size	Nz	Nf	ENf	Nf/ENf	Λ	p-value
Total Cultural & Creative Industries	1	302	9,824	1,445	875.9	1.6	140.3	<0.001
	2	154	8,318	925	741.6	1.2	21.8	<0.001
Advertising	1	105	9,833	314	141.4	2.2	90.7	<0.001
	2	99	9,778	255	140.3	1.8	32.1	<0.001
	3	1	35	9	0.5	18.0	17.5	0.00
Architecture & Engineering	1	165	9,589	373	215.8	1.7	50.2	<0.001
Cinema, Music and TV and radio	1	278	9,787	191	68.9	2.8	74.0	<0.001
Fashion	1	80	2,235	108	12.0	9.0	151.3	<0.001
	2	1	104	34	0.6	61.2	107.5	<0.001
	3	7	541	20	2.9	7.0	18.9	<0.001
	4	33	236	10	1.3	8.0	11.8	0.02
Graphic Arts & Printing	1	267	6,998	173	78.6	2.2	40.3	<0.001
	2	158	3,899	117	43.8	2.7	38.4	<0.001
	3	74	2,744	73	30.8	2.4	20.4	<0.001
	4	11	123	11	1.4	7.9	11.5	0.03
Jewelry, Music Instruments & Toys	1	484	9,653	57	27.4	2.1	13.7	0.005
Photography	1	260	6,954	37	12.8	2.9	16.0	0.00
Publishing	1	260	9,642	144	57.6	2.5	45.9	<0.001
	2	1	179	14	1.0	13.1	23.2	<0.001
	3	139	9,148	102	54.7	1.9	17.4	0.00
Research & Development	1	1	207	17	0.5	36.2	45.1	<0.001
Software and Video-games	1	57	2,448	83	27.9	3.0	36.0	<0.001
	2	108	3,916	96	44.7	2.1	20.2	<0.001
	3	52	4,241	95	48.4	2.0	16.0	0.00
Writing, Performing Arts, Visual Arts and Crafts	1	115	5,797	73	23.3	3.1	36.3	<0.001
	2	25	2,379	31	9.6	3.2	15.3	0.00
	3	102	3,734	38	15.0	2.5	12.7	0.01

*Activities related to Heritage have no significant clusters in both years 2009 and 2017

** Photography and Research and Development have significant clusters in 2017 but NOT in 2009

***Firms related to the "Design" have no data in the SABI, i.e. we did not find firms registered under this category

Nb = number of significant clusters; Size = number of locations that form the cluster; Nz = number of firms in the cluster; Nf = number of firms in the specified sector (cultural and creative industries); ENf = Expected number of firms in the specified sector (cultural and creative industries); T-stat = statistic value; P-value = p-value indicates significant level

Source: own elaboration.

In 2017 the total number of CCIs (aggregated) clusters remains the same (2 clusters). However, the number of firms in each cluster shows erratic behavior depending on the number of clusters identified. Concretely, considering one cluster from 248 to 1,445 firms, and considering two clusters from 1,345 to 925. As for the number of clusters at the subsector level, it increases and

is now distributed as follows: Advertising (3 clusters); Architecture (1); Audio-Visual (1); Fashion (4); Graphic (4); Jewellery (1); Photography (1); Publishing (3); R+D (2); Software (3); and Arts (3).

Apart from the number of clusters, their geographical distribution is important, as firms' preferences in terms of spatial proximity are shaped by the attractiveness of each area and, especially, the potential for agglomeration economies to be generated locally. Figures 2 and 3 show the overall distribution of CCIs clusters, demonstrating the key role played by the city of Barcelona, a result supported by previous analyses (see, for instance, Coll-Martínez *et al*., 2019 for a specific analysis of this area, but also Boix *et al.,* 2015, for a CCIs cluster analysis throughout Europe) that highlight the urban nature of CCIs clusters (Lazzeretti *et al*., 2008). This validates the argument presented by Gong and Hassink (2017) on the importance of the quality of place and urban locations in attracting CCIs.

Figure 2 Cultural & Creative Industries (All Inclusive) (Elliptic Clusters, 2009)

Source: own elaboration.

Figure 3 Cultural & Creative Industries (All Inclusive) (Elliptic Clusters, 2017)

Source: own elaboration.

Apart from reasonable changes due to firm turnover between 2009 and 2017, Figures 2 and 3 suggest that the benefits of clusters are greater closer to the main agglomerated areas (i.e., in and around Barcelona), as in these places it is easier to maximize interactions. Previous results refer to clusters of CCIs as a whole, but in terms of clusters of specific CCIs, the results are slightly different. These specialized clusters are driven by local sources of competitiveness arising in given industries which reinforce the role played by smaller urban areas.

4.3 Industry-Specific Clusters: Subsectors of CCIs

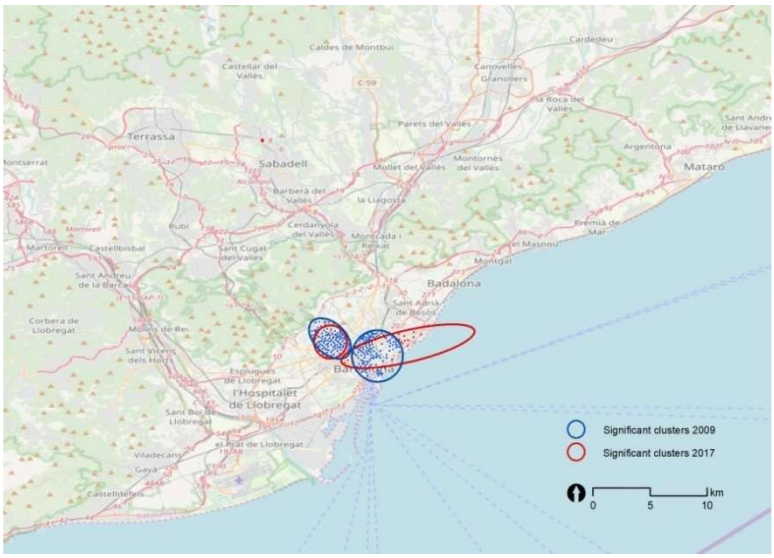
When referring to the industry-specific cluster results for 2009 (see Figure 4), a clear preference for agglomeration in the core of the metropolitan area has been demonstrated. There is at least one cluster of all the industries in Barcelona city, and the additional ones are in different municipalities of the metropolitan area. This depends on their industry specialization, but they are usually located in cities with a 19th century[29] manufacturing tradition.

[29] In any case, as shown by Boix *et al.* (2015) for a European analysis, CCIs clusters differ at the industry level.

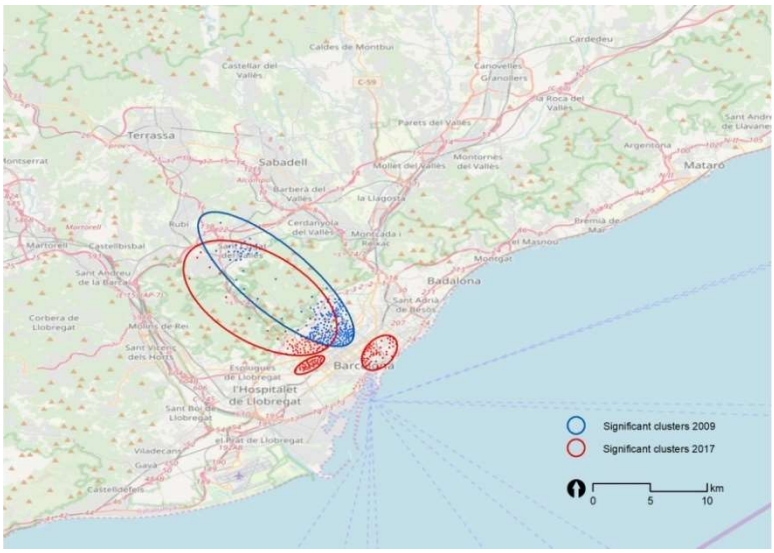
In general terms, subsectors linked to the high-tech, cultural, and service-oriented industries tend to cluster in Barcelona, whilst those closely connected with manufacturing activities cluster farther away from the core of the FUAB. An exception to this close connection to Barcelona city is the Fashion industry cluster, located outside Barcelona city center. However, this CCIs cluster is mainly driven by Fashion firms and not by a wide agglomeration of CCIs firms. Findings on Fashion clusters for the FUAB are thus in line with the findings of Polèse *et al.* (2007) on manufacturing location patterns in Spain. The results show that manufacturing firms follow a constrained decentralized model where they prefer to locate in medium-sized cities close to the major metropolitan areas but not urban centers, and this pattern has been quite stable (between 1991 and 2001). This result is also consistent with the findings by Boix *et al.* (2015) for European regions, as Fashion firms tend to cluster in the core of the big metropolitan areas of Paris and London but in their peripheries in the case of Barcelona.

Figure 4. Subsectors in Cultural & Creative Industries (Elliptic Clusters, 2009-2017)[30]

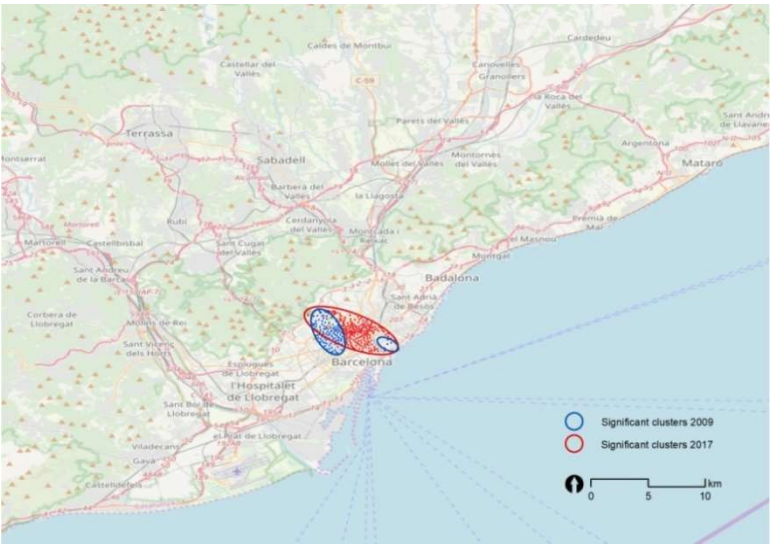
Advertising



Architecture and Engineering



Cinema



Graphic Arts and Printing

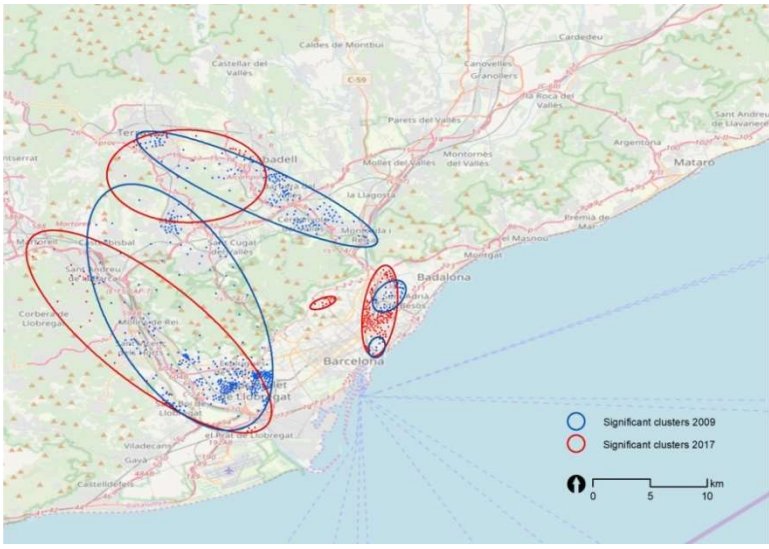
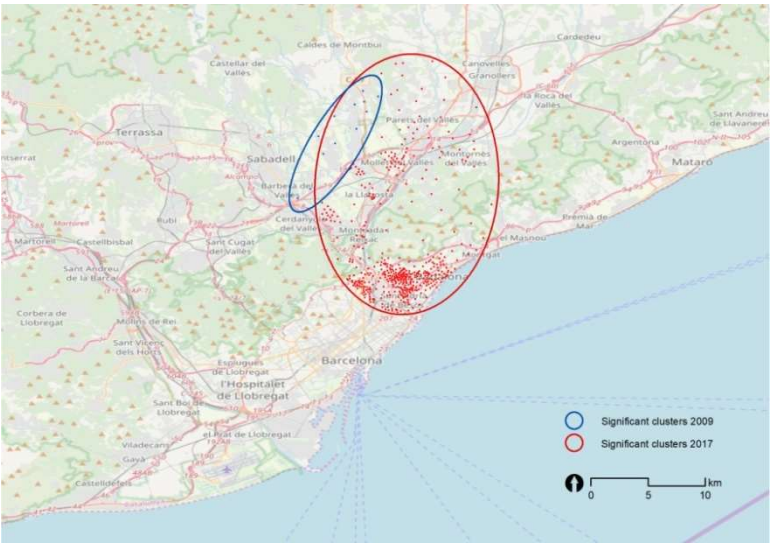


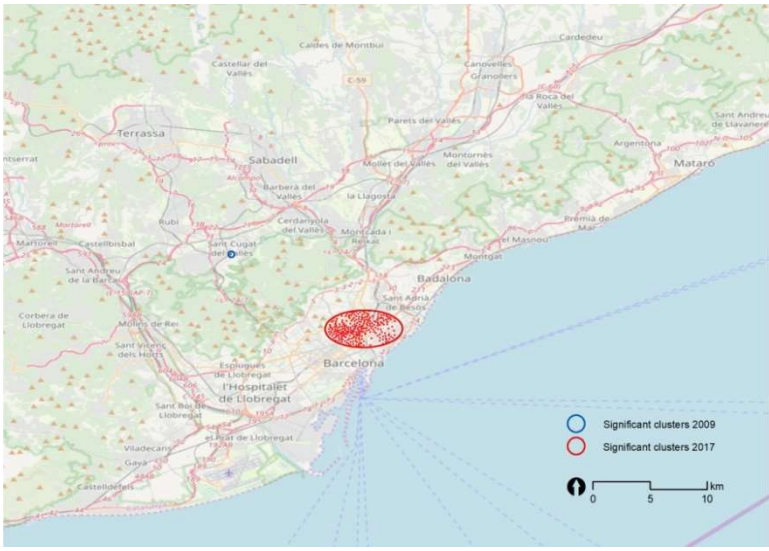
Figure 4. Subsectors in Cultural & Creative Industries (Elliptic Clusters, 2009-2017) **(cont.)**

[30]As we do not detect any significant clusters for "Activities related to Heritage", we only provide maps for 11 subsectors rather than 12.

