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Published Version:
Bernini Cristina, emili silvia, medei renato (2021). The spatial agglomeration of the MICE industry. THE INTERNATIONAL JOURNAL OF TOURISM RESEARCH, 23(5 (September/October)), 770-780 [10.1002/jtr.2440].

Availability:
This version is available at: https://hdl.handle.net/11585/832500 since: 2021-09-16

Published:
DOI: http://doi.org/10.1002/jtr.2440

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Abstract: MICE is one of the most profitable sectors of the tourism industry, with an effective impact on local economies. However, the investigation of its spatial agglomeration has not been fully explored. In this study we use information on the venues' characteristics and territorial distribution to identify convention firms' agglomeration, through a constrained clustering algorithm. This approach enables the inclusion of both non-geographical aspects, measured by the Krugman sectoral index, and geographical information. Findings show the existence of developed and developing convention agglomerations, with different MICE offers. Using convention demand data, we improve the cluster's profiles and propose some managerial strategies.

Keywords: MICE industry; industrial agglomeration; spatially constrained clustering; Krugman index.

Introduction

The Meetings, Incentives, Conferences, and Exhibitions (MICE) is the most profitable sector of the hospitality industry (Jones & Li, 2015) with high levels of fragmentation and competition between established and new markets (Locke, 2010). The International Congress & Convention Association (ICCA) (2019) estimated that the number of international meetings doubled every 10 years between 1963 and 2013; however, this exponential growth slowly decreased between 2013 and 2017, as the sector had reached a stage of maturity. According to ICCA (2019), 12,937 new meetings took place worldwide in 2018. Italy had 522 new meetings and 168,578 participants, and it was ranked sixth among the top ten countries for international meetings.

Regarding economic impact, the World Travel & Tourism Council (2018) estimated that the Travel & Tourism sector (of which MICE is the primary segment) accounted for 10.4% of global

GDP and 319 million jobs, or 10% of total employment in 2018. In Italy, business travel tourism accounts for 20.9% of total tourism expenditure, highlighting the significance of this sector.

Despite the significant influence of the MICE industry on local economies (Kim & Chon, 2009) and several other economic sectors (Getz, 2008), its territorial characteristics and spatial distribution have not been fully explored in the literature. The location of convention firms results to be one of the main drivers of all economic agents involved in the MICE's activities (Sylla et al., 2015; Alananzeh et al., 2018); besides, there are evidences of large heterogeneities of firms' geographical distribution and concentration across the world (Rubalcaba-Bermejo & Cuadrado-Roura, 1995). Several studies have also suggested that the investigation of the spatial features of the MICE industry are fundamental for its further development (Boers & Cottrell, 2007; Bernini, 2009). Conversely, a detailed analysis of the MICE industrial agglomeration, based on statistical-balanced information about structural characteristics and geographical distribution of venues, is currently lacking.

Starting from the pioneering work of Marshall (1920), industrial agglomeration refers to firms belonging to a specific industrial sector and locating in the same geographic area. These agglomerations produce external economies of scale and localization externalities, from which all firms in the area can benefit. The analysis of spatial agglomeration of industries highlights positive effects in terms of cooperation, competitiveness, expansion and diffusion dynamics, and specialization in each economic sector, becoming an important tool for government agencies in the implementation of interventions and assistance operations of economic development programs (Enright & Newton, 2005; Frenken et al., 2020; He et al., 2008).

Industrial and spatial agglomeration and clustering have attracted significant attention in tourism, as a useful conceptual tool to understand the economic strength or competitiveness of tourism destinations and geographic areas (Jackson & Murphy, 2002). Sölvell et al. (2008) and Weidenfeld et al. (2010) highlight tourism as a spatial phenomenon with a high level of agglomeration. Moreover, there is evidence that local tourism development can be achieved through spatial agglomeration by supporting small and medium-size enterprise's (SME) productivity, performances, innovative capacity, and local business critical mass (Ribeiro-Soriano, 2017).

Based on these arguments, the enhancement in the identification of spatial agglomerations of tourism firms is fundamental to support policy recommendations. Nevertheless, even if the concept of industrial cluster has been traditionally used in regional studies (Porter, 2003; Uyarra & Ramlogan 2016), the use of statistical algorithms to identify them has been introduced only recently (Guo et al., 2019). Therefore, the idea is to investigate spatial agglomeration phenomena in MICE tourism, combining the concepts of industrial agglomeration and statistical clusters, through the integration of convention venues' characteristics and information about geographic distribution of firms across the territory. Therefore, the identification of MICE agglomerations by statistically balancing the economic and spatial information is achieved through a constrained clustering procedure (Legendre & Legendre, 2012), specifically the Ward-like hierarchical algorithm proposed by Chavent et al., 2018.

