



PAPER

Title: Location patterns of audio-visual communication firms

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Subject area: *Creative Industries: Location Patterns and Growth Generation (Special Session)*

Abstract: *This paper is about location patterns of audio-visual communication firms, a cultural and creative industry that includes activities related to motion picture, video and television programme production, post-production and projection activities, as well as sound recording and music publishing activities. These industries tend to agglomerate at the core of big metropolitan areas in order to benefit from agglomeration economies operating in these areas. Our results for these industries show a strong agglomerated pattern at the core of the metropolitan area of Barcelona, as well as close inter-industry linkages with other cultural and creative industries.*

Keywords: *location, audio-visual industry, agglomeration*

JEL codes: R30, Z10

1. Introduction

Empirical evidence provided by several scholars¹ indicates that Cultural and Creative Industries (CCIs) tend to agglomerate at the core of big metropolitan areas, as there these firms may benefit for the economic environment they do need in terms of private services provided by other firms, specialised labour markets and intense knowledge spillovers arising from several industries also located there. Nevertheless, specific knowledge about specific CCIs is still insufficient, as most of analyses have been carried out at a wider industry aggregation level. This is the case, for instance, for firms belonging to audio-visual communication industries, for which there is no specific empirical evidence analysing in a detailed way the type of metropolitan areas in which they locate their activities.

Audio-visual communication industries include a wide range of activities related to motion picture, video and television programme production, post-production and projection activities, sound recording and music publishing activities, and TV and radio broadcasting. Although industry classifications identify up to nine distinct industries², all these activities share, in general terms, some common inputs, profile of workforce and locational requirements. In this sense, it is common for workers to move across firms of these industries, as skills required are quite similar across them. Firms from audio-visual industries use to locate close to each other, typically at the core of metropolitan areas, in order to maximise accessibility to their main sources of inputs. In general terms, as Audio-visual communication industries belong to CCIs (concretely, to the creative/technological part of these industries), they tend to share similar location patterns with them, although unfortunately there are not detailed analysis providing enough information in order to fully assess these similarities. A detailed look to literature (see next section) will provide some interesting insights into exhaustive case studies analysis, but unfortunately there are no longitudinal analyses trying to identify

¹ See, among others, Coll-Martínez et al. (2018).

² Concretely, following NACE codes are included: 5912, 5914, 5915, 5916, 5917, 5918, 5920, 6010 and 6020. Additionally, there are as well closely related activities not being analysed in this paper as Software Edition, Advertising and Wired, Satellite and other Telecommunication activities.

common location patterns to the whole industry. Solving this limitation will be one of main aims of this paper.

Accordingly, this paper aims to shed some light to empirical location literature by competing previous contributions regarding CCIs urban location patterns with specificities of audio-visual communication industries. This analysis will allow to better understand location processes of these industries and will help to improve public policies aiming to attract / maintain these activities by providing the type of economic environments required by firms in these industries in terms of urban preferences, inter-industry and intra-industry linkages. Our main assumption is that geography matters for these industries (Pratt, 2000), as it influences current and potential competitiveness and, consequently, location decisions become as important as any other managerial decision taken by firms. In this sense, our empirical application focus on Barcelona, as this case is of clear interest, in view of growing attractiveness for cultural and creative firms in general and audio-visual firms in particular. Concretely, a large number of activities linked to audio-visual industry are being clustered in and around Barcelona, both in terms of firms and in terms of firms' support activities. A recent example of the attractiveness of the area is the recent announcement that ISE (Integrated Systems Europe), the largest audio visual integration show in Europe, will move to Barcelona in 2020 after several years in Amsterdam.

The structure of this paper is the following. Second section reviews location literature about CCIs and addresses main points raised by scholars, third section details characteristics of dataset and provides some descriptive statistics, fourth section describes methods and discusses main results, and fifth section concludes and indicate directions of further analyses.

2. Literature review

Cultural and Creative Industries (CCIs) have experienced a dynamic growth pattern in developed countries in recent years and are considered important growth drivers. These

industries tend to agglomerate in larger metropolitan areas of these countries (specially at the cores), hire an important share of skilled workforce, generate large networks of suppliers in and around specialised clusters and, in general terms, exert positive effects over the rest of economic activities.

Although traditional analyses about location patterns of these industries have focused in large geographical areas as countries and regions, recent contributions concentrate on smaller areas as metropolitan areas and regions and even at an intraurban level, as recently Arauzo-Carod et al. (2017) for the metropolitan areas of Barcelona and Madrid and Coll-Martínez et al. (2018) also for the metropolitan area of Barcelona.

CCIs include a wide range of heterogeneous activities, some of them closer to the cultural dimension of the whole CCIs and many others closer to the technological dimension. Among the laterers, there are the audio-visual and media firms, that include motion picture, video and TV programme post-production; motion picture projection; motion picture and video production; TV programme production; motion picture and video distribution; TV programme distribution; sound recording and music publishing, and radio and TV broadcasting. These activities tend to be driven by a reduced number of large corporations worldwide located at the centre of a few metropolitan areas (Braczyk et al., 1999; Scott, 2000b) that settle down complex relationships with local suppliers (Krätke, 2002) at the same time that they create worldwide cultural markets through generation of media contents. These media clusters in big metropolitan areas are characterized by flexible firms' networks in which small flexible firms interact with worldwide media leaders, generating agglomeration economies in terms of knowledge spillovers (Krätke and Taylor, 2004). In spite of nowadays importance of these clusters³, it is also true that advances in communication technologies weaken that tendency to cluster, although face-to-face interactions still matter (Pratt, 2000), specially when dealing with informal knowledge which is not easy to be transferred and shared through these technological tools.

³ In any case, importance of CCI clusters differ across subindustries (Oakey et al., 2000).