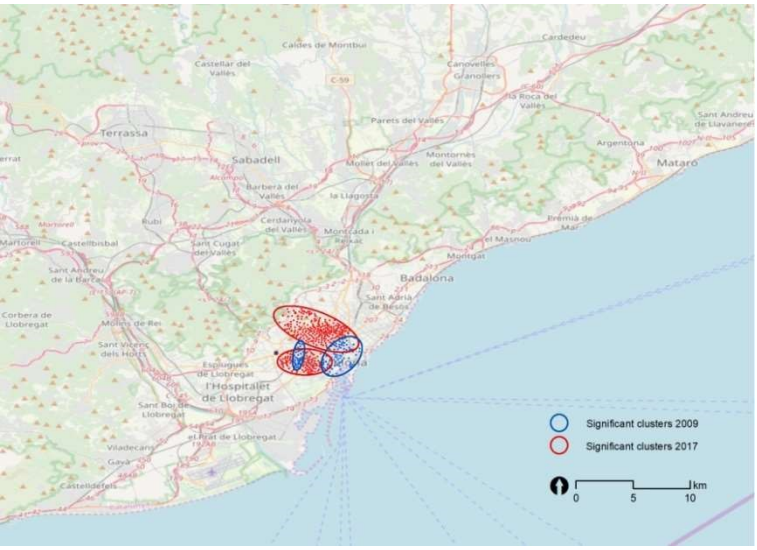
Jewelry, Music Instruments and Toys



Photography



Publishing



Research and Development

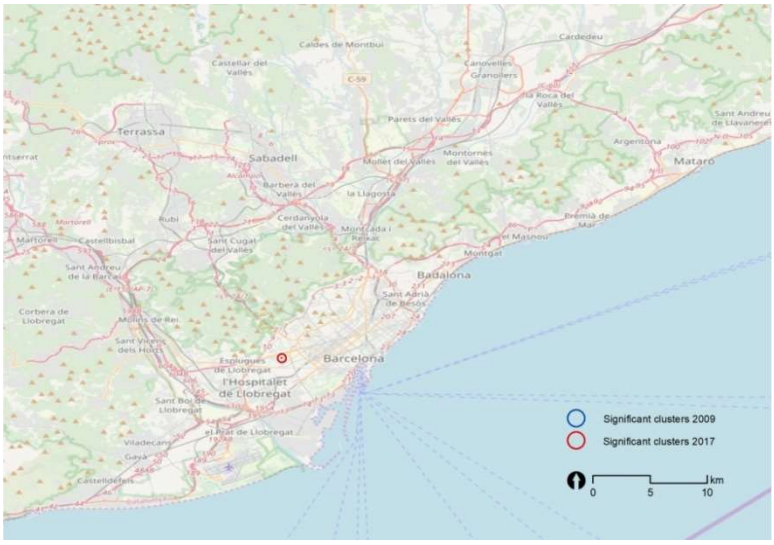
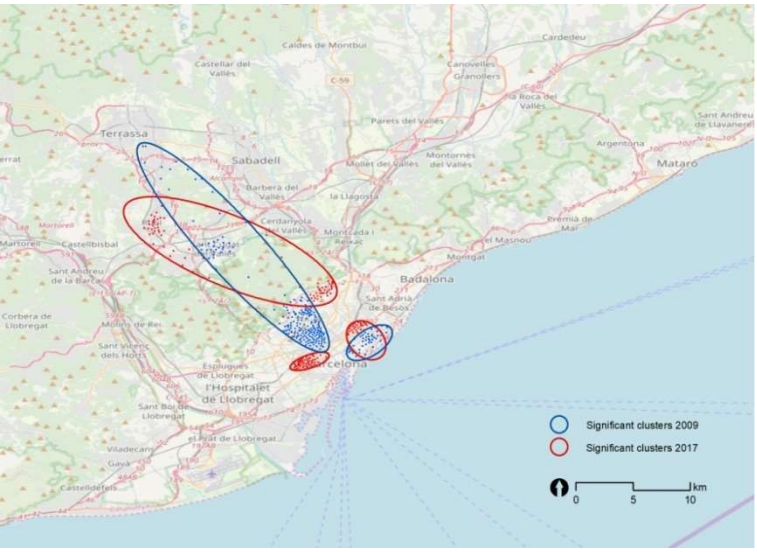


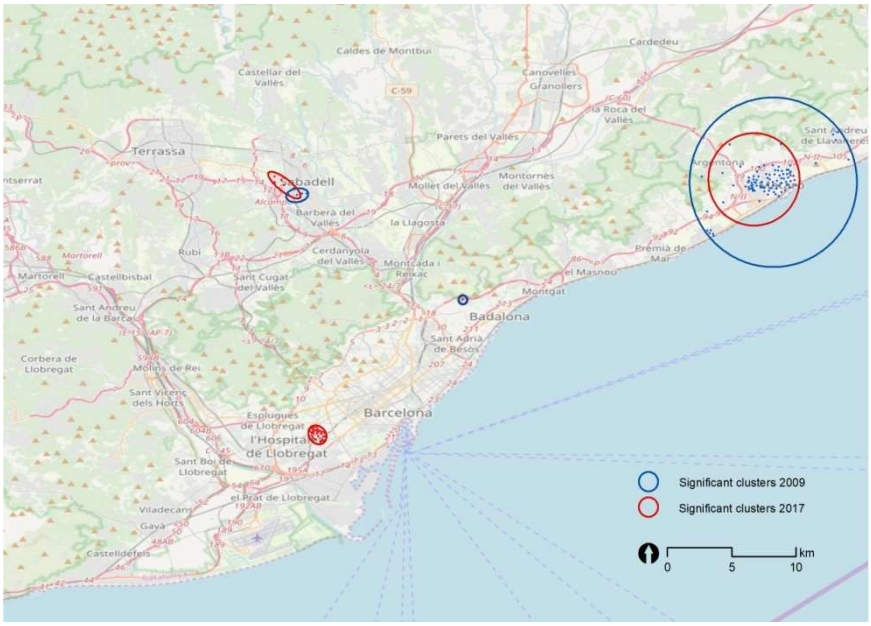
Figure 4. Subsectors in Cultural & Creative Industries (Elliptic Clusters, 2009-2017) (cont.)

Software and Videogames



Writing, Performing Arts, Visual Arts and Crafts

Fashion



Source: Own elaboration.

Results for 2017 are quite similar to those of 2009, which is reasonable taking into account that cluster formation is a medium to long-term process. Nevertheless, there is one interesting

difference that arises when comparing both periods. It seems that clusters located in Barcelona city center have strengthened over this period. This process can be understood in terms of urban resilience during times of economic downturn (Martin and Sunley, 2015) as firms located in dense urban areas are "protected" by a complex network of firm interactions that help them to continue operating in markets, as our results suggest for Barcelona (i.e., a "Barcelona effect"). An additional explanation is provided by the role of public policies supporting cluster formation in areas like the 22@ district in Barcelona (Viladecans-Marsal and Arauzo-Carod, 2012), as high-tech firms in several CCIs have tried to benefit from the advantages existing in these areas. It is also true that competition is tough in these locations, and that increased competition makes survival more difficult, but our results suggest that the net changes are positive. This is in line with the findings by Dyba *et al*. (2019), who explain that firms in a mature cluster use a greater variety of external knowledge sources and more knowledge-intensive sources than those in growing clusters do. This circumstance may be explained by more homogeneous and well-established knowledge pools in the later stages of a cluster life cycle, and/or by greater competition among firms supplying similar products. In addition, while there is a common trend among symbolic knowledge-based CCIs subsectors, such as art and media-related activities to located closer to the city center, there is on the contrary a significant presence of strong mature and sustaining manufacture-related clusters and emerging ones in periphery areas (fashion cluster as an example of a mature one and jewelry as an emerging one). This sheds light on the important role that periphery areas have.

Figure 4 shows clusters at the subsector level. It is worth noting that the number of industries differs across these figures as not all of them have been identified for the 2 years considered. In general terms, we can distinguish clusters between those located in the core of the FUAB and those located in its periphery. The core-oriented clusters correspond to industries like Advertising, Audio-Visual, Heritage, Photography, Publishing and Arts; namely, traditional creative industries. This clustering pattern is consistent with findings by Asheim *et al.* (2017), who emphasized the role of active policy intervention in the media cluster development of Scania (Southern Sweden), a quite similar process to that of the 22@ district in Barcelona, thanks to measures like infrastructure investments, creation of research and innovation centers, location of public universities, etc.

Looking deeper into the previously specified clusters, we have identified several cultural programs and institutions (mainly implemented by the Catalan government using EU Structural

Funds and regional funds) that may have favored cluster formation and growth. Firstly, in the core of Barcelona, the clusters of Advertising, Graphic and Audio-Visual firms have strengthened and grown between 2009 and 2017, and two new clusters of Photography and Architecture firms were created in 2017 in an area where they had not been concentrated before. Scanning this geographical area, we find the Disseny Hub Barcelona (established in 2012), a new innovative municipal facility focused on driving the knowledge economy in the design industry. Secondly, at the heart of the new cluster of Photography firms in 2017, we find the *Hospital de la Santa Creu i Sant Pau*, which is the cultural project that has received the largest amount of funding in absolute terms during the period 2007-2011 in Spain. Thirdly, there are other initiatives inside clustered areas, such as The *Barcelona Laboratori, Barcelona Art Factories, The Creative Research Park, the Institut de Cultura de Barcelona*, and the *i2cat Foundation*. Hence, provided with the detailed geographical level of our findings, specific neighborhoods and districts in the FUAB can be found to be indispensable for the support of innovation and creativity in the region. Although we cannot identify the specific nature and direction of the relationship between previous public intervention or funds and the firms inside CCIs clusters, there is empirical evidence suggesting their positive role in the development of creative clusters (Foord, 2009), so it is reasonable to assume that these patterns also apply to the case of FUAB.

The periphery-oriented clusters correspond mainly to Architecture, Fashion, Graphic, and Jewelry. It seems clear that locational behavior has something to do with the previous economic activities carried out at the local level (i.e., path dependence), factor endowment and the creative "atmosphere" that attracts and retains certain activities. In this regard, our results coincide with those by Kiroff (2017), as it is reasonable to assume that architecture firms are attracted to the heritage buildings of an area, its unique imagery, and the local brand of locations other than the urban core of the city, suggesting that other location factors could be creative industry sector dependent. Thus, the characteristics of a place play an important role.

There is also evidence of industries that seem to follow both strategies (i.e., core and periphery), such as Software, which is distributed in several clusters in Sant Cugat del Vallès, in the 22@ district, and the Diagonal avenue in Barcelona. Nevertheless, we guess that this result is partially biased by the industry aggregation level used in this paper (i.e., software and video-game firms are grouped together), as there is clear empirical evidence showing the existence

of a concentration of video-game firms in 22@ (Méndez-Ortega and Arauzo-Carod, 2019), where they benefit from the large knowledge spillovers arising from a concentration of similar firms and the existence of several training institutions and specialized suppliers.

It is also interesting to notice that high-tech industries like R+D and Software show some sort of suburbanization in Vallès Occidental county. Several high-tech firms have located in that area in recent years (especially in and around Sant Cugat del Vallès and the Autonomous University of Barcelona), helping to upgrade the traditional manufacturing base existent before in a process similar to that described by Asheim *et al.* (2017). The interactions among several cluster actors (e.g., public and research institutions) is an important factor in the attraction of high-tech firms and the development of spin-off dynamics from big firms.

Furthermore, comparing the findings from the two years, based on theoretical frameworks of Andersson et al. (2004) and Menzel and Fornahl (2009), we can identify emerging and mature clusters by comparing the number of clusters for each CCIs subsector and the number of firms within each cluster. Furthermore, the size of the cluster (i.e., the number of locations that form each cluster) can reveal the shrinking or expansion in the shape of the cluster. For instance, the findings on one of the Fashion clusters, located in the periphery part of the FUAB, show that the cluster is in its sustaining stage. The number of firms slighted decreased, and the cluster did shrink in shape, revealing a trend towards to the central, focal point, of the cluster. On the other hand, an example of an emerging cluster is that of Photography in 2017, incorporating 37 firms, agglomerating in the core of Barcelona. Explicitly, the sustaining cluster of fashion is similar in its context to Third Italy (Becattini, 2002). An example of a strong growing clusters in the core of Barcelona is Advertising, having the number of firms increasing between the two years, still the two clusters have changed in shape, and incorporated nearby neighborhoods throughout the years showing a slight change in their path, but still co-agglomerating with similar art and media related clusters of symbolic knowledge base. The publishing sector have seen a similar trend of a growing/mature cluster; however, it seems that it is shifting from the core toward the borders with the periphery part of Barcelona. Such findings again emphasize the role of the periphery, without underestimating that of the core.

A general approach to previous results indicates that, due to asymmetries, space matters and firms look for these asymmetries when deciding on the location of their venues. That is why

several specialized clusters emerge and survive throughout time, attempting to take advantage of existing business and social ties in different locations as well as the availability of specialized labor and infrastructures, public resources, and intermediate and final markets.

5. Conclusions

This paper has shed some light on CCIs clustering, focusing on the specific case of FUAB. Although clustering patterns have been extensively analyzed for economic activity as a whole and for some manufacturing industries, empirical evidence regarding CCIs is still scarce. There are several analyses of clustering patterns in these industries, however, these are made mainly from a qualitative perspective, without providing strong empirical evidence supporting clustering behavior.

This paper contributes to the empirical literature of CCIs spatial patterns with the following findings: *i)* CCIs firms tend to cluster, especially in core or urban areas (e.g., in and around Barcelona), *ii)* there are structural differences at the industry level in terms of clustering that can be interpreted given the heterogeneities of the knowledge bases of the industries *iii)* clustering patterns are quite stable in the short and medium term, *iv)* there is urban resilience (i.e., a "Barcelona effect") benefiting CCIs clusters, and *v)* clusters in the periphery areas of FUAB show growth patterns that shall be emphasized.

There are several policy implications arising from this paper. The first one refers to the natural tendency of firms to cluster, which is also true for CCIs. This fact suggests the advantages of providing location conditions to facilitate similar industry cluster formation, assuming that if firms look for neighbors similar to themselves, it is because they benefit from this geographic proximity. The second one refers to the urban resilience identified when comparing the cluster maps for 2009 and 2017. In this sense, if dense urban areas (e.g., Barcelona) provide additional resilience, then public administrations should take this urban effect into account when designing land planning for specific economic activities. Finally, the third one suggests that, although there is a clear tendency to cluster inside big urban areas, there is still room for smaller cities to house specialized CCIs clusters.

The main limitation of this paper refers to the dataset. This paper relies on Mercantile Register data (i.e., SABI), which is the most common source of information for studies based on the

location of economic activity in Spain. Although this dataset provides a clear picture of the overall distribution of economic activity, it is about firms, not about establishments. This issue could be a problem in the case of multi-plant firms, but these are unusual in CCIs.

As for future extensions of this research, it is clear that after identifying where and when CCIs cluster, it is necessary to analyze whether that pattern has any effect in terms of firm efficiency and/or turnover (i.e., entry and exit). Therefore, a future extension of this paper will concentrate on the effects of clusters in terms of the locational determinants of firms belonging to the same CCIs in order to check whether the benefits of clusters are perceived as strong locational determinants by entering firms. Additionally, departing from our results, there is room for additional research that attempts to evaluate the impact of local, regional, and EU funds used to promote CCIs in order to quantify their (positive) effect for some clusters.

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Appendix

Table A.1 CCIs definition and their correspondence at industry-level (NACE Rev. 2. 2009-NACE 93 Rev. 1)

	NACE 2009	Equivalence NACE 93 Rev. 1
Fashion		
Manufacture of leather garments	1411	18100
Preparation of work clothes.	1412	18210/25241
Preparation of other outer garments.	1413	18221/18222/25241
Making of underwear.	1414	18231/18232
Manufacture of other garments and accessories.	1419	17710/18241/18242/18243
Hosiery manufacturing	1431	17710
Manufacture of other knitwear.	1439	17720
Dressing, tanning and finishing of leather; Preparation and dyeing of skins.	1511	18301/19100
Footwear manufacturing	1520	19300
Graphic Arts and Printing		
Graphic arts and related services.	1811	22210
Other printing and graphic arts activities.	1812	22220
Prepress and media preparation services.	1813	22240/22250
Binding and related services.	1814	22230
Specialized design activities.	7410	74841
Jewellery, Music Instruments and Toys		
Manufacture of jewellery and similar items.	3212	33500/36221/36222
Manufacture of jewellery and similar items.	3213	33500/36610
Manufacture of musical instruments.	3220	36300
Manufacture of games and toys.	3240	36500
Other manufacturing industries n.c.o.p.	3299	18243/19202/20510/20521/22110/25130/25241/26820/28753/33100/36630
Publishing		
Book edition	5811	22110
Editing directories and postal address guides.	5812	22110/72400
Newspaper edition	5813	22120
Editorial of magazines	5814	22130/72400
Other editorial activities	5819	22150/22220/72400
Software and Videogames		
Videogame edition	5821	72210/72400
Editing other computer programs	5829	72210/72400
Computer programming activities	6201	72220/72400
Computer consulting activities	6202	72100/72220
Cinema, Music, TV and Radio		
Postproduction activities of film, video and television programs.	5912	92112
Film exhibition activities.	5914	92130
Film and video production activities.	5915	92111
Activities of television program productions.	5916	92202

Activities of distribution of films and videos.	5917	92121/92122
Distribution activities of television programs.	5918	92202
Activities of sound recording and music editing.	5920	22140/72400/74843/92112/92201
Broadcasting activities	6010	64200/72400/92201
Programming activities and television broadcasting.	6020	64200/72400/92203
Reproduction of recorded media.	1820	22310/22320/22330
Architecture and Engineering		
Architectural technical services	7111	74201
Technical engineering services and other activities related to technical advice.	7112	74202/74203/74204
Research and Development		
Research and experimental development in biotechnology.	7211	73100
Other research and experimental development in natural sciences and techniques.	7219	73100
Research and experimental development in social sciences and humanities.	7220	73100/73200
Advertising		
Advertising agencies	7311	74401/74402
Photography		
Photography activities	7420	74811/74812/92400
Writers, Performing Arts, Visual Arts and Crafts		
Performing Arts	9001	92311/92312/92343
Auxiliary activities to the performing arts.	9002	92313/92342/92343
Artistic and literary creation.	9003	92311/92400
Management of exhibition rooms.	9004	92320
Heritage Activities		
Activities of the museums	9102	92521
Management of historical places and buildings.	9103	92522
Activities of botanical gardens, zoos and nature reserves.	9104	92530
Activities of the library	9105	92510
File activities.	9106	75140/92510

Source: Developed by the authors; CCIs selection adapted from the literature, and codes equivalence adapted from INE (National Statistics Institute, 2010) and based on authors' own judgment.