The class of constrained clustering methods can be seen as the extended form of (unconstrained) clustering: if the latter uses the information about similarities of distances computed among the objects (usually based on socio-economic features), constrained clustering includes a second matrix of dissimilarities where the possible connections between objects are specified either as spatial or temporal constraints.

In our case study, we focus on the Emilia-Romagna (E-R) region, one of the main multi-product tourism destinations and business areas in Italy. In particular, Bologna—the main town of the Emilia-Romagna region—was ranked 46th among European destinations by ICCA (2019). In addition to its cultural heritage and MICE infrastructures, E-R is also one of the greatest mass tourism destinations at European seaside, hosting more than 40 million overnight stays per year (ISTAT, 2019).

To obtain information on the MICE industry, a census of all active facilities in E-R region has been conducted in 2017; consequently, a survey on the MICE demand was realised based on the census in 2018. The availability of both supply and demand data at municipal level represents a unique opportunity to evaluate spatial agglomeration, to suggest policy recommendations and to improve spatially-detailed development programs for the tourism sector (usually available at NUTS-2 or NUTS-3 levels). Specifically, regarding the MICE structure in E-R, the regional governance system has identified three different macro areas (Emilia, Bologna and Modena, Romagna), which show a high concentration of conference supply. Conversely, a general enhancement in the effectiveness of the policy-based recommendations can be achieved by the identification of more specific groups of units, in term of both similar characteristics, contextual effects, geographic conformation, political assessment and territorial related aspects.

This study contributes to the literature in several ways. It is the first to use a constrained clustering approach to identify spatial agglomeration of the MICE industry. Second, to enhance the effectiveness of the analysis, we used territorial data at the municipality level, instead of individual georeferenced firms. This approach enables policy strategies and recommendations to be developed at the cluster level, furnishing an adapting instrument for a local perspective of national policies. Third, cluster results are supported by data on the convention demand, providing a clear picture of the spatial performance of the MICE industry in E-R region.

Literature review

Spatial analysis of MICE industry

Owing to its significant economic relevance, MICE has been intensively investigated in literature (Getz & Page 2016). The main topics include: (i) MICE sector as one of the component of a multidimensional tourism system (Bramwell & Lane 2014, Chon & Weber 2014); (ii) MICE's impact in promoting national economy balances (Dwyer & Forsyth, 1998); (iii) the analysis of decision processes of convention's attendees (Zhang et al., 2007; Kim & Chon, 2009); (iv) the convention planners' selection processes (McCabe, 2009); (v) the investigation of the main determinants of the MICE demand (Carvalho et al., 2016; 2019); (vi) the geographical distribution analysis of facilities on the territory (Alananzeh et al. 2018; Bernini, 2009). In particular, this last field is the most recent topic explored, owing to the growing availability of spatial and georeferenced data (Cong et al., 2014).

In this framework, there is a general consensus that the conference's location is one of the main drivers of all economic agents. Rubalcaba-Bermejo & Cuadrado-Roura (1995) defined the geographical concentration of economic activities as a determinant issue in the analysis of the spatial distribution of exhibitions. Sylla et al (2015) examined limits and development opportunities of MICE industry in Łódź (Poland). The authors shared the insights into the several factors, such as accommodation, location, infrastructure, and image that define the status of the convention sector. Nonetheless, the authors did not base their analysis on analytical instruments but used descriptive statistics and maps.

In the analysis of the conference sector in Jordan, Alananzeh et al. (2018, 167) investigated MICE facilities as a factor of the spatial distribution of conferences, aiming at directing the venues "of future conferences to less favoured areas that are marginalized and poor." Their model is effective in predicting the best location in terms of economic and social sustainability to host future events. However, there was no spatial pattern but random distribution of conferences (i.e., not clustered, nor dispersed) in the data. The authors overlooked the distinction of possible conference events, assuming that all areas, including rural or unattractive territories, could host conferences of high international standard with adequate number of attendees.

Considering individual firms' geographical distribution, Cong et al. (2014) motivated their investigation of MICE clusters in Beijing, China, as a useful instrument to affirm and study competition and cooperation strategies inside and outside the clusters, as well as to provide relevant statements to policymakers. Among limitations of the study, authors depict the use of geographic variables exclusively, without including information about both the demand and the fragmented nature of the MICE supply. Similarly, Fang et al. (2017) investigated the temporal evolution of the spatial pattern of exhibition enterprises in the Pearl River Delta Region, China. Using the Ripley K function, the authors showed an increase in the number of enterprises agglomerations, moving from a single-centre pattern to a multi-centre stage. The spatial analysis is conducted exclusively on distances between firms, without involving structural characteristics of the convention supply to identify agglomerations.