As these are dynamic industries being rapidly transformed by technological change, when analysing location patterns of audio-visual industries it is important to understand the radical transformations that have occurred from the second half of XXth century. In this sense, if we refer to motion picture industry, there has been a vertically disintegration process that has externalised to market an important number of actions previously organised inside large vertically integrated firms (Christopherson and Storper, 1986). This type of market organisation has fuelled the clusterisation process of a large number of firms with plenty of market interactions among them, as firms in that industry tend to specialise and, consequently, to differentiate from competitors but, at the same time that specialisation increases, final outputs can be sold to different type of clients or final markets (Storper and Christopherson, 1987). This process helps to integrate larger labour markets in which skills are easily transferrable to different sub industries as TV and radio production, sound recording or motion pictures. The consequence is that additional incentives to locate in close areas are generated, both for firms involved in audio-visual markets and for workforce with the required skills. At the end diversified labour markets expand and reinforce urban and metropolitan attractiveness as location venues (Jacobs, 1969). Additionally, spin-off processes may increase agglomeration as new firms may prefer to be located close the previous ones in order to benefit from tacit knowledge of these markets (Oakey et al., 2000).

Although audio-visual industries weight an important share of CCIs, in terms of location behaviour they have received considerably less attention by scholars, specially in Europe, except for worldwide clusters of audio-visual industries located in Hollywood (Scott, 2004), New York (Pratt, 2000; Currid and Williams, 2009, 2010), Los Angeles (Scott, 1996; Currid and Williams, 2009, 2010), Vancouver (Coe, 2001) or Toronto (Vang and Chaminade, 2007). Krätke (2003) and Krätke and Taylor (2004) focus on “Media Cities” described as “(...) cultural and media centres operating at very different geographical levels. They range from small-scale local urban clusters in the media industry to the cultural metropolises of the global urban and regional system” (Krätke, 2003, p. 605). On a worldwide approach they have analysed the so-called “Global Media Cities” using data from the biggest 33 global media firms located in 284 cities worldwide. Concretely, they have found that European cities dominate this list in

terms of media connectivities thanks to cultural regional diversity, generating polycentric structures of media clusters, and, among them, identified Barcelona as one of leading European cities. In general terms, worldwide empirical evidence shows that audio-visual industries tend to agglomerate at intra-urban level in order to minimise transaction costs by facilitating interactions with other firms in the same or close industries (Pratt, 2000; Scott, 1988). Nevertheless, increasing technological complexity may reduce potential knowledge sharing and, then, economic incentives to cluster (Oakey et al., 2000).

Catalan audio-visual and communication industry is highly agglomerated in and around metropolitan area of Barcelona and weights and important share of the industry in Spain⁴. Concretely, according to data from ACAC (2016) sales of this industry in 2013 were around 1768 million euros and 1,503 employees in 1628 firms. Economic crisis of 2007/2010 had a great impact in terms of added value, as in these industries added value moved from 0.44% in 2008 to 0.28% in 2013⁵, mainly caused by a dramatic consumption in media products by Catalan households. This important downturn destroyed around 15% of jobs and 21% of firms in audio-visual industries between 2008 and 2013. Apart from the effects of the recent economic crises that negatively affected the audio-visual industry (i.e., effects that, to a lesser extent, were shared by all economic activities in Barcelona), one could argue that Barcelona lacks critical mass in order to be a global city for audio-visual industries. Even if this argument may be reasonable in a European context, it is also true that when considering south European countries the relative weight of Barcelona's industry is of key importance.

⁴ Value added of the industry in Catalonia weights 17,3% of that of Spain, whilst workforce represents 18,7% and firms are 19%. In an European context Catalan added value was between that one of Portugal and Denmark, whilst number of jobs in Catalonia (10746) was larger than that of Norway (10648), Belgium (9473), Denmark (9144) and Portugal (8377). In terms of relative weight of employment in audio-visual industries (0.39% of total employment), Catalonia stands at the top-3 only behind UK (0.49%) and Norway (0.41%).

⁵ Related activities also had similar decline as for Advertising industries (from 0.57% of Catalan value added in 2008 to 0.57% in 2013), Software Edition industries (from 0.044% to 0.040%), and Wired, Satellite and other Telecommunication activities (from 0.47% to 0.35%).

3. Data and methodology

3.1 Study area

Data about audio-visual firms come from dataset *Sistema de Análisis de Balances Ibéricos* (henceforth SABI) compiled by INFORMA D&B and Bureau Van Dijk, with data from the Spanish Mercantile Register. This database contains exhaustive information on balance sheets at the firm level. Concretely, as audio-visual industries have no formal recognition in terms of statistical classifications, according to industry's activities we have selected active firms by the end of 2015 belonging to both production (codes 5912) and broadcasting industries (codes 6020)⁶ (See Table 1).

[INSERT TABLE 1]

Spatial range of firms considered in this paper includes those located in the Metropolitan Area of Barcelona (MAB, hereafter). MAB comprises 36 municipalities with a total population of 3.2 million inhabitants (2015) covering 636 km². This area weights 42% of Catalan population and 52% of Catalan workforce. The capital of MAB is the city of Barcelona, who is also the capital of Catalonia, an autonomous region northeast Spain. The city has about 1.5 million inhabitants in a geographical area of 101 km².

3.2 Methodology

We use two different point pattern approaches (Lloyd, 2010) with geolocated firms in order to check 1) whether firms from Audio-visual industry tend to cluster in certain parts of the MAB or if, by the contrary, they spread alongside the whole metropolitan area⁷; and 2) whether the strength and extent of Audio-visuals agglomeration differs from that of other economic activities and whether these patterns change across and between different CIs sectors.

⁶ In order to select firms to include in our dataset, in addition to aforementioned audio-visual industries we only considered active firms (by the end of each year) and those with georeferenced data.

⁷ A similar analysis for location of firms has been applied by Arbia et al. (2015).