Chapter Four

Location Patterns of Cultural and Creative Industries: Role of Clustering

Paper [3] presented in this chapter is coauthored with Josep-Maria Arauzo-Carod and Fernando López Hernández. It has been published in the Working Papers Collection at ECO-SOS, URV (DT 05-2021).

1. Introduction

Cultural and Creative Industries (CCIs) are receiving growing attention by scholars from different academic disciplines ranging from sociology, geography, economics, urbanism, and business. Our interest in them combines focuses of several of these areas as we care about how CCIs firms locate, why CCIs firms choose to be close to other firms, and, finally, whether spatial proximity is needed for the interactions that CCIs firms have with each other. As the title of this paper indicates, the main interest of it is location issues, but this is not only about pure geographical issues but, on the contrary, about implications of these location decisions.

In this paper, we focus on CCIs for several reasons, the most important one being the fact that these industries are hypothesized to have an important economic role (at least) in more developed countries. Nevertheless, when dealing with CCIs it is not clear at all what do scholars mean when talking about them. In this sense, literature is quite wide and departs from seminal contributions by the Department of Media, Culture, and Sport (DCMS, 1998), but has been later followed by a wide literature trying to better define and identify which activities to be included as CCIs, which is still controversial. Nevertheless, there are extensive contributions by public organizations as UNCTAD and OECD that may help, as well as extensive work by authors as Luciana Lazzeretti (see, among others, Lazzeretti *et al.,* (2008, 2012)).

As we do not aim to carry out a methodological contribution dealing with the identification of the activities to be considered as being part of CCIs, we will use a wide definition of them, trying to have a broad perspective in terms of activities having a cultural and/or creative dimension.[31] Accordingly, we have selected twelve industries to be taken into account by this analysis. Concretely, these are advertising; architecture and engineering; cinema, music, TV, and radio; fashion; graphic arts and printing; jewelry, musical instruments, and toys; photography; publishing; research and development; software and video-games; writing, performing arts, visual art, and craft; activities related to heritage.

This is an empirically driven analysis aiming to identify location patterns of CCIs and how existing clusters of these industries may modulate these decisions. Concretely, we depart from

[31]Check Appendix 1 for a detailed list of these activities.

a previous analysis by Maddah *et al.* (2021) in which CCIs clusters are identified in the Functional Urban Area of Barcelona (FUAB) using data from the Mercantile Register corresponding to 2009 and 2017. As this paper clearly identifies the number and extend of clusters for these industries, we use similar data for 2010-2013 about new firms entering the same area, computing their location choices, and inferring their locational determinants. Our results provide empirical evidence about the persistence of location patterns (i.e., clusters attract firms of the same industries).

The relevance of the study on firms' entries and clusters is observed by its recent centrality in the academic and empirical literature, as well as policy discussion. Both theoretically and empirically, in the analysis of modern economic geography, the spatial knowledge spillovers, industrial clusters, firms' entry, entrepreneurship, growth, and survival, are all topics getting much attention from the scholars. As for policy debate, the current shift on European political and economic agendas is towards a more regional and local "place-based" policy approach. This is in line with Smart Specialization strategies. As emphasized in the (European Commission, 2013) report on the role of clusters in smart specialization strategies, "Cluster policies can provide a core toolkit to engage with and develop sectors of the economy in which a region has a significant position. They can guide the concentration and integration of economic policies around specific areas of the economy. And they can help avoid the pitfalls of traditional industrial policies, which often use tools that limit competition and thus ultimately competitiveness" (p.4). More specifically on cultural and creative industries, since 2012, the European Union has been addressing issues related to the contribution of cultural and creative industries/clusters to economic transformation through smart specialization (European Union, 2012). As the aim of this paper is to identify whether clusters of CCIs affect the location decisions for firms in the FUAB, thus it contributes to aligning local public policy agendas to offer tailored support for CCI cluster policies. This in turn reinforces the role of CCIs in the local economy and innovation.

We have structured the paper as follows. In the next section, we review the literature on location determinants, with a particular focus on specificities of CCIs firms. Then, we present data and the methods used. Next, we discuss the main results. Finally, we summarise our main conclusions and discuss some policy implications.

2. Location determinants: specificities of Cultural and Creative Industries (CCIs)

By and large, place matters. Firms tend to search for *strategic* locations in search for advantages of agglomeration factors, local knowledge spillovers, and spatial proximity to urban amenities, similar producers, or targeted consumers. Numerous studies in the literature emphasize agglomeration economies as a determinant for firm location (Arauzo-Carod *et al.,* 2010; Delgado *et al.,* 2010; Wenting *et al.,* 2011). On location determinants of high-manufacturing activities, Arauzo-Carod (2009) found that new manufacturing establishments are positively influenced by firm density and the percentage of high-tech firms. This reflects the importance of industrial concentration and specialization in attracting firms' entries. Distance to main cities and the density of high-tech workforce have a negative influence as shown in the latter study, thus undermining the influence of urbanization aspects and occupational characteristics. Other studies have found diverse impacts on location decisions of firms given the variation in the nature of the industries. For example, Arauzo-Carod and Viladecans-Marsal (2009) for some metropolitan areas in Spain, found that urbanization economies had a positive influence on the location of new firms belonging to the low- and high-technology groups, but there was no effect for intermediate technology firms. Whereas localization economies had a positive significant impact on all the industries analyzed. Hence, evidence emphasizes the importance of sectoral specialization at a local level in attracting new firms in this sector.

Other studies have focused on the differences between urban and rural areas, rather than industrial differences, in evaluating the impact of agglomeration economies. Artz *et al.* (2016) found that firms are more likely to locate in markets with an existing cluster of firms in the same industry (with concentrations of suppliers or customers, and college-educated workers) and that firms are less likely to enter markets with no incumbent firms in the sector.

The influence of geographical concentration of firms on location decision, mainly acknowledged by the work of Marshall (1920) has further called an additional strand of literature that focuses on the role of clusters. The general confirmation is that clusters fuel the firms' entries. Frenken *et al*., (2018) show that there is strong evidence that clusters promote entry, but little evidence that clusters enhance firm growth and survival. The authors reveal the need to emphasize sectoral heterogeneity in this line of research.

Belussi (2018) studies MNEs entries in relation to the cluster life-cycle and finds that evolving clusters attract foreign MNEs that are interested in absorbing the newly created pool of local

knowledge, which in turn allows the co-development of MNEs and local firms. As well mature clusters encourage the entries of MNEs; this encourages further cooperation with local institutions and research centers. This finding emphasizes the role of clusters as engines not only for firms' entries but also for creating an attractive environment of numerous cluster actors such as universities and public institutions. Similarly, Delgado *et al*. (2010) address the role of regional clusters in regional entrepreneurship. The authors find that strong clusters are also associated with the formation of new establishments of existing firms, thus influencing the location decision of multi-establishment firms.

2.1 Location of CCIs

Despite the growing importance of cultural and creative industries, studies on location determinants of firms' entries in those industries are still scarce. A general study by Coll-Martinez and Arauzo-Carod (2017) shows that location determinants are quite similar both in creative and non-creative industries and that both industries are positively influenced by the specialization level of creative industries. In a thoroughly focused approach on software and video game firms in Barcelona, Méndez-Ortega and Arauzo-Carod (2019) found that SVE and video game firms follow patterns similar to other service industries by tending to cluster around some central areas of the Metropolitan Area of Barcelona (MAB) as a whole, and Barcelona city center in particular. However, the authors found a limited influence of inter-industry localization economies as they emphasized that f the SVE and video game firms differ do not tend to locate close to the same type of industries.

On the other hand, Cook and Pandit (2008) found that strong clusters in Film and Television sectors promote entrepreneurship, which in turn promotes cluster strength in a self-reinforcing dynamic and that some firms are better able than others to benefit from cluster location due to superior firm competencies and absorptive capacity. Heebels and Boschma (2011) address the publishing sector in Amsterdam and found that the Amsterdam cluster did not function as an attractor for publishing firms from other regions, but rather acted as an incubator for firms that relocated to other regions. Finally, applying a qualitative case study approach, a study on the leather products cluster in Florence by Randelli and Lombardi (2014) found that among all clusters, only the Florence cluster had an asymmetric path in the period 1995-2011, compared to a general trend of decline in the number of firms. The Florence fashion leather cluster, lead by Gucci, continues to have a positive rate of new firms, even faced with the global crisis. This

finding calls attention to the importance of well-established brands in attracting entrepreneurship in the same sectors.

Location of creative firms is very much associated with direct access to urban amenities, consumer market (tourists for example), lifestyle, places that act as platforms/catalysts for individual expression and inspiration, social networks, and other socio-psychological dimensions. A strand of literature that complements the discussion on firms' entries and location decisions is one that focused on artistic/cultural entrepreneurship (Heebels and Van aalst, 2010; Rius-Ulldemolins, 2012; Cunningham and Tolonen, 2019, and Murzyn-Kupisz and Dzialek, 2019). The majority of those studies used a qualitative methodology. Scott (2004) emphasized the importance of spatial agglomeration for creative firms' entries to the Hollywood film cluster, arguing that firms benefit from informal networking, knowledge spillover and creativity stimulation, more available and efficient local services, specialized organizations, and cultural facilities. Similarly, Heebels and Van aalst (2010) advocated the importance of spatial concentration for creative firms' entries, yet reflected on the individual characteristics by differentiating between location decisions of "experimental" and "established" creative entrepreneurs. Other researchers as well highlighted the importance of both social and spatial context (Cunningham and Tolonen, 2019). Murzyn-Kupisz and Działek (2019) linked the artistic and cultural firms' physical location decision to four dimensions (1) specific quarter type (2) potential economic and spatial advantages (3) desired visibility in urban space and (4) targeted customer types. The authors found differences among respondents, as some favor locating their firms in inner-city areas (historic quarters) to benefit from social contacts, large flows of customers (mainly tourists), and prestigious image of the city and cultural heritages, while others prefer less prestigious periphery parts of the city, targeting local clients and benefiting from other advantages.

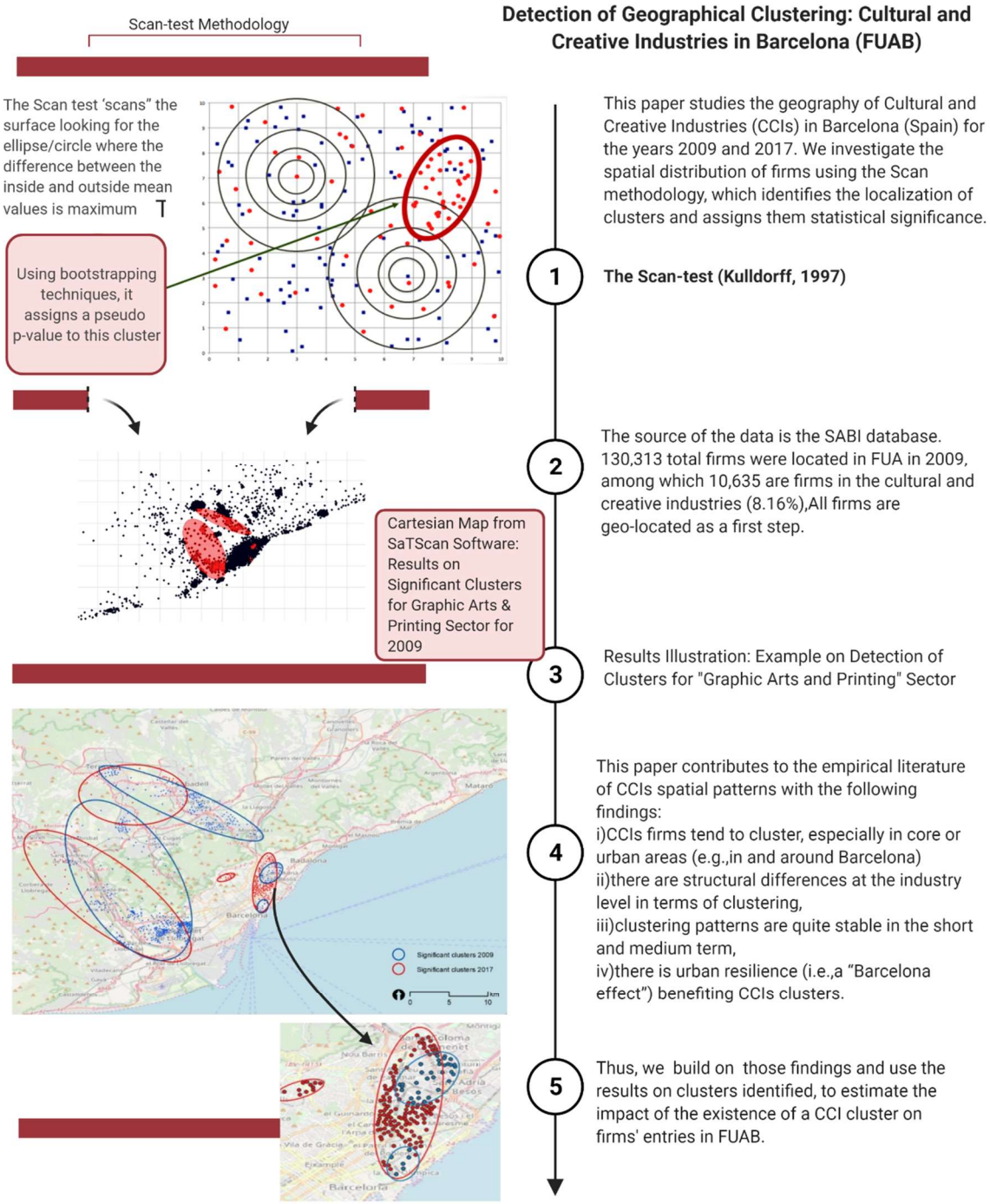
2.2 Clustering of CCIs

Mainly studied in the field of economic geography, Lorenzen and Frederiksen (2008) described clusters as "geographical agglomerations of firms that enjoy economies (positive externalities) from being located the same place" (p. 2). Clustering of cultural and creative industries has been a focus of numerous studies in the last decade (Maddah *et al.,* 2021; Coll-Martínez *et al.,* 2019; and Boix *et al.,* 2015, among others). Theoretically, Lorenzen and Frederiksen (2008) explained cultural and creative clusters in terms of urbanization and localization economies.

Localization economies are those positive externalities firms may enjoy from co-location, in the effect of industrial specialization. Whereas urbanization economies are allocated to positive externalities related to urban location. Examples of urban clusters of CCIs as identified in preceding literature are software and videogames (Maddah *et al*., 2021 for Barcelona; Méndez-Ortega and Arauzo-Carod, 2020 for Barcelona, Lyon, and Hamburg), ICT and biotech (Lorenzen and Frederiksen, 2008), advertising, cinema, music, TV and radio, graphic arts and printing, photograph, publishing, writing, performing arts, and crafts (Maddah *et al*., 2021). Such urban clusters benefit from urban amenities, universities, as well as research and public institutions and investment. However, mature industries such as furniture (Lorenzen and Frederiksen, 2008) and fashion manufacturing (Maddah *et al.*, 2021) cluster in nonurban areas because they rely on product flexibility, variety, and incremental innovation, and benefit hugely from localization economies.