An in-depth analysis of the extant literature on MICE's spatial characteristics shows the powerful insights of the identification of convention destination's clusters, both in literature and operational frameworks, thus highlighting spatial information as a fundamental issue.

Clustering algorithms

Among the possible uses of spatial information in supervised and un-supervised statistical methods, Fouedjio (2016) classified clustering procedures by embodying spatial analysis in four groups: i) algorithms where geographical coordinates are inserted in the clustering procedure as other variables; ii) non-spatial clustering based on a spatial dissimilarity measure; iii) algorithms where spatial proximity variables are used to limit clustering results; iv) spatial model-based clusters.

For this study, the first and fourth types of algorithm appear inadequately accurate (i.e. geographical variables lose their representative meaning) and too demanding in terms of statements (i.e. assumptions, distribution and model specification). Moreover, despite the presence of similar behaviours between the remaining two types of methods (ii and iii), Romary et al. (2015) indicated that the approaches in the second class provide only smoothness in the dissimilarity matrix, without consistently improving the results about spatial dependency. Therefore, in this analysis we will consider the category of algorithms where spatial proximity variables are used to limit clustering results.

In this class of methods, well-known as constrained clustering procedures (Dinler & Tural, 2016; Legendre & Legendre 1998), a set of restrictions are imposed to constrain the possible solutions in line with theories (i.e., economic, social, and scientific), or with respect to the temporal evolution or the spatial contiguity in the data; in particular, the last constraint is one of the most commonly used in empirical analyses.

The choice of a specific algorithm takes into consideration both conventional features of clustering methods (e.g. agglomerative vs partitioning techniques, Everitt et al. (2011)), and specific characteristics of constrained approaches (Ferligoj & Batagelj, 1982; Grossi et al., 2017). Specifically, this study adopts the Ward-like hierarchical algorithm proposed by Chavent et al. (2018) with spatial constraints as the ideal solution: the advantages of this algorithm lie in the inclusion of spatial contiguity constraints and in the possibility of referring to a statistical measure that only partially enables the researcher to control for the relevance of geographical and non-geographical information in the clustering solution.

The method

The algorithm provided by the Chavent et al. (2018) combines the two (not necessarily Euclidean) dissimilarity matrices, i.e. D_0 and D_1, through a parameter $\alpha \in [0,1]$ that leads to a control for the inclusion of spatial features in the 'economic' clustering result.

As in standard clustering problems, let $P_K = (C_1, \dots, C_K)$, be a partition of the dataset in K clusters. The basic hierarchical Ward-like method minimizes the pseudo-within cluster inertia of P_K, defined by $W(P_K) = \sum_{k=1}^{K} I(C_k)$, where $I(C_k), k = 1, \dots, K$, represents the pseudo-inertia of cluster k, measured as a function of dissimilarities between the units. A new partition P_{K-1} is obtained aggregating the two clusters in P_K that guarantees the minimum pseudo-within cluster inertia with the new partition P_{K+1}.

Considering two dissimilarity matrices, the central measure is represented by the mixed pseudo inertia of the cluster C_k, which is defined as a combination of inertias $I_\alpha(C_{k0})$ and $I_\alpha(C_{k0})$ calculated by D_0 and D_1 respectively, through a mixing parameter, defined by α and representing the weight of the constraining matrix in the clustering solution, as

$$I_{\alpha}(C_k) = (1-\alpha)I_{\alpha}(C_{k0}) + \alpha I_{\alpha}(C_{k1}). \qquad (1)$$

In this setup a new partition P_{K+1}^{α} is obtained minimizing the mixed pseudo-within cluster inertia $W_{\alpha}(P_K^{\alpha}) = \sum_{k=1}^{K} I_{\alpha}(C_k)$..

The idea of including the mixing parameters in the inertia formula leads to a control for the homogeneity due to the two dissimilarity matrices, separately. Then, the choice of the parameter α becomes crucial. The authors suggest defining α evaluating the proportion of the total mixed pseudo inertia due to the partition P_K^{α} on a grid of J values for $\alpha \in [0,1]$, analytically defined by

$$Q_{\beta}(P_K^{\alpha}) = 1 - \frac{W_{\beta}(P_K^{\alpha})}{W_{\beta}(P_1^{\alpha})} \in [0,1] \qquad (2)$$

where $\beta = 0, 1$ stands for socio-economic and geographic partitions respectively. The two sets of values $Q_0(P_K^{\alpha})$ and $Q_1(P_K^{\alpha})$ obtained separately for the two dissimilarity matrices can be plotted as the proportions of total pseudo inertia explained by D_0 and D_1. Specifically we simultaneously evaluate the patterns of loss in homogeneities (economic and spatial) starting from $Q_0(P_K^0)$ (where only D_0 enters in the algorithm) and $Q_1(P_K^0)$ (where only D_1 is considered). Hence, the value of α can be chosen by the intersection of the two normalized proportions of total pseudo inertia, as a trade-off between the loss in economic and the loss in spatial homogeneity in the results.