Nearest-Neighbour Index

Among point pattern techniques, a Nearest-Neighbour Index (NNI) analysis allows to check whether distance among firms is similar / shorter / longer than that predicted for a random distribution (i.e., if all firms were randomly distributed across the metropolitan area). Concretely, the NNI compares the mean value of the observed distance between each point (i.e., firm belonging to audio-visual industry) and its nearest neighbour with the expected mean distance assuming a random distribution through the whole area, as shown here:

$$NNI = \frac{\text{Observed Average Distance}}{\text{Expected Average Distance}}$$

The observed average distance and expected average distance can be computed as follows:

$$\text{Observed Average Distance} = \frac{\sum_{i=1}^n d}{n}$$

$$\text{Expected Average Distance} = 0.5 \sqrt{\frac{A}{n}}$$

where d is the distance, n is the number of neighbouring links, and A is the total area of the area considered. At this point, it is important to take into account that NNI index is sensitive to the spatial definition of the area. Logically, larger areas may imply longer distances among points (i.e., firms), but it is possible to control for that by using only the minimum area that would include all the existing points (i.e., MAB).

In terms of NNI values, those close to 0 indicate a clustered pattern (as the observed distances are shorter than expected and firms are closer to each other), values close to 1 indicate a random pattern (as the observed distances are quite similar to those expected), and, finally, values of around 2.149 indicate a dispersed pattern (as the observed distances are longer than expected).

M-function

To measure agglomeration and coagglomeration, we use the *M*- and *m*-functions, which are distance-based methods introduced by Marcon and Puech (2003, 2010) and Lang et al. (2016). These functions can be understood as the natural counterparts of the well-known location quotient in a continuous space approach.⁸ The *M*- and *m*-functions are two relative distance-based measures that compare the proportion of firms of interest in a given reference neighbourhood to the proportion of firms of interest in the whole area

Both the *M*- and the *m*-functions are comparable across industries, control for the overall agglomeration patterns of industries and for industrial concentration, remain unbiased across geographical scales, and allow for statistical significance testing (Marcon and Puech 2010; Lang et al. 2016). They also control for inhomogeneous space and enable a straightforward interpretation and comparison of the results.

We calculate the intra and inter-industry *M*-functions for every 1000 m between 0 and 50 km at the industry level for Audio-visual industry. We use the package *dbmss* for the calculations (Marcon and Puech 2015). We use the plain coordinates (X-Y) for each firm located in the MAB. In the following, we explain a detailed definition of *M*-functions of agglomeration and coagglomeration.

Evaluating agglomeration at intra-industrial level

The *M*-function for intra-industrial spatial agglomeration in a circle of radius *r* for a sector *S* is

$$M(r, S) = \frac{\sum_{i=1}^{N_S} \frac{e_{iSr}}{e_{ir}}}{\sum_{i=1}^{N_S} \frac{E_S - e_i}{E - e_i}}$$

where $i = 1, 2, \dots, N_S$ is an index for firm and $e[E]$ denotes [total] number of firms in the area of study. The function works as follows. First we identify all firms belonging to

⁸ The location quotient (LQ) is defined as $LQ = (L_{ij} / L_j) / (L_i / L)$, where L_{ij} is the workforce in industry j in region i , L_j is the total workforce in industry j , L_i is the total workforce in a region i , and L is total employment in the area of reference (e.g. region, country, etc.). A LQ above 1 indicates that the clustering of industry j in region i is larger than the national average, so the region is specialised in this industry.

sector S in the area of study. Here, a *sector* S refers to a type of firm (Audio-visual or subsectors of Audio-visual Industry). For each of these firms, we draw a circle of radius r (e.g. 1 km). Within this distance, we count the number of firms belonging to sector S (e_{iSr}). We then express the sum of this quantity over i as a proportion of the number of firms belonging to firms in all sectors within the same circle (e_{ir}). Next we divide this ratio by sector S ' weight in total activity in the whole area.

The benchmark of the M function is one. M -values *equal to one* indicate that whatever the considered radius, there are proportionally as many employees belonging to sector S as there are in the global area, or that there is a completely random location of firms in this sector S . M -values *larger than one* indicate that there are proportionally more employees close to firms in sector S in a radius r than in the global area, which corresponds to the existence of relative geographic agglomeration of sector S at distance r . M -values *smaller than one* indicate that there are relatively fewer employees in sector S within a radius r than in the global area, or that sector S is relatively dispersed at distance r .

We calculate the statistical significance of the M -function by constructing confidence intervals for the null hypothesis of independence of firm locations, according to which the firms belonging to sector S locate following the same pattern as the others. We determine these intervals using Monte-Carlo methods in the following way: First, we generate a large number of simulations (100). Next, we choose a confidence level of 5 percent so that the 95 percent confident interval of M for each value of r is delimited by the outer 5 percent of the randomly generated values. There is significant relative agglomeration (dispersion) in a given sector if the corresponding M -values are larger (smaller) than one and are outside the confidence interval bands.

Evaluating coagglomeration at inter-industrial level

The inter-industrial version of the M -function assesses the presence of coagglomeration. This measure has the same properties as the intra-industrial one. M -functions of coagglomeration for sectors S_1 and S_2 are defined as:

$$M_{S_1 S_2}(r) = \frac{\sum_{i=1}^{N_{S_1}} \frac{e^{i S_2 r}}{e^{i r}}}{\sum_{i=1}^{N_{S_1}} \frac{E_{S_2}}{E - e_i}}$$

$$M_{S_2 S_1}(r) = \frac{\sum_{i=1}^{N_{S_2}} \frac{e^{i S_1 r}}{e^{i r}}}{\sum_{i=1}^{N_{S_2}} \frac{E_{S_1}}{E - e_i}}$$

$M_{S_1 S_2}(M_{S_2 S_1})$ depicts the spatial structure of firms belonging to sector $S_2(S_1)$ that are found around sector $S_1(S_2)$. The value shows whether the relative density of firms $S_2(S_1)$ located around those of sector $S_1(S_2)$ is larger or smaller than the observed for the whole area. The statistical significance of the inter-industrial M -functions is tested using the same methodology of the intra-industry indicator described above, although the construction of the confidence intervals is slightly complicated. Significant values of $M(r, S_1, S_2)$ may be due to interactions between sectors, or to S_1 or S_2 individual patterns. So, the null hypothesis should control for both S_1 and S_2 patterns. Thus, the null hypothesis point set for $M_{S_1 S_2}(r)$ is generated by keeping S_1 points unchanged and redistributing all other points onto all other locations. We follow the same process for S_2 . There is significant coagglomeration whenever both values are significantly different from their respective null hypothesis (Marcon and Puech 2003).