Inner cities are commonly a preference for CCIs clustering (Landry, 2012). In Europe, the largest clusters of CCIs are located in the inner parts of the largest cities (Boix *et al.,* 2015). Agglomeration benefits, knowledge spillovers, social networking, historical quarters, and rich cultural districts are, among others, benefits that CCIs exploit in such places. As we focus on Barcelona city in this paper, we build on a detailed study on clustering of CCIs, at sub sectoral level, in the FUAB provided in the previous chapter of this thesis. Thus, we present in Figure1 a brief description of the approach of the previous chapter and in Figure 2 their detailed findings on clusters in the FUAB between 2009 and 2017, using the SaTScan Methodology, which will be the departing point of this paper and the source of the main measure of firms' agglomeration, our variable of interest (existence of a cluster) in the estimation of firms' entries.

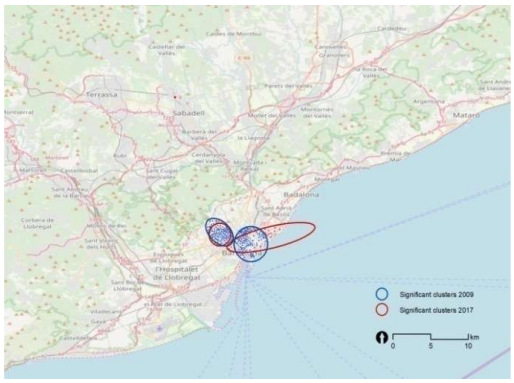
Figure 1.A SaTScan Approach to Identifying Clusters: Summary of Maddah *et al.* (2021)



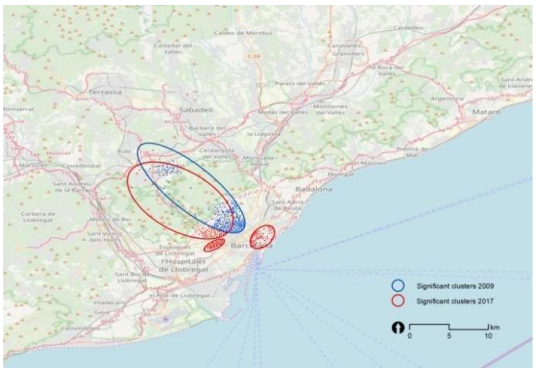
Source: Authors' own elaboration.

Figure 2. Significant Clusters of Cultural and Creative Industries in FUAB

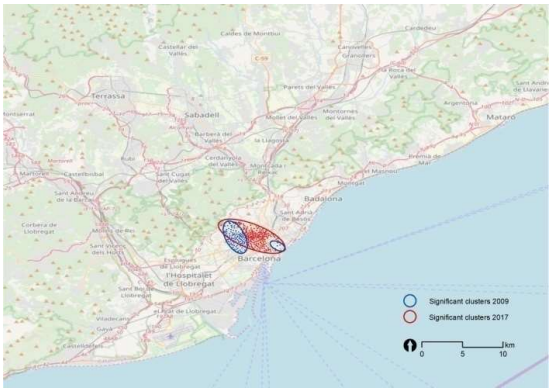
Advertising



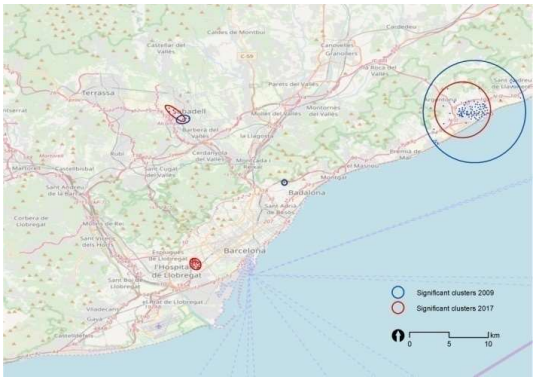
Architecture and Engineering



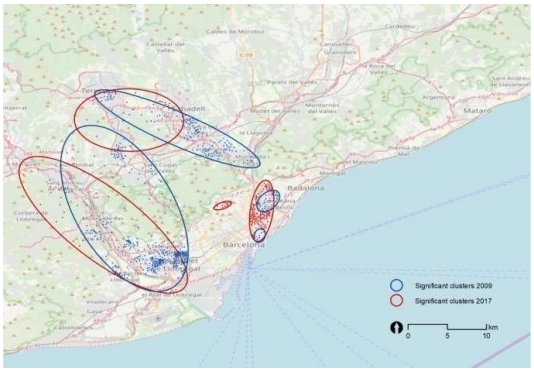
Cinema, Music, TV and Radio



Fashion



Graphic Arts and Printing



Jewelry, Musical Instruments and Toys

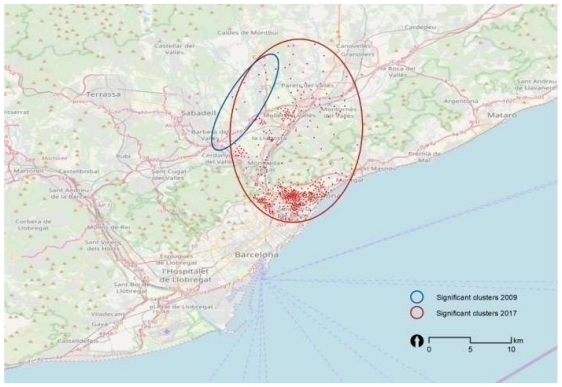
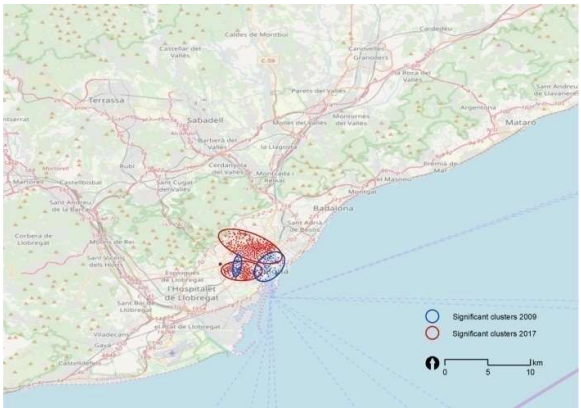


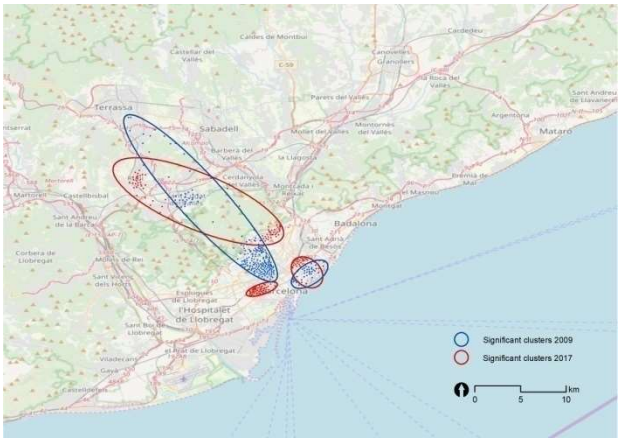
Figure 2. Significant Clusters of Cultural and Creative Industries in FUAB (cont.)

Publishing



Writing, Visual and performance arts and crafts

Software and Videogames



Source: Maddah *et al.* (2021).

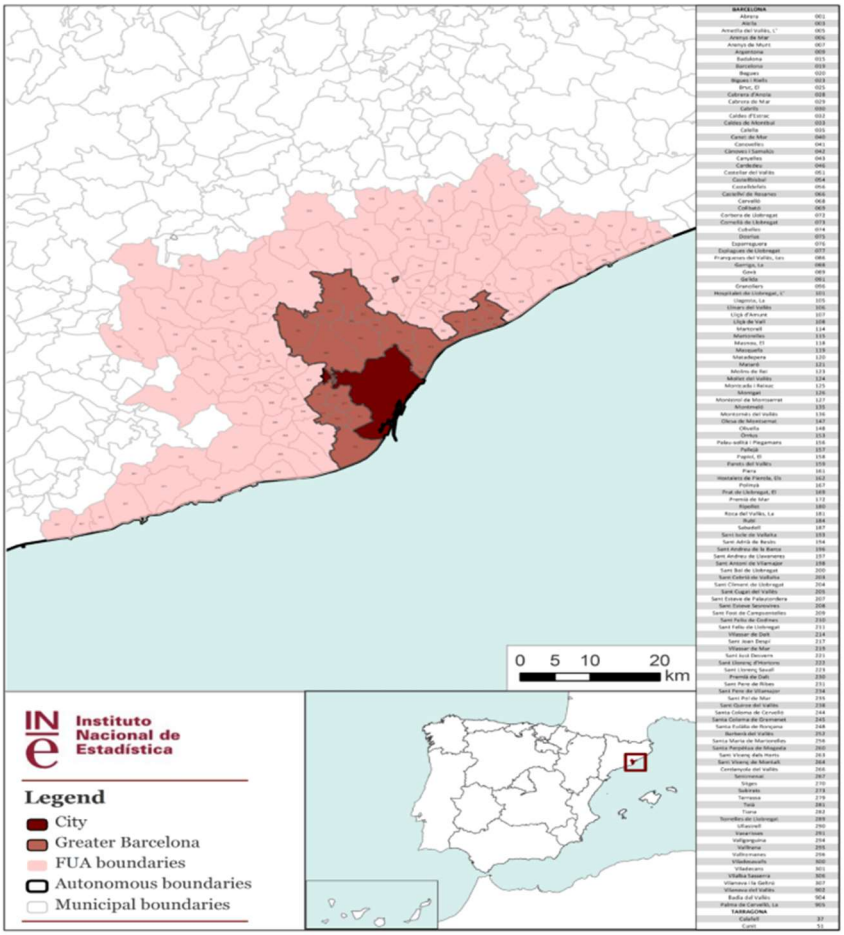
Markusen (2014) argues that city leaders help improve their cities by targeting resources when they know where this capacity is located and how organizations choose sites: "*In fashioning good policy and making funding and planning decisions, what do city leaders and advocates need to know about the location preferences of artists, arts organizations and arts participants?"* (p.581). Through this study, we aim to fill an existing gap in this area. In particular, our contribution is that we directly study the firm location choice with respect to the existence of an industry-related cluster, suggesting higher agglomeration benefits attract new firms. Qualitative analysis and case studies still dominate this field of inquiry on the relationship between creative clusters and firms' entries (Markusen, 2014). To the best of our knowledge, our paper is the first empirical study that examines the role of geographically identified significant CCI clusters in encouraging new firm entry. This approach provides a bridge between the empirical new economic geography literature on urban cities and clusters and the empirical literature on the firm location.

3. Data and Methodology

3.1. Sample and Data

Our main data source is the SABI database (*Sistema de Análisis de Balances Ibéricos*), from INFORMA D&B. Specifically, SABI collects data from the Spanish Mercantile Registry, where mercantile firms are obliged to deposit their balance sheets on an annual basis. SABI provides information on a large number of variables regarding these firms, including birth date, balance sheets, income, expense accounts, number of employees, the industry at 4 digits level, sales and assets, and the geo-referenced location (X and Y coordinates). Although SABI is the most usual source for studies of the location of economic activity in Spain, this database is about firms, not establishments, being that in the case of multi-plant firms, data refers to firms, not to their establishments, so in those cases SABI will provide the information in an aggregated way for the firm as a whole, using the location of the headquarter. Obviously, having disaggregated information for all the establishments would allow a much more precise analysis, especially as regards the spatial distribution of economic activity. However, this bias is not presumed to be relevant given that, according to data from 2006, multi-plant firms in Spain are estimated at just over 1% of the total (Jofre-Monseny *et al*., 2018).

Figure 3. Functional Urban Area of Barcelona



Source: INE

This paper analyses location determinants at the Functional Urban Area of Barcelona (FUAB) (Spain). The FUAB comprises the city of Barcelona and 137 surrounding municipalities (see Figure 3). According to Spanish Statistical Institute (INE), a Functional Urban Area consists of a group of municipalities and their commuting zones. Overall FUAs are areas where there is an integrated and easily identifiable labor market inside its geographical boundaries. Concretely, FUAs rely on commuting criteria (i.e., areas where 15% or more of the employed population commutes to the city center) and spatial contiguity criteria. In terms of size, the FUAB has a resident population of almost 5 million people (1,5 of them correspond to the city of Barcelona). There are around 2.5 million jobs in Barcelona province (13.6% of jobs in Spain) among which 1.1 million jobs are in Barcelona (5.9% of the employed population in Spain and 35.5% of Catalonia). 54.1% of the jobs in Barcelona are knowledge-intensive. The core of the FUAB is thus the city of Barcelona, a global city with plenty of cultural infrastructures where most of Catalan CCIs activities agglomerate, ranked by the Cultural and Creative Cities

Monitor (European Commission, 2017) as the ninth large city in terms of vitality and creativity (Barcelona Data Sheet, 2018). This data on Barcelona city justifies the need to break-down the city into smaller geographical areas to accommodate for the disparities among Barcelona city and remaining FUAB municipalities. Therefore, the spatial units of the analysis include 147 spatial units: i) the core of the FUAB (i.e., 10 districts inside the city of Barcelona) and ii) the periphery of the FUAB (i.e., 137 surrounding municipalities) (see Figure 4 in Section 3 for details).

3.2. CCIs' Identification

As we want to analyze the effects of CCIs clusters in the FUAB identified in Maddah *et al.* (2021), in this paper we just consider the 11 CCIs used there. Namely, Advertising; Architecture and engineering; Cinema, Music, TV, and radio; Fashion; Graphic arts and printing; Jewellery, Music instruments, and toys; Photography; Publishing; Research and development; Software and video-games; Writing, Performing arts, Visual art, and craft (see Appendix 1 for details). In any case, that selection fits with previous approaches in terms of CCIs identification, such as those of Lazzeretti *et al*. (2008), Lazzeretti (2013), and Bakhshi *et al*. (2013).

3.3. Empirical strategy

We estimate the number of firms locating in the FUAB (i.e., the dependent variable) as a function of a vector of local characteristics of the 147 spatial units considered. Specifically, we will estimate location determinants for the 11 CCIs subsectors considered in this paper, as well as for all CCIs together and, to control for CCIs specificities, all firms, and all non-CCIs firms.

Dependent Variable

As mentioned previously, the identification of the geographical unit is the first step. For the purpose of this study, we have selected the municipalities of FUAB and disaggregated Barcelona city into ten districts. To construct the dependent variables (1) all firms' entries (2) CCIs entries (3) Non-CCIs entries (4) industry-specific entries, we use firm registration records from SABI to build measures for firms' entries for each year between 2010 and 2013. We identify the industrial sector, in which firms operate, at the 4-digit level of European Standard

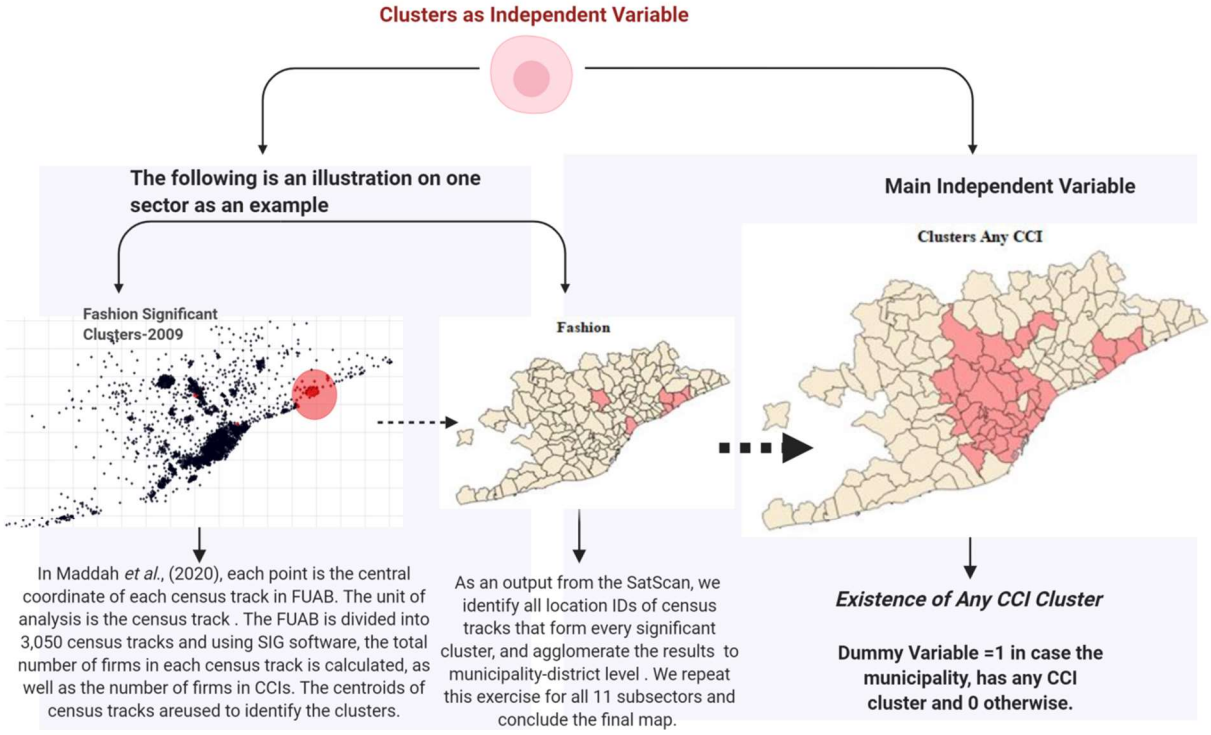
NACE-2009 Industry Classification (Appendix 1), and then geo-locate all firms, using QGIS, to assign its relevant location (municipality/district) which is our geographical unit. Our dependent variable is thus the number of firms entering a spatial unit (municipality/district).