A critical factor of the procedure entails defining the measurements of the dissimilarity matrices. In general, regional comparisons of sectoral concentration can be examined referring to two dimensions: industry's characteristics and geographical location (Spencer et al., 2010). Among specialization or concentration measures proposed for D_0 to capture relationships, connections, concentrations, co-locations or agglomerations of industries (for a review see Kopczewska, 2018), one of the most used index in the regional and sectoral framework is the Krugman dissimilarity index (hereafter, KD).

The KD index is defined by

$$KD = \sum_j KD_j = \sum_j \left| \frac{x_{ij}}{\sum_j x_{ij}} - \frac{x_j}{\sum_i \sum_j x_{ij}} \right| \qquad (3)$$

where x_{ij} is the number of units of area i, with $i = 1, \dots, R$, for the jth sector, with $j = 1, \dots, S$; hence, KD_j can be seen as the Krugman specialization dissimilarity index for each industry.

The main characteristic of KD is to compare the observed empirical values with empirical global (benchmark) distributions, since it is built as a relative measure of specialization. Its value ranges from 0 (representing an industrial distribution entirely in line with the global one, i.e. the reference distribution observed in the whole area) to a maximum of $2\,(R-1)/R$, with R representing the total number of territorial units. Since the diversification in the industrial structure of a specific area is consistent with the distribution observed in the region, the Krugman index will be higher (Moga & Constantin, 2011; Vogiatzoglou, 2006). Thus, the index represents the instrument to identify and, from a policymaker point of view, support the economic contribution made by each region to the national economy.

The spatial counterpart of the dissimilarity matrix D_0, i.e. D_1, is obtained starting from a binary contiguity matrix. The specification considered among possible spatial weighting matrices (for a review of alternative specifications see Corrado & Fingleton (2012)), is motivated by empirical characteristics of the data presented below. Then, each entry of D_1 is calculated as one minus the related value observed in the binary spatial weighting matrix.

To ensure the adequacy of this investigation and ~~then the~~ reliability of results, the effective presence of a spatial dependence structure in the data has been tested through a set of Moran'I spatial autocorrelation tests (Moran, 1950). This measure allows to.. Specifically, the Moran'I index is given by

$$~~I~~I^M = \frac{\sum_i \sum_j w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2} \frac{N}{\sum_i \sum_j w_{ij}}, \qquad i,j = 1, \dots, N, \qquad -1 \le I \le 1$$

with N the number of spatial units; $x_\cdot$ is the variable of interest for the $\cdot\, th$ unit, and $\bar{x}$ the related mean; the spatial weights are represented by w_{ij}, and they are equal zero if $i = j$ (diagonal entries of the spatial weighting matrix). Values of I^M greater (lower) than zero stand for positive (negative) spatial autocorrelation. Under the null hypothesis of spatial randomization (absence

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Formattato: Tipo di carattere: Corsivo, Apice of autocorrelation), the statistic is asymptotically distributed as standard Normal, $(I^M \not{I}) = \frac{I^M \not{I} - E(I^M \not{I})}{\sqrt{VAR(I^M \not{I})}}$, with expected value of this index equal $E(I^M \not{I}) = -1/(N-1)$, and variance $VAR(I^M \not{I}) = E(I^M \not{I}^2) - [E(\not{I} I^M)]^2$.

The case study: the MICE industry in Emilia-Romagna

Definition and measurement

ICCA (2017) claims that MICE sector is composed of advanced facilities designed with the primary function of hosting congresses and events of various nature and size. In addition, a large number of firms and institutions, whose core business is neither convention nor tourism, professionally sell their facilities on the market. As depicted by Getz & Page (2016), business events depend on the availability of convention and exhibition centres, as well as, smaller locations, in line with the characteristics of the event. However, these firms and institutions are not easy to be identified since the sector "suffers from the lack of official definitions and measures useful in identifying firms that professionally sell convention facilities in the market." (Bernini, 2009). To overcome the lack of information on both the supply and demand side, we conducted two surveys in the E-R region (i.e., Appendixes B and C). First, a census of all active facilities in the region was conducted in 2017. Second, a survey on the MICE demand was developed to gather data on the number of conferences and attendees, and events' characteristics in 2018.