4. Results

A first insight into spatial distribution of active firms in 2006 (see Figure 1) shows that there is a clear clustered pattern of audio-visual firms at the centre of the MAB and, concretely, at the core neighbourhoods of the city of Barcelona.

[INSERT FIGURE 1]

[INSERT FIGURE 2]

Nine years later (2015) there is a clear persistence of this spatial distribution, as shown in Figure 2. In this sense, data from Audio-visual firms located in Barcelona accounts for 86,9% of the those of the whole metropolitan area (444 out of 511)

4.1. NNI Results

NNI analysis provides an introductory profile of potential clusterisation of firms belonging to Audio-visual industry. Concretely, Table 2 clearly shows a high clustered pattern of these firms, as they tend to locate at closer distances than expected from a random distribution inside the whole MAB. This trend is quite similar for both years, as observed average distance with closest neighbour was 229,3 metres in 2006 (259,5 in 2015) whilst expected average distance was 628,0 metres in 2006 (730,0 metres in 2015), so firms tend to locate closer than expected to each other, clustering in certain (central) areas of MAB and being absent for the vast majority of MAB. Accordingly, NNI value for the whole MAB is quite low, 0.365 in 2006 and 0.355 in 2015, and even with a slight reduction between 2006 and 2015.

[INSERT TABLE 2]

NNI analysis only describes location of firms without analysing location determinants, but if it is assumed that location decisions are taken under rational schemes aiming to maximise firms' revenues and productivity, it is reasonable to assume that for most of firms current location responds to attractiveness of central areas.

4.2. *M* Results of relative spatial agglomeration and co-agglomeration

Intra-industry Agglomeration

First, we analyse the intensity and strength of the intra-industry agglomeration (dispersion) of all audio-visual industry compared to other economic activities in the MAB for the years 2006 and 2015 (Figure 3).

[INSERT FIGURE 3]

The *M*-function for both years peaks at very short distances (close to 0 km) and shows a continuous decay as the distance increases. Concretely, in 2015 the degree of spatial agglomeration in a radius of up to 1 km is 13, which means that up to this distance, the agglomeration of firms in audio-visual is 13 times greater than the agglomeration of firms in all other sectors. These results support our expectations about a high intensity and rapid distance decay for the agglomeration of audio-visual industry because of their

need for proximity to other creative partners and cultural infrastructures as well as to neighbourhoods where demand for cultural and creative goods and services is higher (Scott 2000a; Currid and Williams 2009, 2010). Even these results show a clear persistence in the patterns of agglomeration of this industry in the MAB; they also show that the intensity of the agglomeration has increased over these years, departing from an *M*-value of 13 in 2006 to an *M*-value of 27.20 in 2015. This result may be a consequence of the economic crisis of 2007, which led to a reduction of the industrial fabric that mostly occurred in the peripheral and less competitive areas of the MAB. This was a situation that increased a higher spatial concentration of the industry in the most productive areas.

Despite the clear agglomeration of audio-visual industry, it is relevant to analyse whether there are some specificities at sub-sector level. Table 3 shows the *M*-functions results for 2015 and for all audio-visual sectors with more than 10 firms, that is, all out of them except for TV distribution sector.⁹

[INSERT TABLE 3]

In almost every case, the audio-visual sectors show significant agglomeration within the first stretch of the *M*-function (0-7km), except for Mpost and Mdist sectors. From the second stretch (7-14km) the agglomeration loses its intensity and it is not significant in most cases. These results have not significantly changed from 2006. All in all, these results confirm previous expectations about the strongest incentives of Audio-visual firms to concentrate in and around Barcelona (Coll-Martínez et al., 2018; Arauzo-Carod et al., 2017). Their agglomeration may largely be explained by their need to be close to neighbourhoods where the demand for services and cultural goods and the presence of high-value infrastructure necessary to their cultural production (e.g., stages, recording studios, etc.) is higher and by the fact that proximity enhances their innovation and flexibility by promoting information flows, network interaction and relational ties among a diverse range of agents (Scott et al. 2001; Currid and Williams 2010).

⁹ We do not analyse sectors in which the number of firms is less than 10, as the number of firms in these cases is too small to yield reliable predictions of agglomeration patterns. In this regard, TV distribution sector (5918) was not included in the analysis due to the lack of georeferenced data of active firms in the sector.

Inter-industry Agglomeration

The aggregate results for the coagglomeration between Audio-visual industry and creative industries (CIs) are shown in Figure 4 and 5.¹⁰ According to these results, there is significant coagglomeration between audio-visual sectors and the other CIs in the MAB. Specifically for 2006 (Figure 4), CIs are attracted by audio-visual industries at very short distances, where the *M*-function reaches 1.99, that is, up to the first km, the agglomeration of CIs firms around those of audio-visuals firms is 1.99 times greater than for the whole area. Moreover, the coagglomeration values of CIs around audio-visual industries are statistically significant also at very short distances with a value of 1.83. Even the intensity of the coagglomeration has not significantly changed from 2006, results for 2015 show that there is only significant coagglomeration from the first km with a value of 1.20 for both cases (Figure 5). The coagglomeration between these subsectors in the case of Barcelona can be mainly explained by the fact that firms operating in those sectors are mainly located in the 22@ district (Barber and Pareja Eastaway 2010; Viladecans-Marsal and Arauzo-Carod 2012).¹¹ In this case, the coagglomeration between these sectors can be explained both by the interconnection of tightly-knit production networks, as well as a result of an induced cluster policy in order to provide those facilities and services enhancing their activity (i.e., larger spaces and co-working facilities, proximity to specialised human capital formation centres, public aids, etc.).

[INSERT FIGURE 4]

[INSERT FIGURE 5]

Results for coagglomeration for the different Audio-visual industry subsectors, and those with the whole of audio-visual industry are summarised in Table 4.¹² As expected,

¹⁰ These figures should be read as follows. Figure *a* shows that the relative density of firms in CIs located around those of audio-visual is larger in a radius of 1 km than for the whole area. Figure *b* shows that the relative density of firms in audio-visual industries located around those of CIs is non-randomly distributed along the whole area.