Independent Variables

To estimate the location decisions of firms in FUAB, we use preceding theories and empirical methods used to categorize and select variables at local level. We assume that agglomeration economies are of key importance when choosing a new venue. Our main variable of interest refers to the existence of a cluster of CCIs altogether, any CCI, and the specific CCI industry in the same municipality/district (the variable is adapted from Maddah *et al*., 2021). In Maddah *et al.* (2021), clusters of firms are identified at the census tract-level. For the purpose of this paper, the findings are aggregated to the municipality and district level using basic estimations on SatScan and QGIS.

We identify all location IDs of census tracts for every significant cluster to spot the municipality/district. For example, if a cluster has location IDs census-tracts 801901002, 801901004, and 800610005, then the cluster is aggregated in municipalities 8019 and 8006 (see Figure 4). The focus on local spatial units for creative industries is being emphasized more than ever. Markusen (2014) reflects that city mayors, urban scholars, real estate interests, arts community members, and policymakers have engaged in vital debates about whether to designate cultural districts, what kinds of resources should be devoted to them, and what kinds of success to anticipate if created.

Figure 4 Geographical Units Transformation: Clusters in Spatial Units



Source: Authors' own elaboration.

After testing a set of variables, five additional variables were chosen for empirical estimations of the model. We use the Variance Inflation Factor (VIF) for the selection among variables. For example, variables *Land Price of New Construction* and the *Number of workers affiliated to the General Social Security* were excluded. Also, our choice of variables depends on the availability of all variables needed at the municipality and district level. Table 1 highlights the descriptive statistics of the selected explanatory variables and their definitions.

Those variables are *pop*, the population of municipality/district for the base year 2009. This variable is a fundamental demographic variable that measures agglomeration economies. The *Stock* variable is the initial total number of firms in municipality/district for 2009, measures the density of incumbent firms. Generally, in theoretical models of entrepreneurship, income level influence the creation of new enterprises, which is why we include the variable *Income* that is the general tax base per taxpayer for 2009. Finally, two geographic dummy variables are included (1) *Sea* and (2) *CBD* (Central Barcelona District). If the municipality is on the

seashore, the variable *Sea* takes the value of 1. As for the CBD, it is "*Eixample*" district. This district is known as the hub of creativity in Barcelona. Referring to Rius-Ulldemolins (2012) the center of Eixample has witnessed the location of some thirty art galleries since the twentieth century, and ever since has become the place of modern art (as compared to the Gothic Quarter where the traditional art was concentrated). By 2012, Eixample has had the lion's share of medium-importance galleries (56%) as compared to the other 9 districts of Barcelona, and 72% of the high importance galleries (Rius-Ulldemolins, 2012). Considering the "creative" aspect of the industries in this study, and the argument in preceding literature that artistic entrepreneurs consider the "look and feel of the place" to locate their firms (Heebels and Vaanalst, 2010), this variable is found relevant.

Table 1. Descriptive Statistics-Explanatory Variables

Variable	Description	Source	Obs	Mean	Std. Dev.	Min	Max	Variance
Clucci	Total CCIs Clusters (Dummy Variable x=1 if municipality has a cluster; x=0 otherwise)	Maddah *et al*., (2021)	147	0.027	0.163	0	1	0.027
Cluanycci	Any CCIs Clusters	Maddah *et al*., (2021)	147	0.293	0.456	0	1	0.208
Cluadv	Advertising Clusters	Maddah *et al.,* (2021)	147	0.041	0.199	0	1	0.039
Cluarc	Architecture and Engineering Clusters	Maddah *et al.,* (2021)	147	0.027	0.163	0	1	0.027
Clucin	Cinema, Music, TV and Radio Clusters	Maddah *et al*., (2021)	147	0.034	0.182	0	1	0.033
Clufas	Fashion Clusters	Maddah *et al*., (2021)	147	0.048	0.214	0	1	0.046
Clugra	Graphic Arts and Printing Clusters	Maddah *et al*., (2021)	147	0.204	0.404	0	1	0.164
Clujew	Jewellry, Music Instruments and Toys Clusters	Maddah *et al*., (2021)	147	0.034	0.182	0	1	0.033
Clupub	Publishing Clusters	Maddah *et al*., (2021)	147	0.041	0.199	0	1	0.039
Clusof	Software and Videogames Clusters	Maddah *et al*., (2021)	147	0.034	0.182	0	1	0.033
Cluwri	Writing, Performing Arts, Visual Arts and Crafts firms	Maddah *et al.,* (2021)	147	0.027	0.163	0	1	0.042
pop	Population per municipality/district (2009)	Idescat, from the INE's Continuous Register	147	33567.780	55071.220	308	269188	3030000000
Stock	Total Number of Companies(2009)	SABI (2010)	147	383.456	854.930	0	5946	730905.2
Income	General tax base per taxpayer (EUROS)	Own calculation based on Idescat	147	22600.640	5149.928	15597	45964	26500000
Sea	Dummy Variable; x=1 if municipality is on the seashores, x=0 otherwise	Own Observation	147	0.190	0.394	0	1	0.155
CBD	Dummy Variable Central Barcelona District (Eixample=1; 0 otherwise)	Own Observation	147	0.007	0.082	0	1	0.007

Table 2 shows the correlation matrix of the selected variables which shows that we do not have a problem with multicollinearity.

Table 2. Correlation Matrix of Independent Variables

	Cluanycci	**pop**	**CBD**	**Sea**	**Stock**	**Income**
Cluanycci	1					
pop	0.5536*	1				
CBD	0.1287	0.3553*	1			
Sea	0.0689	0.2420*	-0.0401	1		
Stock	-0.0334	-0.0734	-0.0131	0.1326	1	
Income	0.0402	-0.0668	0.0909	0.0434	0.1132	1

Legend: * Significance at 5%

3.4. Econometric methodology

Our dependent variable is the number of firms entering a spatial unit (municipality/district), which is a discrete non-negative integer. As we are trying to estimate a possible relationship between clusters' existence and firms' entries at a local level and given the nature of the dependent variable, we follow the preceding research on the location of firms (Arauzo-Carod, 2010). For modeling the discrete outcome, we employ count-data models as our methodological approach in conducting this empirical analysis.

The descriptive statistics of the dependent variables show signs of overdispersion and zero inflation. As a matter of example, zeroes scored an average of 50% for entries at the sectoral level and more than 25% for CCI firms' entries. But this wasn't the case for total firms' entries and non-creative firms. Referring to Cameron and Trivedi (1998) count-data models can deal with the "zero problem". This problem is very common in studies on firms' entries, mainly those which estimate entries in a highly disaggregated spatial unit (Arauzo-Carod, 2008). Still, considering municipalities/districts which are not receiving any entry is essential as this provides relevant information because the characteristic of these units (mainly the existence of a CCI cluster/or not) can help to explain why they have not been chosen by any firm to locate (spatial units where y=0). Otherwise, the results will be biased. The structure of the count-data models allows the handling of both positive and zero entries given that both types of dependent variables contribute to the estimation (Cameron and Trivedi, 1998) Another main

methodological concern when using a CDM to analyze location patterns is to follow one of the two potential schemes (Arauzo-Carod, 2008; Guimarães et al., 2003): *i)* to consider that location decisions are taken according to a vector of variables shared by all entrants (z*ij*= z*i*), and *ii)* to consider that location decisions are taken according to a vector of variables shared by groups of entrants (z*ij*= z*ig* for *g* = 1, 2,…, G, where G is the number of groups). In this paper grouping of entrants is done using the specific CCI to which each firm belongs, although CCIs are also considered altogether, as well as non-CCIs as all firms.

In the selection among count data models, the departure point is the Poisson Model (PM). This model has an advantage in dealing with the excess zeroes problem, however, has limited capabilities in dealing with "overdispersion" (the variance > the mean). The descriptive statistics in this paper specify that there is an overdispersion problem. These results lead to two suggestions: 1) apply the Negative Binomial model (NBREG) or 2) maintain the conditional mean assumption E(ylx) = exp(x'β), and in this case, one can proceed to use the Poisson maximum likelihood estimator (MLE), which retains its consistency, but relax the equivariance assumption to obtain a robust estimate of the variance-covariance matrix of the estimator (VCE) (Cameron and Trivedi, 1998), p.556). The second approach is chosen for the dependent variable *All Firms entries*. For CCIs entries, and sub-sectoral entries, the Zero-Inflated Negative Binomial model (ZIPM) is used. For the Non-CCIs entries, the Negative Binomial Regression model (NBREG) is used. The results of models are quite similar; however, based on the Akaike information criterion, the favored model for entries is selected. On a final note, similarly to Paper [1] to control for the spatial dependence, the spatial lagged variable of the existence of CCI cluster, and then for the existence of subsectoral clusters is incorporated in the model.

Table 3 show descriptive statistics of the dependent variables, which show signs of overdispersion and zero inflation. As a matter of example, zeroes scored an average of 50% for entries at the sectoral level and more than 25% for creative entries. But this wasn't the case for total firms' entries and non-creative firms.

Tables 3. Descriptive Statistics-Dependent Variables

Variable	Description	Obs	Mean	Std. Dev.	Min	Max	Variance	Count
Enttotal	Total Firms' Entries	147	59.388	149.857	0	1420	22457.14	8730
Entccis	Total CCIs' Entries	147	6.020	16.870	0	156	284.6	885
Entnonccis	Total Non-CCIs' Entries	147	53.367	133.439	0	1264	17805.9	7845
Entadv	Entries of Advertising Firms	147	0.966	3.667	0	34	13.444	142
Entarch	Entries of Architecture & Engineering Firms	147	1.367	3.785	0	37	14.330	201
Entcin	Entries of Cinema, Music, TV and Radio Firms	147	0.524	1.967	0	16	3.868	77
Entfas	Entries of Fashion Firms	147	0.401	1.441	0	10	2.078	59
Entgraph	Entries of Graphic Arts and Printing Firms	147	0.878	1.930	0	17	3.725	129
Entjew	Entries of Jewellry, Music Instruments and Toys Firms	147	0.190	0.577	0	5	0.333	28
Entphoto	Entries of Photography Firms	147	0.082	0.299	0	2	0.089	12
Entpub	Entries of Publishing Firms	147	0.340	1.421	0	14	2.021	50
Entrd	Entries of Research and Development Firms	147	0.150	0.666	0	5	0.443	22
Entsoft	Entries of Software and Videogames Firms	147	0.857	2.344	0	17	5.493	126
Entwri	Entries of Writing, Performing Arts, Visual Arts and Crafts firms	147	0.265	0.855	0	6	0.731	39

Focusing on the location phenomenon may generate a bias if not considering municipalities / neighbourhoods not chosen by any firm. Concretely, data of CCIs entering firms between 2010 and 2013 shows that municipalities / neighbourhoods out of where effectively chosen by, at least, one firm, whilst zero entries did occur at some of them. Any potential bias disappears when using a CDM as these models show how many times each area is chosen by a firm, being that those where y = 0 (i.e., not chosen by any firm) are also relevant because values of independent variables there explain why they have not been chosen.

When using a CDM to analyze location patterns there are two potential schemes (Arauzo-Carod, 2005; Guimarães *et al*., 2003): *i)* to consider that location decisions are taken according to a vector of variables shared by all entrants ($z_{ij}= z_i$), and *ii)* to consider that location decisions

are taken according to a vector of variables shared by groups of entrants ($z_{ij}= z_{ig}$ for $g = 1, 2,\ldots, G$, where G is the number of groups). In this paper grouping of entrants is done using the specific CCI to which each firm belongs to, although CCIs are also considered altogether, as well as non-CCIs as all firms.

Concretely, we model location decisions at the neighbourhood level with an exponential conditional mean function (Cameron and Trivedi, 1998):

$$E[Y|X] = \mu = e^{W-X\beta}$$

where the dependent variable Y is a vector that contains the number of new firms located during a period in one of the municipalities/neighborhoods. Most recent contributions that analyze firms' location determinants focusing on the characteristics of sites potentially selected by new firms rely on Count Data Models (CDM) (see Arauzo-Carod *et al*., 2010, for an extensive review of the empirical literature). As the CDM family is quite large[32], to discriminate among alternative CDM, we follow Cameron and Trivedi (1998).

Concretely, the number of new firms (i.e., belonging to a CCI or non-CCI industry) in a municipality/neighborhood is a function of the local specific characteristics previously described:

$$Y_{ij} = \beta X_j + \beta W X_j + \varepsilon_{ij}$$

where Y_{ij} is the number of new firms belonging to industry i located in a municipality/neighborhood j, $X_j$include the previously explained set of covariates, WX_j include the spatially weighted average of neighboring areas of most of the previous covariates (where W is a symmetric row-standardized matrix with elements taking values 1/0 depending on whether two areas are considered as neighbors –i.e. if they share a common border-, and X_j includes covariates with spatial variation), and ε_{ij} is an error term.

[32] Among the main CDM we may assume the Poisson distribution, the negative binomial distribution (NB), the zero-inflated Poisson (ZIP) and the zero-inflated negative binomial (ZINB). Typically, the Poisson specification is the starting point for these analyses, although it is not able to deal with the two main problems of data about entries in location analysis: 'overdispersion' and 'excess of zeroes'. That limitation can be easily solved by using NB, ZIP and ZINB specifications.

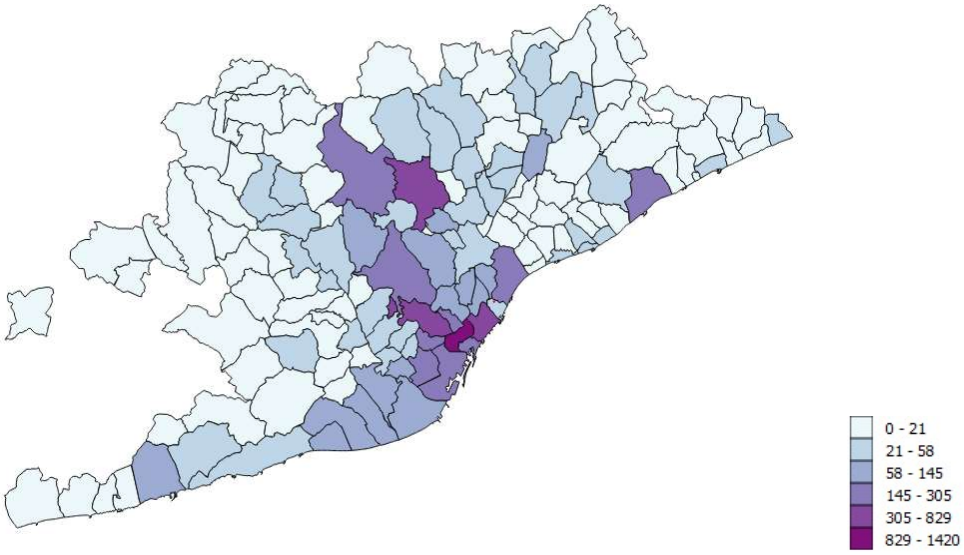
4. Results

4.1 Exploratory analysis: Descriptive Statistics and Maps

Figure 5 shows the spatial distribution of total entries (cumulative from 2010 until 2013) to FUAB, CCIs' entries, and Non-CCIs entries, respectively[33]. The spatial distribution of firms shows a common trend among firms to locate on the urban part of the FUAB, with the periphery part generally having zero entries. The concentration becomes higher in the heart of Barcelona city, with variations within its ten districts.