In classifying convention firms, we combined the classification adopted in the international context (Chon & Weber, 2014; UNWTO, 2006) with the one proposed by the Italian Observatory of Congresses and Events (OICE, 2019). In particular, we propose a classification mainly based on the core business and mission of each firm category[1] that considers:

(i) convention hotels (hereinafter, CH) as accommodation firms selling a space permanently equipped for meetings;

[1] For a detailed description of the MICE classification, please see Table A1 in Appendix A

(ii) convention centers (CC) as the core business of the MICE;

(iii) big events centers (BEC), presenting a large capacity to host conventions and meetings with a high number of participants (e.g. convention rooms inside fair center as a different typology because of the different core business of the fair centers, and arenas and sports palaces);

(iv) institutional offices (IO), mainly located in public buildings, as university and chambers of commerce;

(v) unconventional rooms (UR) as inclusive of venues such as historical buildings as conference rooms, and theaters, cinema and auditorium as cultural spaces;

(vi) venues with a number of seats lower than 50 (Small).

The MICE supply and demand in Emilia-Romagna

To measure the dimension of the convention supply, we use the number of convention firms and the number of seat places dedicated permanently to conferences and meetings (i.e., as the number of rooms in the accommodation sector).

The region hosts a total of 1,121 conference facilities and 388,718 seat places (Table 1), with substantial variability across typologies and provinces (see Figure B1 and Table B1 of Appendix B). Rimini is the smallest province (in terms of the surface) but with the highest density of convention firms and seat places (0.229 facilities and 85.13 seat places per km2). Bologna, the main town in the area, hosts 21.05% of the total MICE, but its offer is spread in the territory (0.064 facilities and 27.31 seat places per km^2).

[Insert Table 1]

Out of 331 municipalities in the region, 106 do not have convention facilities (Figure B2 in Appendix B); while only two municipalities host all MICE typologies (Rimini with 100 conference venues and 41,488 seats and Bologna with 97 locations and 49,379 seats). Furthermore, 43% of congress facilities (54% of total seats) are located in the principal provincial towns. IOs and URs (in particular theatres, cinemas and auditoriums) are the most diffused convention facilities; while only seven municipalities host congress centers (CC).

The consistency of the MICE demand is measured by the number of meetings, participants, and conference days. The demand survey (see Appendix D) shows that the MICE industry achieved almost 6.5 million conference days, hosting 53,000 events, and 4.8 million participants in meetings in 2018 (Table 1), while, overall, in E-R the total amount of tourism arrivals and overnights for 2018 was over 11 and 40 million, respectively (ISTAT, 2019).

Accommodation firms (CH) are the primary destination of the MICE activities; they host more than 50% of events in the region, with 40% of attendees and 38% of the entire amount of conference days. The second main relevant class is IOs, which capture more than 16% of events and attendees. The CCs are the core business of the conference industry: they register only a minor quota of events (2%), but these are long-time conferences, up to 17% of conference days and 13% of participants.

Results

To build the socio-economic matrix D_0, we calculate the total Krugman dissimilarity indexes, based on the number of facilities and seat places over each category (i.e., Eq. (3)). Among possible alternatives, the spatial counterpart, i.e. D_1, is defined starting from a binary contiguity matrix. Specifically, each entry of D_1 is calculated as one minus the related value observed in the binary spatial weighting matrix. The different concentration level of industries in each municipality and the heterogeneity among area amplitudes are the main determinants of this choice (Collet & Engelbert, 2013). Indeed, if in small towns, the geographical identification of the unit with the city center or the centroid of the municipality's surface could be reasonable, in large towns (e.g. Ravenna has a surface of 653.82 km^2, Ferrara of 405.16 km^2), the choice to use the city center to calculate distances with neighbourhoods, or the areal centroid of the municipality, can yield misleading results (i.e., it implicitly assumes that the convention supply is located at the municipality center).

To support the investigation of spatial agglomeration, we calculate the Moran'I spatial autocorrelation index, for both facilities and seat places. The test results, showed in Table 2, reveal spatial structures in the data (Anselin, 1998). All tests reject the null of random distribution among locations (absence of spatial dependence in the data), with a p-value always lower than 10%, confirming the existence of spatial patterns for the total amounts of facilities and seat places per municipality as well as for all the Krugman dissimilarity indexes (i.e., calculated for the total number of facilities and seat places and for each MICE categories).

[Insert Table 2]

The constrained clustering algorithms results

In the first step of the analysis, we use solely the economic dissimilarity matrix D_0 calculated on KD values. To identify the number of clusters, we use alternative tests as Calìnski-Harabasz's pseudo-F index, Duda-Hart test and Pseudo-T and Tibshirani gap statistics method (for a comprehensive review, see Gordon, 1999). To ensure the stability of the segmentation, we also randomly split the sample and verify results on the number of clusters in the two subsamples, separately (see Table E1 in Appendix E); in line with the stopping rules implied by the four indexes, the number of clusters is set to five.