¹¹ This district was created in 1998 as a public initiative to encourage the concentration of activities closely related to innovation and creativity by providing networking and work space facilities and granting support.

¹² The diagonal values of the matrix are equivalent to those of intra-industry agglomeration shown in Table 3, as they analyse the concentration of firms in a sector around the same sector. This analysis was carried out for 2006 and the same result was obtained.

the coagglomeration results differ starkly by each kind of Audio-visual sector. There are only two sectors that coagglomerate with the whole of Audio-visual industry, which are Motion picture and video postproduction (Mpost) and Motion picture and video production (Mprod) sectors. This fact may indicate that there are significant differences in the inter-sectoral interdependencies in terms of geographical proximity at the subsector level. However, there is not any significant coagglomeration between any pair of subsectors, which indicates that the interconnection of production networks may be more intense between these sectors and other CCI than within the same Audio-visual industry.

[INSERT TABLE 4]

It is worth mentioning that the preceding examples of coagglomeration between these subsectors and some of them with the rest of CIs support the idea that creative activities have clear incentives to be located in the same places in order to have more possibilities for interaction among different economic agents. This result upholds the dynamics that have been found out by the same sectors in other urban areas such as Paris, New York or Los Angeles (Scott 2000a, Currid and Williams 2009, 2010), where the location sector dynamics for Audio-visual sectors have remarkable similarities.

Spatial analysis with Kernel density maps

In this subsection we show kernel density maps in order to visualise the difference between significant agglomeration for Audio-visual and coagglomeration between Audio-visual and creative firms for 2006 and 2015.

The kernel density mapping for the first group in 2006 shows significant overlap between the red spots indicating the highest density of firms for both types of firms (Figure 6). Interestingly, both Audio-visual and creative firms overlap in the core districts of Barcelona (in particular, in the Eixample and (22@) Poblenou districts).

[INSERT FIGURE 6]

Actually, the agglomeration of the Audio-visual industry may largely be explained by their need to be close to neighbourhoods where the demand for services and cultural goods is higher and by the fact that proximity enhances their innovation and flexibility by promoting information flows, network interaction and relational ties among a diverse range of agents (Scott et al. 2001; Currid and Williams 2010). Corroborating the validity of these explanations for Barcelona is unfortunately not possible given the limitations of our data, but it is certainly an interesting topic for future research.

[INSERT FIGURE 7]

Figure 7 displays a similar pattern than that of 2006 (Figure 6). The overlap of red spots between Audio-visual and creative firms persists in 2015, which shows a clear path dependence in their location decisions. It is interesting to see that even the detrimental effects of the economic crisis on this industry, the firms who remain active in a post-crisis context keep clustering in the core districts of Barcelona. Thus, even the harmful economic crisis impact of the industry, the benefits of agglomeration are still large enough to compensate the costs of being located in core areas (such as higher rental prices, congestion, etc.). This dynamic may also be explained by the historical specialization in Audio-visual activities in the city and the relevance of the Barcelona brand.

5. Conclusions

This paper has analysed location patterns of audio-visual communication firms. As we have focused on Catalan case, we have demonstrated how this industry agglomerates in and around metropolitan area of Barcelona, as in this site firms belonging to this industry can reach all the external inputs they do need, as well as a skilled and large labour market and a large pool of intermediate and final consumers for their outputs.

Albeit exploratory, this paper has provided some clues to understand metropolitan agglomeration patterns of firms belonging to audio-visual industries. This is specially relevant on a context where although it is well-known that such type of industries tend

to agglomerate at big metropolitan areas, empirical evidence points largely to firm industries in an North American context, being studies for Europe very scarce.

In view of the importance of audio-visual communication firms for Catalan economy (both in absolute and relative terms), and the applied approach followed by this paper, there are some relevant policy measures that arise from previous findings. Firstly, as revealed locational preferences of these firms show a clear persistence over time, this suggests that they do require core locations in order to be competitive. That point gives room to public interventions favouring generation and continuity of such audio-visual clusters close to city centre. It is noticeable that according to our results spatial range of these clusters should be quite limited (i.e., up to one km), in order to guarantee the existence of positive spillovers. Secondly, as our empirical results indicate that not all core locations are attractive for audio-visual firms, cluster promotion policies should be quite selective and focus only on those areas demanded by these firms.

Future research will go deeper into firms' locational determinants in order to determine in a precise way the weight of location determinants over location decisions at MAB. Additionally, it will be of great interest to further analyse whether new information and communication technologies may erode cluster formations as suggested by some researchers for the same industry (Pratt, 2000). This is a key issue in view that if Barcelona's attractiveness for these industries is eroded, then agglomeration forces will shrink and the industry will move to other areas, especially those with larger availability of accessible big sites.

Acknowledgements

This research was partially funded by Generalitat de Catalunya (2017-SGR-159) and by Ministerio de Economía, Industria y Competitividad (ECO2017-88888-P). We have benefit from technical discussions with A. Moreno-Monroy as well as research assistance by L. Siles and M. Lleixà.

References

ACAC (2016): *Radiografía Económica de la Industria Audiovisual de Catalunya*, Associació Clúster Audiovisual Catalunya: Barcelona.

Arauzo-Carod, J.M.; Coll-Martínez, E. and Méndez-Ortega, C. (2017): “Aglomeración de sectores intensivos en conocimiento: una aproximación intraurbana”, *Papeles de Economía Española* **153**: 110-126.

Arbia, G.; Cella, P.; Espa, G.; Giuliani, D. (2015): “A micro spatial analysis of firm demography: The case of food stores in the area of Trento (Italy)”, *Empirical Economics* **48**, 923-937.

Barber, A. and Pareja-Eastaway, M. (2010): “Leadership challenges in the inner city: planning for sustainable regeneration in Birmingham and Barcelona”, *Policy Studies* **31(4)**: 393-411.