Figure 5. Firm entries in FUAB (2010-2013)

Figure 5.1 Total Firms Entries in FUAB (2010-2013)



[33] Entries of CCIs-Subsectors Firms in FUAB (2010-2013) are presented in Figure A.1 (see the Appendix)

Figure 5.2 Entries of CCIs to FUAB (2010-2013)

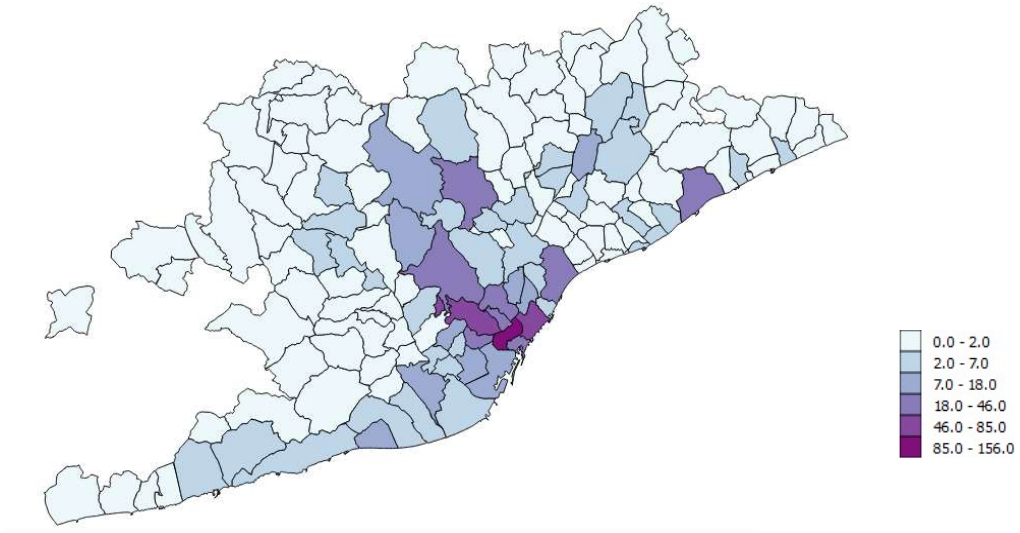
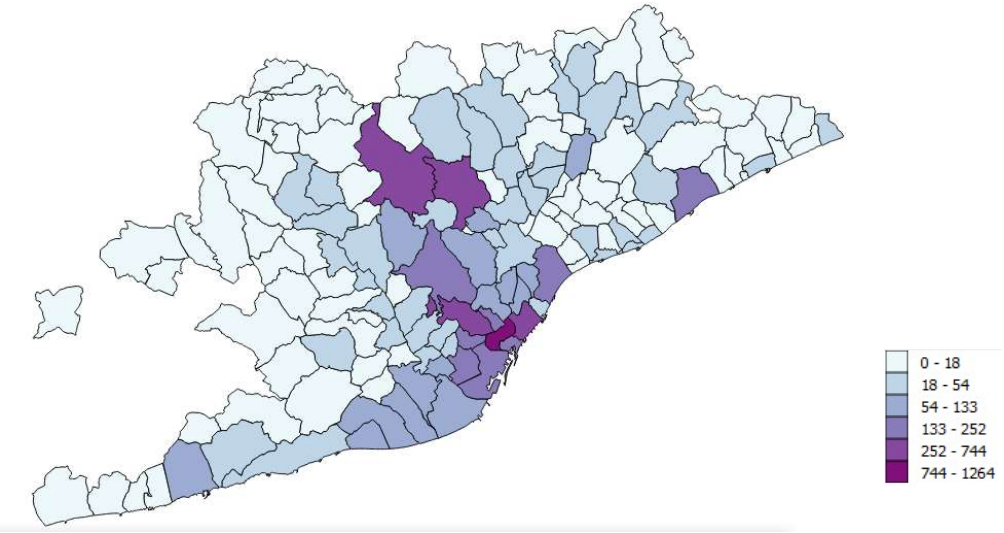


Figure 5.3 Non-CCIs Entries in FUAB (2010-2013)



Source: Authors' own elaboration

4.2. Econometrics

The study uses firms' data from Mercantile Register (SABI), and exploits count data models in the analysis, as elaborated in previous sections. The exploratory analysis reveals the spatial distribution of firms shows a common trend among firms to locate on the urban part of the FUAB, with the periphery part generally having zero entries. The concentration becomes higher in the heart of Barcelona city, with variations within its ten districts.

To start with, Table 4 shows the location determinants of firms' entries in FUAB. This is the baseline specification in which no spatial effects are included. Our variable of interest, i.e., the

existence of a cluster of any CCI *(Cluanycci)* has a significant and positive effect on the entries of all firms, CCIs and Non-CCIs. The population and income levels are significant for all entries, whilst the CBD and stock-09 are only significant for all firms' specifications. Being on the shores of the sea appears to influence CCIs and Non-CCIs as well, but not all firms

Table 4. Location Determinants of Firms' Entries in FUAB (2010-2013)

Entries	**All Firms**		**CCIs**		**Non-CCIs**	
	(Poisson)	Robust Std. Error	(ZINBM)	Std. Error	(NBREGM)	Std. Error
Cluanycci	0.873***	(0.181)	0.488**	(0.181)	0.717***	(0.181)
Pop	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)
CBD	0.414**	(0.179)	0.017	(0.632)	-0.612	(0.944)
Sea	0.198	(0.172)	0.313*	(0.171)	0.503**	(0.188)
Stock	-0.000**	(0.000)	0.000	(0.000)	-0.000	(0.000)
Income	0.000***	(0.000)	0.000***	(0.000)	0.000**	(0.000)
Constant	1.231***	(0.146)	-0.976**	(0.315)	1.209***	(0.334)
Inflate Variables						
Pop			-0.001**	(0.000)		
Constant			3.307**	(1.104)		
N	147		147		147	
Non-zero observations			99			
Pseudo R2	0.8476				0.16	
Log pseudolikelihood	-1653.72					
LogLikelihood			-277.19		-600	
AIC	3319.44		574.38		1216	
Lnalpha			-1.233***	(0.25)	-0.408	(0.135)
Alpha			0.292	(0.073)	0.665	(0.09)

Legend: * p<0.1; ** p<0.05; ***p<0.001.
Source: Authors'calculation.

The results from the first step of the empirical analysis show that the existence of any CCI cluster has a positive and significant effect on the entries of all firms in FUAB. This finding emphasizes the argument on CCIs' ability to foster other economic activities and not only CCIs. Furthermore, this effect remains positive and significant when regressing all CCIs and Non-CCIs separately. The population and income levels are significant for all entries, whilst the CBD and stock-09 are only significant for all firms' specifications. The locational advantages of the sea shores appear to influence the decision of some CCIs and Non-CCIs as well, but not all firms.

When incorporating the spatial variable WCluanycci into the specification (see Table 5), the results reveal slight changes. Whilst both the cluster and its spatial lag remain significant for all firm entries, being in a cluster of any CCI becomes insignificant for both CCIs and Non-CCIs, although the spatial lag is significant and positive for both types of firms' entries.

Table 5. Location Determinants of Firms' Entries in FUAB (2010-2013): Spatial Dependence

Entries	**All Firms_W**		**CCIs_W**		**NonCCIs _W**	
	(Poisson)	Robust Std. Error	(ZINBM)	Std. Error	(NBREGM)	Std. Error
Cluanycci	0.478***	(0.164)	0.099	(0.238)	0.326	(0.250)
Pop	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)
CBD	0.345**	(0.169)	0.098	(0.591)	-0.522	(0.920)
Sea	0.201	(0.166)	0.363**	(0.166)	0.538**	(0.185)
Stock	-0.000*	(0.000)	0.000	(0.000)	0.000	(0.000)
Income	0.000***	(0.000)	0.000***	(0.000)	0.000**	(0.000)
WCluanycci	0.702**	(0.243)	0.773**	(0.305)	0.726**	(0.329)
Constant	1.246***	(0.144)	-0.982**	(0.304)	1.216***	(0.330)
Inflate Variables						
Pop			-0.001**	(0.000)		
Constant			3.302**	(1.125)		
N	147		147		147	
Non-zero observations			99			
Pseudo R2	0.8560				0.16	
Log pseudolikelihood	-1562.5					
LogLikelihood			-274.09		-597.84	
AIC			570.18		1213.68	
Lnalpha			-1.364***	0.266	-0.448	0.136
Alpha			0.256	0.679	0.639	0.09

Legend: * p<0.1; ** p<0.05; ***p<0.001.

Source: Authors'calculation.

This is a surprising finding revealing a spatial spillover effect of clustering that can be interpreted according to the evolution of clusters. Concretely, in this paper data about clusters comes from Maddah *et al.* (2021) that identified them using the Scan-test method (Kulldurff, 1997) in FUAB for 2009 and 2017. As for the econometric estimations, data about clusters corresponds to 2009, but Maddah *et al.* (2021) show that there were important changes in the spatial scope of these clusters between 2009 and 2017. In this sense, none of the ones identified in 2009 disappeared, but they changed considerably in their elliptic shape and size by incorporating surrounding districts and municipalities, which is quite consistent with existing theories about clusters' life-cycle (Andersson *et al.,* 2014). In this sense, our results show that

although for CCIs entries the existence of a cluster is not significantly influencing that location decision, the existence of close clusters matters.

Table 6. Location Determinants of Firms' Entries in FUAB (2010-2013): Subsectors

Variable	ADV	ARCH	CIN	FAS	GRAPH	JEW	PUB	SOFT	Wri
Cluadv	**0.829****								
Cluarc		0.294							
Clucin			**1.531*****						
Clufas				**1.816****					
Clugra					0.123				
Clujew						0.797			
Clupub							0.588		
Clusof								**0.856****	
Cluwri									**1.773****
Pop	**0.000*****	**0.000*****	**0.000****	**0.000****	**0.000*****	**0.000****	**0.000****	**0.00*****	0.000
CBD	-0.256	0.476	0.353	0.388	**0.96****	-1.221	**0.895***	-0.209	-0.294
Sea	-0.071	0.027	0.436	-0.091	0.253	0.044	0.565	0.287	-0.374
Stock	-0.000	0.000	0.000	0.000	**-0.000***	0.000	0.000	0.000	0.000
Income	**0.000*****	**0.000****	**0.000*****	**0.000****	**0.000****	**0.00****	**0.00*****	**0.00*****	**0.000****
Constant	**-4.022****	**-1.630****	**-2.686*****	**-4.049*****	**-1.008****	**-3.337****	**-3.968*****	**-2.042*****	**-1.944****
Inflate									
Pop	**-0.000***	**-0.00****	**-0.00***	-0.000	-0.000**	-0.00	-0.000	-0.000	**-0.000****
Stock									
Constant	**2.402****	**1.651****	**4.13****	0.003	**2.659****	0.887	5.915	**2.643***	**3.300*****
Lnalpha									
Constant	-1.292**	-2.008**	-16.01	-0.661	-14.347	-118.82	-125.76	-15.04	-15.799

Legend: * p<.1; ** p<.05; *** p<.001; Source: Authors' own elaboration.

Table 7. Location Determinants of Firms' Entries in FUAB (2010-2013): Subsectors-Spatial Dependence

Variable	ADV_W	ARCH_W	CIN_W	FAS_W	GRAPH_W	JEW_W	PUB_W	SOFT_W	Wri_W	PHO_W	Rnd_W
Cluadv	0.004										
Cluarc		0.294									
Clucin			**1.033****								
clufas				**1.816****							
clugra					-0.089						
clujew						0.797					
clupub							0.672				
clusof								**0.843****			
cluwri									0.506		
cluanycci										-1.075	2.696
wcluadv	**1.891*****										
Wcluarc		(omitted)									
Wclucin			**1.18****								
Wclufas				(omitted)							
Wclugra					0.451						
Wclujew						(omitted)					
Wclupub							-0.144				
Wclusof								0.068			
Wcluswri									**2.902*****		
Wcluanycci										0.929	0.059
Pop	**0.000*****	**0.00*****	**0.00****	**0.00****	**0.000*****	**0.000****	**0.000*****	**0.000*****	**0.000*****	**0.000****	0.000
CBD	**0.677****	0.476	0.504	0.388	0.771	-1.221	0.604	-0.202	-0.701	-21.809	0.751
Sea	0.108	0.027	**0.621***	-0.091	0.278	0.044	**.738***	0.291	-0.526	**1.284***	0.974
Stock	0.00	0.00	0.00	0.00	-0.000*	0.000	0.000	0.000	0.000	0.001	-0.005**
Income	**0.00*****	**0.00****	**0.000*****	**0.00****	**0.000****	**0.000****	**0.000*****	**0.000*****	**0.000*****	0.000	0.000**
Constant	**-3.762*****	**-1.630****	**-3.421*****	**-4.049*****	**-1.232****	**-3.337****	**-4.955*****	**-2.056*****	**-4.501*****	**-5.657*****	-8.9**

Table 7. Location Determinants of Firms' Entries in FUAB (2010-2013): Subsectors-Spatial Dependence (cont.)

Inflate											
Pop	**-0.000***	**-0.000****	-0.00	-0.00	**-0.000****	0.000		0.000			-0.000*
Stock							0.077		0.072	0.057	
Constant	**2.383****	**1.651****	**4.192****	0.003	**2.678****	0.887	-230.151	**2.646***	-212.976	-104.624	2.205**
Lnalpha											
_cons	-28.005	-2.008**	-16.488	-0.661	-12.848	-118.828	-15.866	-16.608	-17.920	-18.497	-16.238

Legend: * p<.1; ** p<.05; *** p<.001.
Source: Authors' own elaboration.

Finally, the results on sub-sectors (Tables 6 and 7) emphasize again the heterogeneity among them. While the existence of a cluster in advertising encourages advertising firms to locate in the relevant municipality/area, publishing firms location decisions are not influenced by the existence of a publishing cluster, in line with the findings of Heebels and Boschma (2011) who reveal that the Amsterdam cluster did not function as an attractor for publishing firms. This heterogeneity in the ability of CCIs agglomeration to attract CCIs is emphasized and reveals that even if the cluster is in the center of Barcelona, it might not have the potential to attract similar firms. This is why designing cluster-oriented policy is essential to complement policies of urban cities. The findings for the clusters of Cinema, Music, TV, and Radio are in line with Cook and Pandit (2012) who found that strong clusters in Film and Television sectors promote entrepreneurship. Similarly, results for the fashion cluster encouraging the fashion manufacturer's entry, are consistent with Randelli and Lombardi (2014)on the Florence fashion leather cluster which continues to have a positive rate of new firms.

On a final note, the CBD variable has a positive and significant effect on the graphic arts and printing and publishing firms only. This result emphasizes the role of Eixample, as explained by Rius-Ulldemolins (2012) as the activities of those two sectors are directly related to art galleries and modern art. This sheds light on co-agglomeration patterns of some kinds of creative industries which share a common symbolic knowledge base. Obviously, those firms are art-related and this finding supports literature emphasizing the capability of cultural districts in attracting art activities, among which is the study of Murzyn-Kupisz and Działek (2017) who argue that while some CCI firms favor locating in inner-city areas (historic quarters) to benefit from social contacts, large flows of customers (mainly tourists) and prestigious image of the city and cultural heritages, while others prefer less prestigious periphery parts of the city, targeting local clients and benefiting from other advantages.