Through the clustering results obtained by means of D_0 (Table 3), we can identify a cluster of the core convention municipalities, given by Cluster D, which comprises the principal provincial towns and the main cities in terms of population density. A completely diversified supply characterizes municipalities in this cluster, both in terms of professionalism in the MICE sector (i.e., the cluster has the highest presence of CC and CH, IO and UR), and capacities.

[Insert Table 3]

Cluster #A includes municipalities with a degree of diversification close to cities in Cluster #D, with a KD of facilities lower than 1. Every municipality of this group presents at least one convention firm for each category; however, the averages of both facilities and capabilities are mostly lower than the averages observed in Cluster #D. Cluster #B and #E are the most specialized groups: in #B are included municipalities with conference facilities of the category CH and UR (i.e., theatres, cinema, auditorium, corporate offices, amusement parks, shopping centres, spas, and historic buildings). The cluster #E comprises municipalities with one institutional facility (with a mean of about 150 seats). Cluster #C consists of cities that do not provide any kind of facilities.

Despite the economic meaning of the clustering results based on economic information, the mapping solution shown in the upper left panel of Figure 1 reveals the strong inadequacy of the solution for policy makers to provide recommendation at specific-specialization areal level.

The next steps of the clustering procedure imply the definition of the dissimilarity matrix D_1 and the identification of the parameter α. The intersection of the normalized values of total mixed pseudo inertia (Figure E1 in Appendix E) suggests a value of $\alpha = 0.425$, which guarantees enhancement of the geographical cohesion without excessive deterioration of the socio-economic homogeneity obtained at the starting step with $\alpha = 0$ (see Table E2 in Appendix E for further details). Then, the starting result with D_0 and the final constrained clustering solution are reported in Figure 1, from left to right respectively. The profile of each cluster is presented in the next section.

[INSERT Figure 1]

The constrain-cluster profiling

To better profile ~~evaluate~~ the constrained clusters~~ing result~~, we also consider ~~improve the analysis using data~~information provided by the MICE demand survey on the number of events and participants, for each macro-category of facilities and clusters (Table 4 and Figure 2).

Cluster #3. The MICE Cores: Geographic areas in this cluster represent the most professional and specialized convention agglomerations in the region. The professional degree of these areas is well depicted by the relevance of CC and BEC units; the quotas of facilities and seat places of these two classes to the regional total offered by these categories are 65.6% (21) and 74.8% (over 83,000 seats), respectively (Table 4~~3~~). The hotels also offer a substantial offer, which covers almost 60% of the regional supply. The presence of all other MICE facilities is important, and so the sector may benefit substantially from a strong and diversified network of convention firms in these municipalities. In particular, we identify three main areas in this cluster: the first area is on the Adriatic coast, where the principal municipality (in terms of population density and convention facilities) is Rimini, with 100 convention facilities; moving from south to north, the second agglomeration can be identified in Bologna (97 venues), first municipality for capacity with more than 49 thousand seats (eight thousand more than in Rimini), and the third area, located between the two main towns of Modena and Reggio nell'Emilia (collectively host about 44 thousand seats). In term of demand, the clusters is confirmed as the core of the MICE sector in Emilia-Romagna showing the most relevant results in terms of events (62% of the total regional number) and attendees (53%). The high level of accessibility implied by the presence of a diversified transportation infrastructure that includes railway lines, highways, and airports (Zelinsky, 1994), the professionalism of hosting locations (Getz, 2008), but also the high level of attractions and entertainment amenities (Baloglu & Love 2003) on the territories of this cluster, guarantee a high demand and remarkable flows of attendees. Cluster #3 includes Bologna, which the ICCA (2019) annual ranking identifies as the 46th convention destination in Europe (i.e., in Italy it is positioned behind Rome, Milan and Florence). Nonetheless, the numbers related to the convention offer and demand in Rimini, as well as in Modena and Reggio Emilia (all these destinations belong to #3), prove that these areas have the capacity to grow up and develop the MICE sector in line with Bologna, thanks to their proximities.

Cluster #5. Art and Conventions: Municipalities in cluster #5 present a full MICE offer, hosting all the categories of the convention supply; however, a large proportion of these facilities are not of a professional standard. Compared with cluster #3, here we observe higher relative percentages of both institutional and unconventional facilities. In this cluster, there are, on average, more than two IOs offering convention services and two UR facilities (e.g. theaters, cinemas, auditoriums, corporate offices, amusement parks, shopping centers, spas, and historic buildings) in each municipality. Similar to cluster #3, this cluster is located in three of the main areas of the region: the largest is the agglomeration at the provinces of Ravenna and Ferrara; from east to west, the second area includes municipalities of the Bologna province (see Figure 1), while the third area is identified in Parma. All these areas are classified by the Italian Institute of Statistics as art and historical locations. Then, these municipalities combined the MICE offer to their core tourism business, which is the cultural heritage and tourism segment, ~~providing~~capturing 15% and 18% of the total amount of regional events and attendees, respectively. quali strutture sono più usate?