Braczyk, H.J.; Fuchs, G. and Wolf, H.-G. (eds.) (1999): *Multimedia and Regional Economic Restructuring*, London: Routledge.

Christopherson, S. and Storper, M. (1986): “The city as studio, the world as backlot: The impact of vertical disintegration on the location of the motion-picture industry”, *Environment and Planning D: Society and Space* **4**: 305–320.

Coe, N. M. (2001): “A hybrid agglomeration? The development of a satellite-Marshallian industrial district in Vancouver’s film industry”, *Urban Studies* **38(10)**: 1753–1775.

Coll-Martínez, E.; Moreno-Monroy, A. and Arauzo-Carod, J.M. (2018): “Agglomeration of creative industries: An intra-metropolitan analysis for Barcelona”, *Papers in Regional Science*, forthcoming.

Currid, E. and Williams, S. (2009): “The geography of buzz: art, culture and the social milieu in Los Angeles and New York”. *Journal of Economic Geography* **10(3)**: 423–451.

Currid, E. and Williams, S. (2010): “Two cities, five industries: Similarities and differences within and between cultural industries in New York and Los Angeles”, *Journal of Planning Education and Research* **29**: 322–335.

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

Krätke, S. (2003): “Global media cities in a world-wide urban network”, *European Planning Studies* **11(6)**: 605–628.

Krätke, S. (2002): “Network Analysis of Production Clusters, The Potsdam/Babelsberg Film Industry as an Example”, *European Planning Studies* **10(1)**: 27–54.

Krätke, S. and Taylor, P.J. (2004): “A world geography of global media cities”, *European Planning Studies* **12(4)**: 459–477.

Lloyd, C.D. (2010): *Spatial Data Analysis*, Oxford University Press: Oxford (UK).

Marcon, E.; Traissac, S.; Puech, F. i Lang, G. (2015): “Tools to Characterize Point Patterns: dbmss for R”, *Journal of Statistical Software* **67 (3)**: 1-15.

Marcon, E. i Puech, F. (2009): “Measures of the geographic concentration of industries: improving distance-based methods”, *Journal of Economic Geography* **10 (5)**: 745-762.

Marcon, E. i Puech, F. (2003): “Evaluating the geographic concentration of industries using distance-based methods”, *Journal of Economic Geography* **3 (4)**: 409–428.

Oakey, R.; Kipling, M. and Wildgust, S. (2001): “Clustering among firms in the Non-Broadcast Visual Communications (NBVC) sector”, *Regional Studies* **35(5)**: 401–414.

Pratt, A.C. (2000): “New media, the new economy and new spaces”, *Geoforum* **31(4)**: 425–436.

Scott, A.J. (2004): “The other Hollywood: the organizational and geographic bases of television-program production”, *Media, Culture & Society* **26(2)**: 183-205.

Scott, A.J. (2000a): “The cultural economy of Paris”, *International Journal of Urban and Regional Research* **24(3)**: 567–582.

Scott, A.J. (2000b): *The Cultural Economy of Cities. Essays on the Geography of Image-producing Industries*, London: Sage.

Scott, A.J. (1996): “The craft, fashion, and cultural-products industries of Los Angeles: competitive dynamics and policy dilemmas in a multisectoral image-producing complex”, *Annals of the Association of American Geographers* **86**: 306–323.

Scott, A.J. (1988): *New Industrial Spaces*, London: Pion.

Scott, A.J. and Pope, N.E. (2007): “Hollywood, Vancouver, and the world: Employment relocation and the emergence of satellite production centers in the motion picture industry”, *Environment and Planning A* **39**: 1364–1381.

Storper, M. and Christopherson, S. (1987): “Flexible specialization and regional industrial agglomerations – the case of the United States motion-picture industry”, *Annals of the Association of American Geographers* **77(1)**: 104–117.

Vang, J. and Chaminade, C. (2007): “Cultural clusters, global-local linkages and spillovers: Theoretical and empirical insights from an exploratory study of Toronto’s Film Cluster”, *Industry and Innovation* **14(4)**: 401–420.

Viladecans-Marsal, E. and Arauzo-Carod. J.M. (2012): “Can a knowledge-based cluster be created? The case of the Barcelona 22@ district”, *Papers in Regional Science* **91(2)**: 377–400.

Ward, S. and O’Regan, T. (2007): “Servicing ‘the other Hollywood’: The vicissitudes of an international television production location”, *International Journal of Cultural Studies* **10(2)**: 167–185.

Tables

Table 1. Audio-visual firms at the MAB (2006, 2015)

Audio-visual sub-sectors	Code	2006	2015
5912: Motion picture, video and TV programme post-production	Mpost	110	73
5914: Motion picture projection	Mproject	49	36
5915: Motion picture and video production	Mprod	275	244
5916: TV programme production	TVprod	48	38
5917: Motion picture and video distribution	Mdist	64	40
5918: TV programme distribution	TVdist	3	3
5920: Sound recording and music publishing	Music	105	77
Total Audio-visual		654	511

Source: own elaboration.

Table 2. Nearest-Neighbour Index (NNI) for the MAB (2006, 2015)

Indicators	2006	2015
Observed average distance (m)	229.3	259.4
Expected average distance (m)	628.0	730.0
Nearest-Neighbour Index (NNI)	0.365	0.355
N	654	511

Source: own elaboration.

Table 3. Intra-industry agglomeration of Audio-visual subsectors in the MAB (2015)

Industry	0-7km	7-14km	14-50km
Mpost	<i>NS</i>	<i>NS</i>	<i>NS</i>
Mproject	<i>A</i>	<i>NS</i>	<i>NS</i>
Mprod	<i>A</i>	<i>LA</i>	<i>NS</i>
TVprod	<i>A</i>	<i>NS</i>	<i>NS</i>
Mdist	<i>NS</i>	<i>NS</i>	<i>NS</i>
Music	<i>A</i>	<i>NS</i>	<i>NS</i>
All Audio-visual	<i>A</i>	<i>LA</i>	<i>NS</i>

Source: Own elaboration. Note: Agglomeration (A); Low Agglomeration (LA); Non significant (NS); Dispersion (D). M results after applying 1.000 simulations.