5. Conclusions

This paper has some light on the location patterns of CCIs using data for the Functional Urban Area of Barcelona (FUAB) between 2010 and 2013. We have analyzed whether the existence of CCIs clusters does attract new firms from the same industries. We conclude that clusters of CCIs encourage the entry of a firm (both CCIs and Non-CCIs) to a specific municipality/district. This finding highlights the need to incorporate cluster policies in agendas of local governments based on a well-informed analysis of clusters at a local level.

This paper adds some key insights to location literature, as entry patterns of CCIs have been previously analyzed using rough measures of clustering of stock of CCIs firms, whilst we address these limitations by using the Scan-test methodology, which identifies the localization of clusters and assigns a statistical significance.

The main limitation of this paper refers to the dataset. In this sense, this paper relies on Mercantile Register data), which is the most usual source for studies of the location of economic activity in Spain. Although this dataset provides a clear picture of the overall distribution of economic activity, it is about firms, not about establishments. Nevertheless, although this issue could be a problem in the case of multi-plant firms (i.e., for which data refers only to the main plant), this is not the case for most of CCIs firms, as most of them have only a single plant.

Our results have important policy implications in terms of firm entry promoting policies, as public administrations must know in a detailed way the type of economic, social, and cultural environment firms do require to settle down in a given area.

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Appendix

Table A.1 CCIs definition and their correspondence at industry-level (NACE Rev. 2. 2009-NACE 93 Rev. 1)

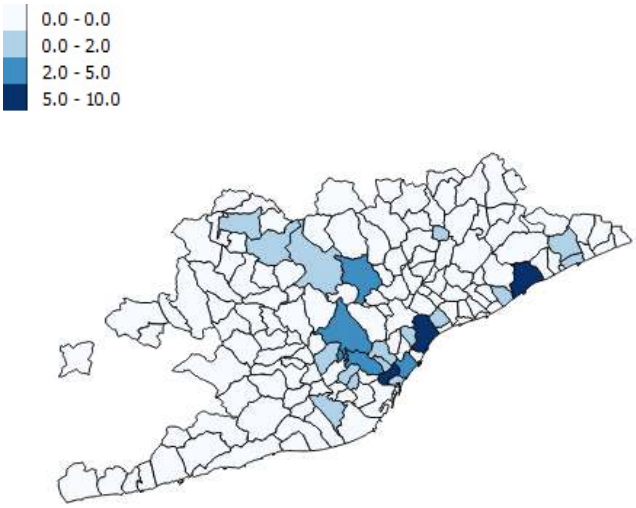
	NACE 2009	**Equivalence NACE 93 Rev. 1**
Fashion		
Manufacture of leather garments	1411	18100
Preparation of work clothes.	1412	18210/25241
Preparation of other outer garments.	1413	18221/18222/25241
Making of underwear.	1414	18231/18232
Manufacture of other garments and accessories.	1419	17710/18241/18242/18243
Hosiery manufacturing	1431	17710
Manufacture of other knitwear.	1439	17720
Dressing, tanning and finishing of leather; Preparation and dyeing of skins.	1511	18301/19100
Footwear manufacturing	1520	19300
Graphic Arts and Printing		
Graphic arts and related services.	1811	22210
Other printing and graphic arts activities.	1812	22220
Prepress and media preparation services.	1813	22240/22250
Binding and related services.	1814	22230
Specialized design activities.	7410	74841
Jewelry, Music Instruments and Toys		
Manufacture of jewelry and similar items.	3212	33500/36221/36222
Manufacture of jewelry and similar items.	3213	33500/36610
Manufacture of musical instruments.	3220	36300
Manufacture of games and toys.	3240	36500
Other manufacturing industries n.c.o.p.	3299	18243/19202/20510/20521/22110/25130/ 25241/26820/28753/33100/36630
Publishing		
Book edition	5811	22110
Editing directories and postal address guides.	5812	22110/72400
Newspaper edition	5813	22120
Editorial of magazines	5814	22130/72400
Other editorial activities	5819	22150/22220/72400
Software and Videogames		
Videogame edition	5821	72210/72400
Editing other computer programs	5829	72210/72400
Computer programming activities	6201	72220/72400
Computer consulting activities	6202	72100/72220
Cinema, Music , TV and Radio		
Postproduction activities of film, video and television programs.	5912	92112
Film exhibition activities.	5914	92130
Film and video production activities.	5915	92111
Activities of television program productions.	5916	92202
Activities of distribution of films and videos.	5917	92121/92122
Distribution activities of television programs.	5918	92202
Activities of sound recording and music editing.	5920	22140/72400/74843/92112/92201
Broadcasting activities	6010	64200/72400/92201

Programming activities and television broadcasting.	6020	64200/72400/92203
Reproduction of recorded media.	1820	22310/22320/22330
Architecture and Engineering		
Architectural technical services	7111	74201
Technical engineering services and other activities related to technical advice.	7112	74202/74203/74204
Research and Development		
Research and experimental development in biotechnology.	7211	73100
Other research and experimental development in natural sciences and techniques.	7219	73100
Research and experimental development in social sciences and humanities.	7220	73100/73200
Advertising		
Advertising agencies	7311	74401/74402
Photography		
Photography activities	7420	74811/74812/92400
Writers, Performing Arts, Visual Arts and Crafts		
Performing Arts	9001	92311/92312/92343
Auxiliary activities to the performing arts.	9002	92313/92342/92343
Artistic and literary creation.	9003	92311/92400
Management of exhibition rooms.	9004	92320
Heritage Activities		
Activities of the museums	9102	92521
Management of historical places and buildings.	9103	92522
Activities of botanical gardens, zoos and nature reserves.	9104	92530
Activities of the library	9105	92510
File activities.	9106	75140/92510

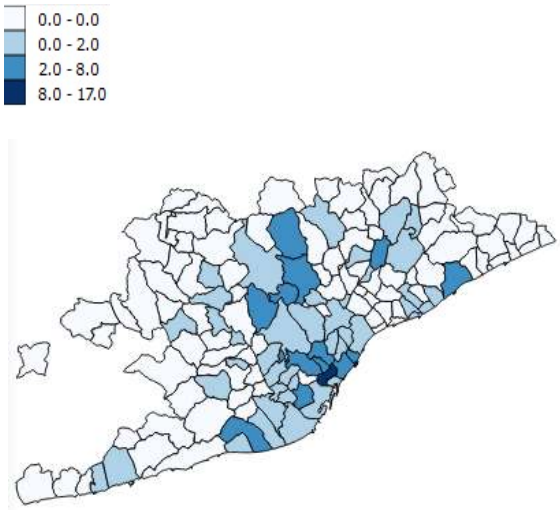
Source: Developed by the authors; CCIs selection adapted from the literature, and codes equivalence adapted from INE (National Statistics Institute, 2010) and based on author's own judgment.

Figure A.1 Entries of CCIs-Subsectors Firms in FUAB (2010-2013)

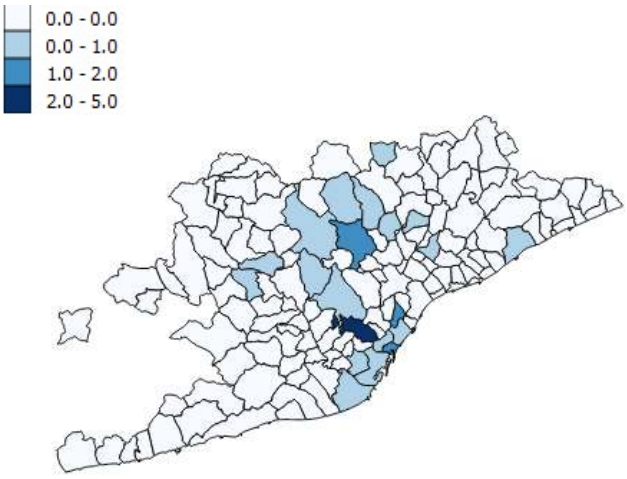
Fashion



Graphic Arts and Printing



Jewellry, Music Instruments & Toys



Publishing

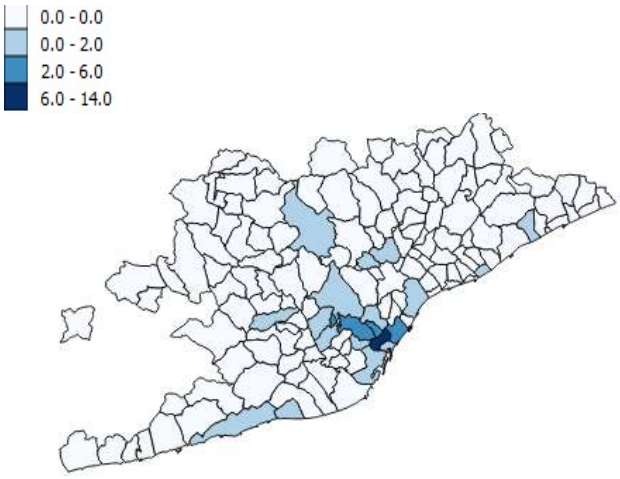
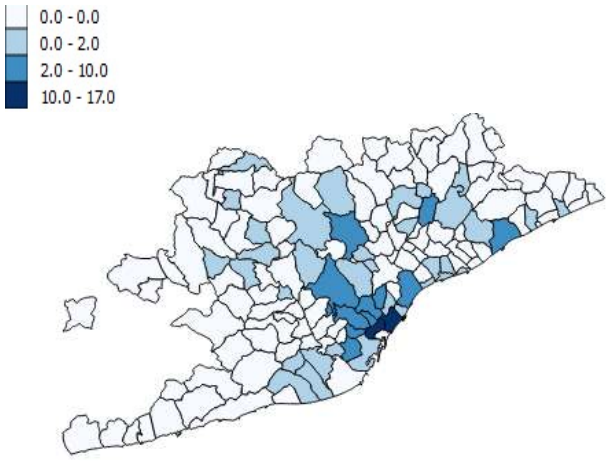
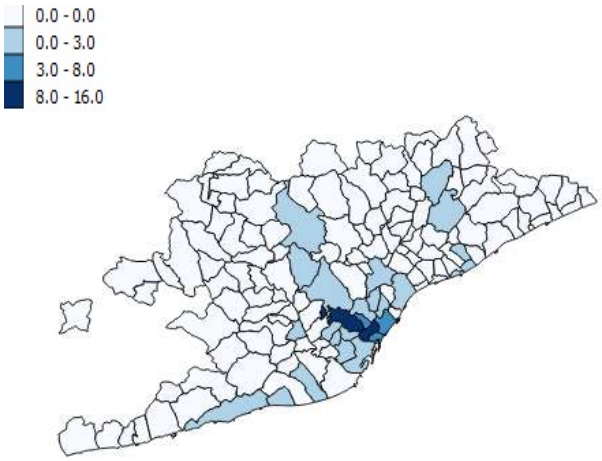


Figure A.1 Entries of CCIs-Subsectors Firms in FUAB (2010-2013) (cont.)

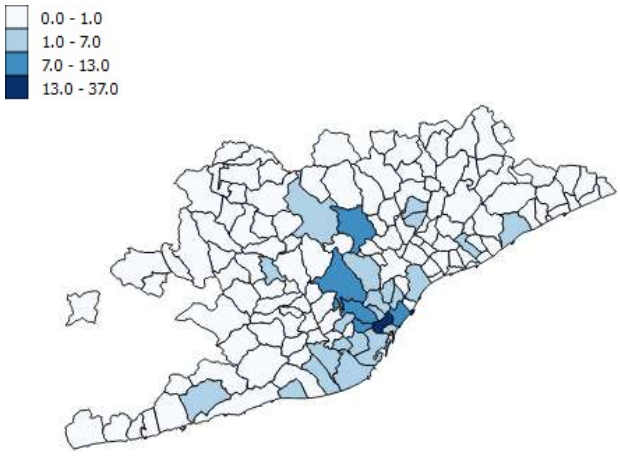
Software and Videogames



Cinema, Music, TV and Radio



Architecture and Engineering



Research and Development

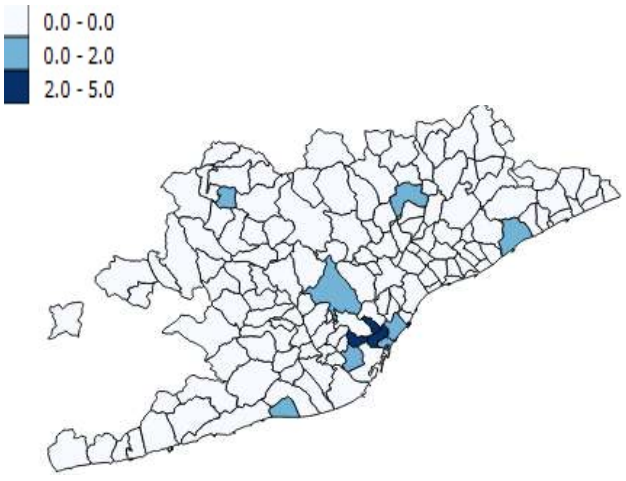
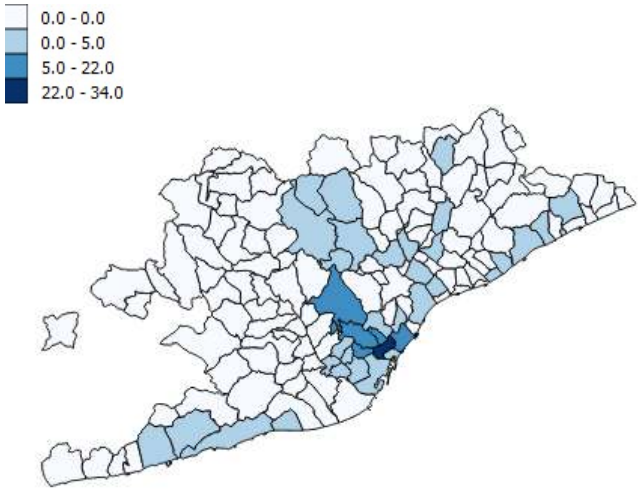
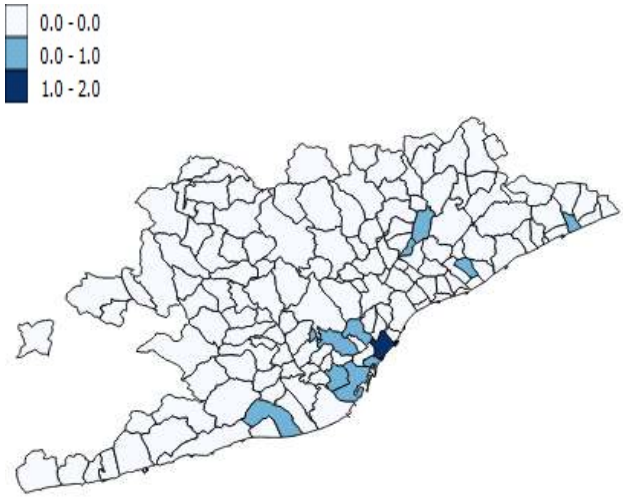


Figure A.1 Entries of CCIs-Subsectors Firms in FUAB (2010-2013) (cont.)