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Cluster #2. MICE in progress: It is a vast spatial cluster, comprising 109 municipalities and 33% of the region; however, it hosts the low-quality segment of the convention supply, which ~~recording~~attract a small share of the regional demand (10% and 12% of total events and attendees, respectively), mainly in institutional offices and unconventional facilities. Municipalities in this area are spatially distributed in the neighborhood of the areas covered by clusters #3 and #5; from an economic perspective, their convention offers complete the total offer of the core clusters, but it is actually in a first stage of the MICE life cycle (Bernini, 2009).

[Insert Table 4~~3~~]

Cluster #1. MICE is running: This group of municipalities benefits of the positive influence of the core clusters (#3 and #5), . hosting the 10% of events and attendees of the regional demand. The number of facilities in this cluster are similar to cluster #2, but they differ with regard to firms' capacity: seat places of both CH and IO facilities are more than double the capacities of those observed in cluster #2 (the average values move from 97 and 90 seats in cluster #2, to 191 and 192 in cluster #1 for hotels and institutions, respectively). Overall, these venues host 10% of events and attendees of the regional demand in quali strutture???. The closeness to cultural and tourism destinations benefits the local convention offer and accelerates its growth to the professional segment.

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Cluster #4. Out of the MICE sector! Of the 78 tows in cluster #4, 73 do not show conference facilities, representing 69% of the 106 municipalities of the region without convention supply. The main exception here is represented by Piacenza (one of the main towns). The proximity to Parma and the neighborhood to Milan seems to be the most important motivations behind the scarcity of the offer of the city. Cluster #4 is confirmed to represent the watershed group also by demand analysis: facilities collected in this cluster hosted less than 3% (1,574) of the total number of events and 7% of attendees (324,273). quali strutture?

[INSERT Figure 2]

DiscussionManagerial Implications

To evaluate the constrained clustering result, we improve the analysis using data provided by the MICE demand survey on the number of events and participants, for each macro-category of facilities and clusters (Table 3 and Figure 2).

The information provided by thisResults analysis furnishesallow important implications for both regional and local destination organization operators (local and regional policy makers), MICE

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tourism ~~industries~~operators, as well as firms ~~not connected (at least, apparently) to this specific~~related to the MICE sector ~~segment~~; moreover, ~~.~~

~~T~~the picture obtained through the analysis highlights the importance of ~~a diversified~~cluster-based policy strategies and recommendations (usually available at a non-suitable spatial detail) to be developed at the cluster level.

The core MICE industry is highly concentrated on cluster #3 and #5. In line with Getz & Page (2016), cluster #3 represents a clear cohabitation of business and pleasure, the last as crucial component in the convention tourism performances. On the other hand, the main offering of municipalities in cluster #5 is heritage and cultural tourism; but it may represent an incentive to diversify their tourism offer toward the business and conference sector (Cong et al., 2014). Here, the structure of the MICE supply suggests ~~the~~ to ~~need~~ further ~~to enhance~~enhancing both the professional degree and the quality of convention venues and accommodation firms.

~~In summary, A~~although the two clusters show different levels of specialization in terms of the MICE offer, the integration of ~~of other types of~~their endogenous resources (i.e., urban, pleasure, cultural and heritage) ~~into~~with ~~the~~ tourism and business services ~~and a~~by using a strategy of product diversification may increase the ~~value~~competitiveness of the local economies. Then, policy makers at this cluster should further encourage the fusion of the heritage and cultural offer with the business and conference demand, to sustain the improvement in the quality of the overall tourism offer towards highly professional standard. Local ~~agent~~operators and event ~~organisat~~organisations~~ions and industries~~ can contribute to a general tourism development program, combining the promotion and ~~the~~ attractiveness of the leisure and business segments, without distinguishing among channels and markets. New investments in entertainment and specific amenities of the territories (e.g. guide tours, theatres, sport centres and activities, and museums) can reinforce the development of business events' demand in these areas.

~~Quite far from the results of~~Differently from Cluster #3 and #5, Clusters #1 and #2 are not entirely professional~~,~~ but ~~they may be~~ are motivated in developing the MICE sectors in their

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Commentato [CB1]: non sono sicura del significato.. tolgiamo?