Table 4. Inter-industry agglomeration between Audio-visual subsectors in the MAB (2015)

	Mpost	Mproject	Mprod	TVprod	Mdist	Music	Audio
Mpost	*	-	-	-	-	-	-
Mproject	<i>NS</i>	*	-	-	-	-	-
Mprod	<i>NS</i>	<i>NS</i>	*	-	-	-	-
TVprod	<i>NS</i>	<i>NS</i>	<i>NS</i>	*	-	-	-
Mdist	<i>NS</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	*	-	-
Music	<i>NS</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	*	-
Audio	<i>A</i>	<i>NS</i>	<i>A</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	*

Source: Own elaboration. Note: Agglomeration (A); Low Agglomeration (LA); Non significant (NS); Dispersion (D). M results after applying 1.000 simulations. (*) refers to the agglomeration level shown in Table 3.

Figures

Figure 1: Location of Audio-visual firms communication firms (2006)



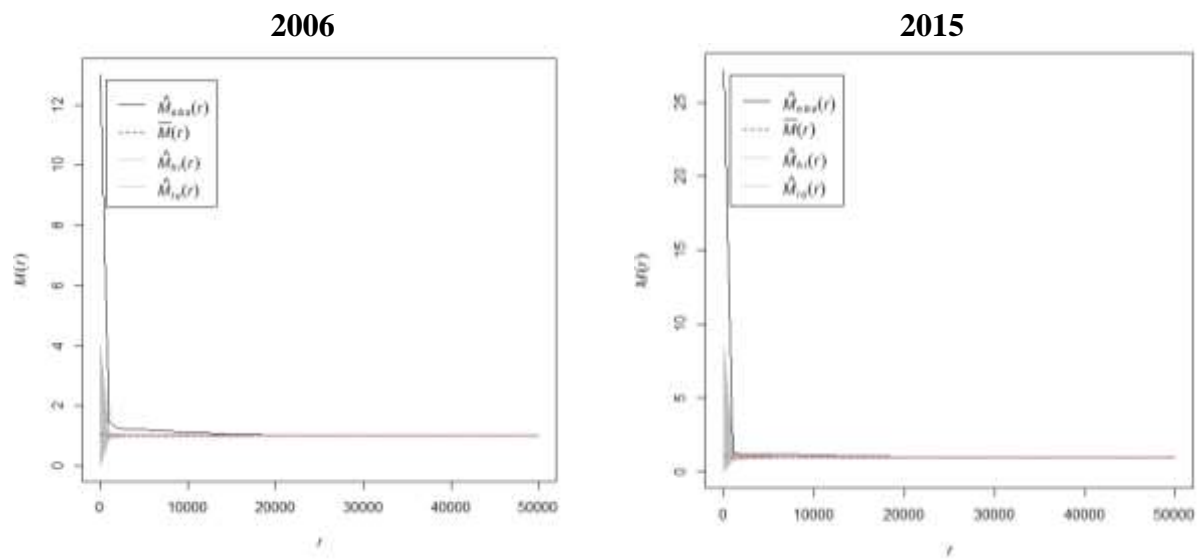
Source: own elaboration with data from SABI and layer from Google.

Figure 2: Location of Audio-visual firms communication firms (2015)



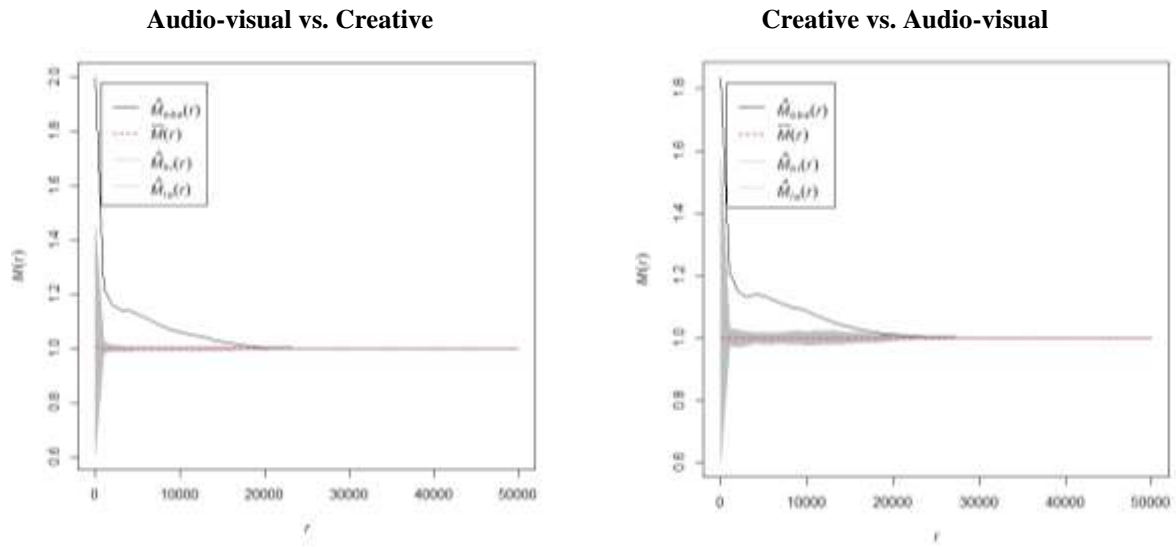
Source: own elaboration with data from SABI and layer from Google.