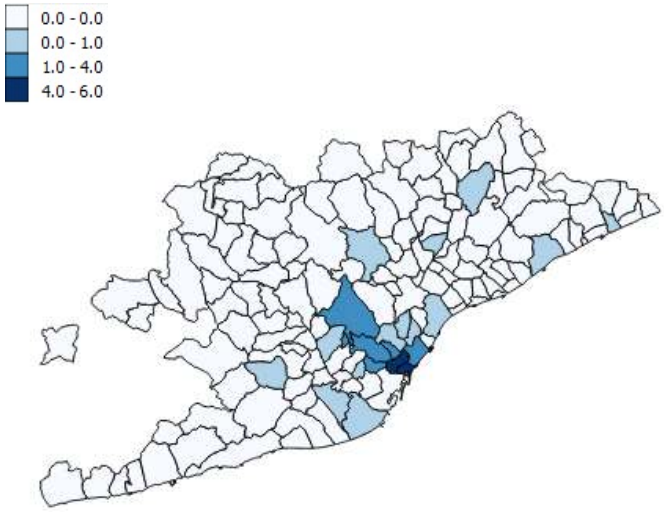
Advertising



Photography



Writing



Source: Authors' own elaboration

Chapter Five

Conclusions and Policy Implications

This thesis is formed of three independent papers (each one included in a separate Chapter) and contributes to the literature in several different ways. First, Paper [1] addresses inquiries on the role of CCIs as engines of employment growth. This issue has attracted considerable attention among researchers as governments have started to look for "hard" evidence explaining CCIs' ability to boost economic activity. Paper [1] thus contributes to this ongoing discussion on empirical analysis of agglomeration economies by addressing the impact of specialization in CCIs on total employment growth at the municipality level in Catalonia, using data from 2001 to 2011. Both the economic and geographical characteristics of Catalonia provide an insightful context to contribute to CCIs' analysis at a local level, as this region includes an assorted form of municipalities (small and medium-sized peripheral municipalities and Barcelona city, along with its urban surrounding), an ample share of CCIs in terms of employment, and a rich cultural heritage that dates back thousands of years and forms the very basis of it's a creative economy that is differentiated on the Mediterranean coast. Paper [1] further investigates whether the effects of local specialization in CCIs are the same across territories and industries to identify whether there are spatial/sectorial specificities that may intensify/decrease the positive effects of these industries. This is a novel approach, since the empirical literature about CCIs analyses almost exclusively large cities and metropolitan areas, and often considers all CCIs together. The main take-away from Paper [1] is that the role of CCIs is still unclear and merits additional analysis since, on the one hand, there is widespread empirical evidence pointing to their positive effects on economic growth, job creation, and knowledge generation, but on the other hand, there is also evidence indicating that their weight and influence is still small. It might be suggested that a potential explanation of this apparent contradiction depends on industry and spatial specificities, and this study has tried to disentangle earlier ambiguous results by considering both detailed CCIs as well as different typologies of municipalities.

Second, Papers [2] and [3] are interrelated and contribute to the literature on clusters, business dynamics of CCIs, and location decisions of firms focusing on the Functional Urban Area of Barcelona (FUAB). Whereas previous studies have been concerned with CCIs agglomeration in general terms, this thesis puts forward a spatially explicit methodology that looks into significant clustering of industry-specific CCIs and their evolution over a period of time. Paper [2] thus provides an improved understanding of (1) geographically measuring the existence and mapping clusters as a departing point for any possible cluster policy, and (2) evaluating

clusters in the context of their lifecycles. The main output of this Paper is directed to policymakers at regional and local levels questioning whether a cluster policy is needed and could be valuable to the region, thus supplying an aid-kit to support decision making based on informative conclusions regarding the complementary role between the core and periphery of main urban areas as well as variances among subsectors of CCIs in their clustering patterns. The paper contributes to the empirical literature on CCIs' clustering, which is still relatively scarce, and main results briefly suggest the following: *i)* CCIs firms tend to cluster, especially in core or urban areas (e.g., in and around Barcelona), *ii)* there are structural differences at the industry level in terms of clustering, *iii)* clustering patterns are quite stable in the short and medium-term, still, the differences among subsectors and local particularities of municipalities/districts encourage the emergence of new clusters and the maturity of others, and *iv)* there is urban resilience (i.e., a "Barcelona effect") along with an evident path-dependence and interdependence in the periphery areas, characterizing and benefiting CCIs clusters.

Paper [3] is an extension to Paper [2] and provides an analysis on whether the existence of a CCIs cluster modulates the location decision of firms (both CCIs and Non-CCIs). The relevance of the study on firms' location decisions and clusters is observed by its recent centrality in academic and policy discussions. The findings contribute to the empirical literature by bridging modern economic geography and industrial clusters on one hand, and location decisions, firms' entry, and knowledge spillovers on the other. Also, for the policy debate, the findings support the need for a more local "place-based" policy approach on European agendas related to CCIs. In this sense, main conclusions reveal that *i)* clusters of CCIs encourage the entry of firms (both CCIs and Non-CCIs) to specific municipalities/districts, *ii)* industry-specific analysis highlights differences among CCIs clusters in their capacity to attract new industry-related firms to a specific area, *iii)* surrounding neighborhoods of clusters can benefit from their existence as they become attractive areas for firms to locate, a process that can explain how geographical borders of cluster evolve (expand or shrink) over time (in line with Paper [2]), *iv)* the core of Barcelona has a significant power in influencing firms' location decisions, mainly driven by its central district Example, yet this effect is mainly driven by art and media-related clusters, and *v)* peripheral clusters have a considerable role as well.

Overall, the results have important policy implications in terms of firm entry promoting policies, as public administrations must know in a detailed way the location preferences and the type of economic, social, and cultural environment firms do require to settle down in a given area. Thus, this thesis further aims to fill an existing gap in the area of supporting policymakers for fashioning good policy consistent with local characteristics of municipalities where firms may locate. This finding highlights the need to incorporate cluster policies in agendas of local governments based on a well-informed analysis of clusters at a local level.

According to the European Commission (2012, p.16), "a CCI mapping aims to acquire an overview of the sector, both in terms of volumes and location. In some countries, mappings have been followed by academic research to identify areas with the greatest potential for development, which in turn leads to political strategies". Accordingly, with this thesis being one of those academic researches on mapping and exploring CCIs, some interesting findings can be translated into policymaking. Thus, few important implications for policy measures are concluded, as an "aid-kit" that can be considered not only for the Catalan context, but also for similar European contexts where similar geographic, economic and cultural characteristics are satisfied.

1- It is vital to recognize the opportunities of creative industries in rural areas of European regions (Chapain and Stryjakiewicz, 2017). While upholding the importance of big cities and urban areas, the findings from this thesis challenge the predominant arguments that creative economy is strictly related to urbanization. Though the findings highlight the indispensable role of the city of Barcelona, policymakers shall design local development strategies that account for the characteristics of remote areas and small cities as well, and progress in developing and supporting rural creative economies that can complement urban ones. Furthermore, such measures can also have two "*multiplier effect*" benefits: (1) to limit the pressures on urban areas with associated problems of gentrification, high population density, lack of affordable housing, and environmental pollution, among others, and (2) to limit the threats in rural areas allocated to depopulation, deterioration of rural tourism, and endangered rural heritage. Essentially, specialization in industry-specific CCIs shall be consistent with the specific local settings and firmly associated with local conditions.

2- With that being said, it is found useful to tie together practices of *Smart Specialization* in rural areas and *Smart Specialization* in CCIs[34]. Smart specialization in CCIs, and relative subsectors, shall be more emphasized in policy-making since it is clear that place matters. In this sense, as highlighted by Szerb *et al.,* (2020), such frameworks are needed to transform policy-thinking from traditional top-down and predominantly sectoral-led approaches to a more local, bottom-up innovation-led approach. Based on the findings of this thesis and the mentioned policy reports, I propose to bridge those two dimensions together to better harness the opportunities in CCIs:

2.1 Local governments and municipalities shall identify the niche CCI activity that promotes innovation and spillover effects (such as the case of the design sector in rural municipalities of Barcelona) in addition to acknowledging the resources needed to design effective policies.

2.2 Understand the type of creative jobs individuals get in rural areas, and the type of entrepreneurship nature in big cities, and design strategies the account for the differentiation between those two. In many cases, rural areas are being characterized as areas of stagnation, and thus there is a need for developing a common vision and commitment among key players (government, firms, academic institutions, and any knowledge-creating institutions-research centers or local creative non-governmental organizations) to create a favorable environment for creative jobs and creative enterprises. While those strategies are applicable for big cities as well, problems associated with rural areas being far away from major cities and dispersion of local resources (among which is the human capital) can be overcome by leveraging technology innovative solutions to enhance sharing information and knowledge (Boschma, 2005).

2.3 As social networking is a major component for the prosperity of CCIs firms; it is useful to differentiate between rural traditions that make certain networks adequate and familiar and urban entrepreneurial networking associated with the urban

[34] In 2012, the European Commission's science and knowledge service, The Joint Research Centre (JRC), launched a Policy Handbook on "How to strategically use the EU support programmes to foster the potential of culture for local, regional and national development and the spill-over effects on the wider economy" (European Commission, 2012). Later in 2014, JRC launched a Policy Brief on Smart Specialisation and Innovation in Rural Areas (European Commission, 2014).

creative economy (see Mahroum *et al.,* 2007). Solutions in this context shall adapt to the socio-economic local environment to drive economic development (Evans, 2009)

2.4 Focus on physical infrastructure that contributes to the emergence of the creative community in three ways:

2.4.1 In big cities, leverage cultural heritage in a sustainable way to create collaborative spaces in big cities, such as the *Barcelona Art Factories* initiative. Similar initiatives foster entrepreneurship by acting as hubs for resources and knowledge without compromising cities' cultural attractiveness

2.4.2 Regeneration of places by looking at suburbanization path of some types of CCI businesses that require multi-disciplinary settings which foster their interactions with universities and research centers in a dynamic way (case of software and R&D firms)

2.4.3 Infrastructure upgrading for places with other local characteristics (mainly periphery areas with manufacturing specialization)

2.5 As well, it is further recommended the usage of spatially explicit tools in mapping CCIs, beyond the ones suggested in the EU mentioned reports, noting that such geographical tools are being more and more available, user-friendly, and proven to provide robust results.

3- Cluster Policies: appropriate support measures shall consider local particularities of industry-specific clusters of CCIs, covering the periphery municipalities of the FUAB, and cultural heritage and urbanization of the core city (i.e., Barcelona) which is the center of creativity. It is recommended to design cluster policies based on the identification of clusters and considering the following: (1) the characteristics of the clusters (significance level, number of firms which form the critical mass, number of locations/districts/neighborhoods involved, spatial proximity and spatial spillover potential (2) lifecycle (position/stage), and (3) cluster players (linkages between institutions, universities, research centers, other firms, customers, etc.).

3.1 Policymakers must be conscious of the *lifecycle* stage of a cluster noting that each stage has explicit needs, suggesting that different policy actions need to be

employed. The findings of the thesis indicate the existence of mature clusters; however, the future of such clusters can be directed to one of the two paths: (1) renaissance/renewal, or (2) decline (Menzel and Fornahl, 2009; European Committee of the Regions, 2010). Therefore, policy measures to sustain and strengthen those clusters shall focus on attracting more firms and fostering innovations through advanced digital synergies. On the other hand, embryo/emerging clusters shall be targeted using different measures (mainly allocated to enhancing support to small enterprises, increasing funds for local universities or research centers that are located within or nearby the cluster, and support their outreach networking). Policies shall aim to increase the number of firms in emerging clusters leading to a critical threshold beyond which cross-fertilization between CCIs and other firms becomes possible and thus creating more cross-sectional job opportunities. Similar to the previously mentioned strategies in Smart Specialization, cluster policies do need to focus on human resources, infrastructure, and innovative technology utilizing more specific targeted approaches depending on the context (industry and location) of each cluster. This is essential to evade the pitfalls of conventional industrial policy. Those measures can include tactics such as promoting face-to-face networking (which is essential for CCIs clusters) via establishing common areas and spaces for the use of creative workers (such as technology parks and initiatives comparable to the 22@ district in Barcelona), fostering education related to digital art, media, creative content, and information technologies.

3.2 Identify any special *anchor* within a cluster; this can be a leading firm, a university, an institutional initiative, or a cultural-historical monument, and implement policies that improve the interaction between the main player and the surrounding firms. And based on identifying industry-specific clusters that can co-agglomerate together, such synergies can be used to develop a more thematic vision of the cluster based on the knowledge base of the industries involved (for example media clusters, instead of disaggregation between cinema, music, tv, radio, advertising, and videogames).

3.3 Technology shall be leveraged in cultural heritage via digitized ways that support creating new employment opportunities and contribute to innovative developments in art and media-related sectors. Barcelona Art Factories, a smart specialization initiative from the EU funds through the Catalan government, is an illustration of how such initiatives can lead to fostering creative environments, as assumed in Paper [3] to have modulated the growth of clusters in the core of Barcelona.

3.4 Given the general argument that clusters cannot be created from scratch at a local level (European Commission, 2019), funds can be used to support existing ones that have potential and can act as drivers for local development both in the periphery municipalities and the core of the FUAB.

On a final note, Sacco (2020) argues that "the COVID-19 crisis highlights the limitations of a growth model centered on the concentration in high-density urban areas. It creates new interest toward decentralized living and the restoration of small villages and communities as new residential options that ensure high-quality of living and new attention toward environmental responsibility the development scenario requires a substantial development of digital technology and territorial strategies to ensure the provision of key local services and the promotion of smart working". This thesis points to the direction and provides empirical evidence on the opportunities of the rural and peripheral areas and designing local strategies that facilitate such processes which are based on more sustainable models of CCIs' role in the economy.

It is important to clarify that this thesis is not diminishing the potential effects of CCIs on the economic activity but to precisely specify the conditions under which these positive effects can be demonstrated. Any smart solution, cluster policy, place-based approach, or smart specialization tool shall be designed and implemented based on the understanding of the specificity of creative industries sectors, their knowledge bases, and the agglomeration and co-agglomeration patterns and role as local economic development tools, in addition to understanding the complexity, heterogeneity, and connectivity of the creative economy.

This thesis has several limitations. While there are some demonstrable conclusions, it is clear that more work needs to be done. Paper [1] used data on small and medium-sized municipalities, whilst most of the literature focuses on what happens in big urban areas (e.g., London or New York) not considering the rest of the territories. Nevertheless, as it is also true that municipalities are quite small and that the spatial range of labor markets may be larger than municipality boundaries, alternative spatial aggregation levels such as counties or local labor markets should therefore also be tested to corroborate previous findings. Furthermore, employment in creative industries can be hidden by data limitations. Additionally, when talking about CCIs, the creative elements come to be occupations, while the business dynamics part is related to firms; which creates a clash between what are CCIs in definition and what one is trying to capture. For instance, traditional manufacturing of furniture includes designers, interior architects, and several creative occupations supporting the process; however, a large percentage of the workforce in that industry is in traditional manufacturing occupations typically. Hence, there is a struggle/vagueness in identifying the creative occupations within those traditional industries and looking at their "business dynamics" as "creative" industries, even though those industries do have cultural or creative elements within. Also, major concerns arise regarding the nature of employment in CCIs, hidden gaps in secondary employment, voluntary work, and role of non-profit organizations, which constitute a significant part of CCIs' employment, yet their potential is still underestimated. For Papers [2] and [3] the papers rely on Mercantile Register data, which is the most usual source for studies of the location of economic activity in Spain. Although this dataset provides a clear picture of the overall distribution of economic activity, it is about firms, not about establishments. Nevertheless, although this issue could be a problem in the case of multi-plant firms (i.e., for which data refers only to the main plant), this is not the case for most of CCIs firms, as most of them have only a single plant.

Regarding future research directions, additionally, to consider alternative temporal settings to disentangle the potentially restrictive effects caused by the economic crisis starting in 2008, future research can explore whether the results hold for alternative periods (Paper [1]). As well, the incorporation of data on creative occupations, not only industries, can enrich the results and help uncover the real potential behind those sectors. Departing from results on clusters there is room for additional research that attempts to evaluate the impact of local, regional, and EU funds used to promote CCIs to quantify their (positive) effect for some clusters, and further explore those clusters not only in terms of size and number of firms, but also in terms of more

intricate synergies, and this can be possibly achieved through qualitative studies on specific clusters. A good approach would therefore be the usage of a mix of qualitative and quantitative methods (focus groups, interviews, and questionnaires, among others).

The cultural and creative industries are one of Europe's focal assets. Their contribution to the well-being of people is beyond measures, obviously seen throughout the COVID-19 pandemic as those sectors helped us to handle the challenges. Research has always suggested that happiness raises productivity and cultural and creative industries are an asset for well-being in its widest sense. Culture rests at the core of the knowledge economy. We are evolving from being passive consumers of culture to a possibility of also being producers of culture. We are in a phase within our economic system where we are facing several challenges; understanding the role of culture in local development is by all means in line with current economic and social needs. I am committed to pursuing an agenda on CCIs exploration, despite the complexity and vagueness hindered on the way. Research shall push forward to keep those discussions going through an integrated approach across different strands of work.

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