Figure 3. Intra-industry agglomeration for Audio-visual Industry in the MAB (M function)



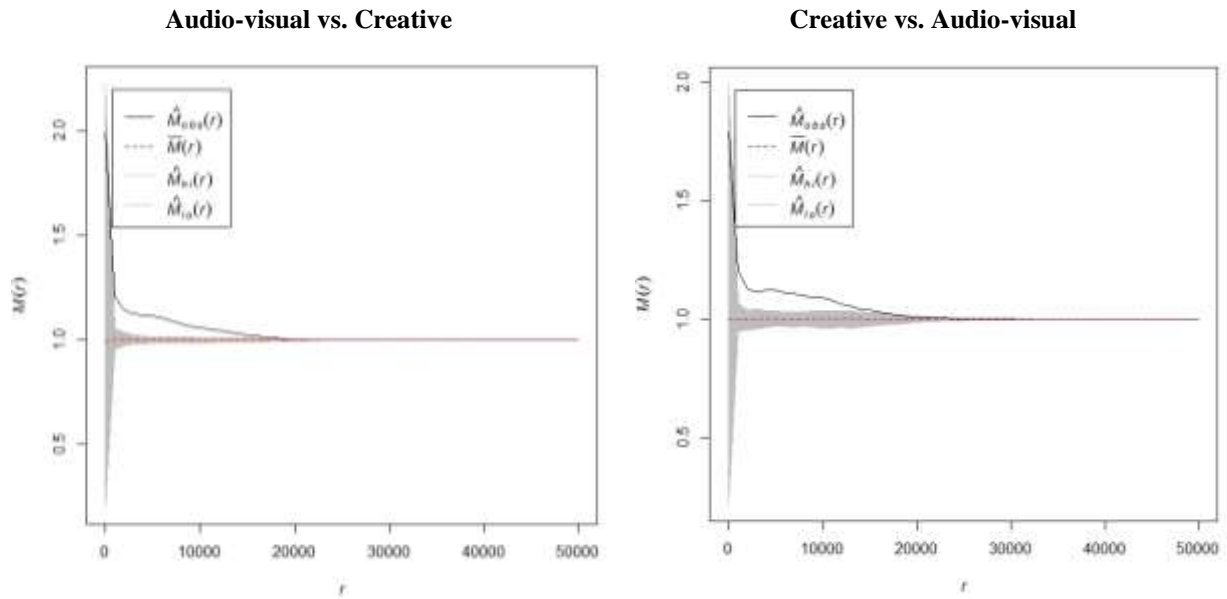
Source: Own elaboration. Note: Vertical axis (M -values); Horizontal axis (metres). 1000 simulations have been applied to obtain each M function.

Figure 4. Inter-industry agglomeration for Audio-visual and Creative Industries in the MAB (M function) (2006)



Source: Own elaboration. Note: Vertical axis (M -values); Horizontal axis (metres). 1000 simulations have been applied to obtain each M function.

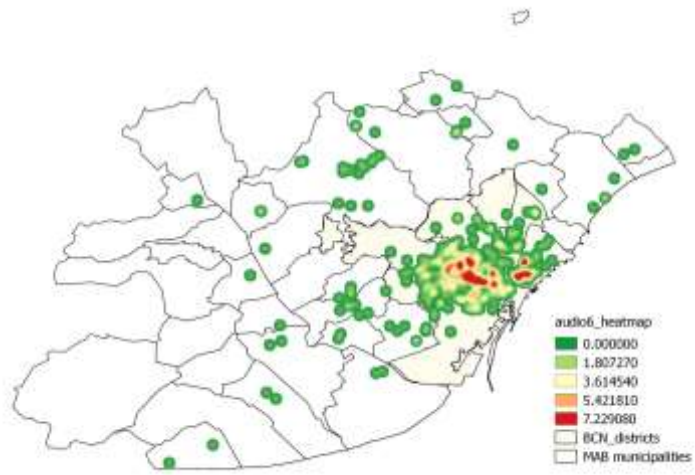
Figure 5. Inter-industry agglomeration for Audio-visual and Creative Industries in the MAB (M function) (2015)



Source: Own elaboration. Note: Vertical axis (M -values); Horizontal axis (metres). 1000 simulations have been applied to obtain each M function.

Figure 6. Kernel density maps for Audio-visual and creative firms (2006)

a) Audio-visual



b) Creative

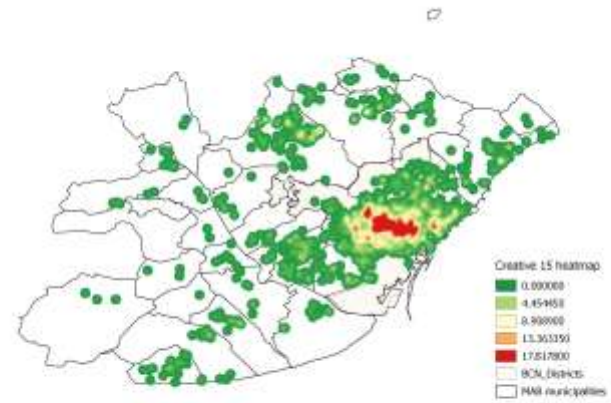
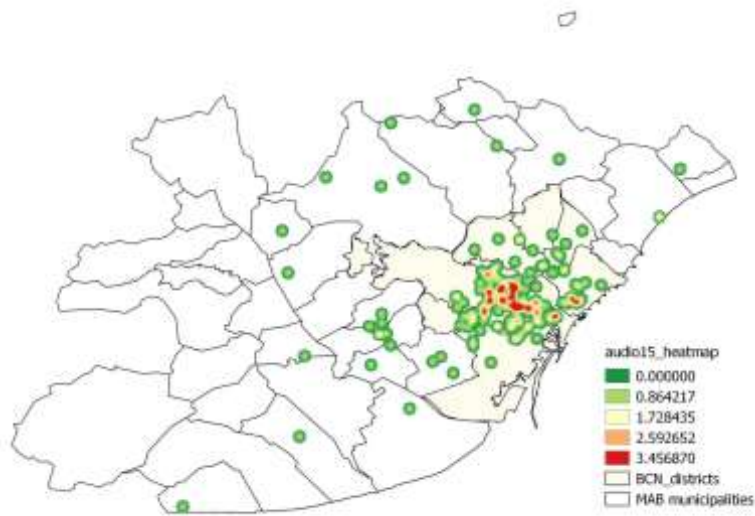


Figure 7. Kernel density maps for Audio-visual and creative firms (2015)

a) Audio-visual



b) Creative