Formattato: Rientro: Prima riga: 1,27 cm areas. The potentialities of cluster #1 and #2 can be developed around a local or regional demand. Tourism business remains a strategy to diversify their offer by exploiting the functional interdependence of areas or external effects of agglomeration (Yang & Fik, 2014; Majewska, 2015). These municipalities are characterized by a low population density and are localized in peripheral areas (Grado et al., 1997), where there is the need to re-examine and reinforce their professional services and image (Bonn et al., 1994), to promote both the facilities and the local attractions (the rural environment and the historical attractions). In line with Sylla et al. (2018), physical and geographical limits of these territories, mainly positioned in rural areas, are difficult to overcome; therefore, an improvement of investments in the road connections, infrastructures and public transportation (e.g. buses and railway) may be of primary interest for regional decision-makers, but also for local governments. At the same time, MICE companies in Cluster #1 and #2, which are in a developing phase of the MICE life cycle, should direct new investments in accommodations, catering and entertainment activities, thus promoting the hospitality feature of the location and taking advantages of the spill-over benefits of being located in the neighbourhood of the MICE core areas. A government's economic support for the promotion of the local products and destination image could be strongly relevant.

Clusters #1 and #2 are not entirely professional, but they may be motivated in developing the MICE sectors in their areas. They capture conferences in institutional offices and unconventional facilities. The potentialities of cluster #1 and #2 can be developed around a local or regional demand. Tourism business remains a strategy to diversify their offer by exploiting the functional interdependence of areas or external effects of agglomeration (Yang & Fik, 2014). A spatial interaction, as the external effect of agglomeration, occurs when the processes of tourism development and productivity spread beyond the borders of territorial units to neighbouring regions (Majewska, 2015). These municipalities are characterized by a low population density and are localized in peripheral areas (Grado et al., 1997), where there is the need to re-examine and reinforce their professional services and image (Bonn et al., 1994), to promote both the facilities and the local attractions (the rural environment and the historical attractions). In line

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with Sylla et al. (2018), physical and geographical limits of these territories, mainly positioned in rural areas, are difficult to overcome; therefore, enhancing the road connections and infrastructures may be of primary interest.

Likewise Clusters #1 and #2 in term of geographic characteristics, but with an almost absent MICE offer,Cluster #4 is confirmed to represent the watershed group: facilities collected in this cluster hosted less than 3% (1,574) of the total number of events and 7% of attendees (324,273); they are mainly hotels. mMunicipalities in cCluster #4 are characterized by a high level of rurality and they are often far from urban centerscentres (e.g. except for the main town of Piacenza), with low degrees of specialization, professionalism, and attractions. Municipalities interested in investing in MICE sector, should be supported by regional agencies. Before the improvement of road connections and infrastructures, these policy makers could create a set of supporting programmes for development and investment in the MICE segmentsector, forsupporting both private industries and local public organisations.

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[INSERT Figure 2]

Conclusions

The MICE industry has an important economic relevance at the territorial level; however, knowledge about its spatial agglomeration is still limited.

The concepts of industrial and spatial agglomeration and clustering have attracted significant attention in tourism literature, as a useful tool to understand and improve the economic strength or competitiveness of tourism destinations and geographic areas (Jackson & Murphy, 2002; Sölvell et al. 2008; Weidenfeld et al. 2010) and to encourage local tourism development (Ribeiro-Soriano, 2017).

Despite the interest of the literature to understand and investigate MICE agglomerations (Alananzeh et al. 2018; Bernini, 2009; Cong et al., 2014; Fang et al., 2017; Guo et al., 2019; Rubalcaba-Bermejo & Cuadrado-Roura, 1995; Sylla et al, 2015), several limitations in the literature can be depicted, concerning either the statistical instruments used for the investigations, the characterization of MICE as multi-product industry, or the geographic dimension in the analysis. T~~herefor~~o fill these gaps~~e~~, ~~the idea~~our study aims at ~~is to~~ investigating the~~e~~ spatial agglomeration ~~phenomena~~ in MICE tourism, combining the concepts of industrial agglomeration and statistical clusters, through the integration of convention venues' characteristics and information about geographic distribution of firms across the territory. In particular, ~~To fill this gap,~~ this study has identified the MICE industrial agglomerations by using a spatially constrained clustering algorithm that only partially enable the researcher to control for the relevance of geographical and non-geographical information. The application of a spatially constrained clustering approach, together with in-depth details of convention firms in E-R, helps in evaluating competitiveness and cooperation actions, and in recommending policy strategies.

The study raises a number of important issues related to the structural and territorial characteristics of the convention clusters in the E-R region. As suggested by Lee & Back (2005), our estimates confirm that events are strongly related to several physical facilities of the MICE sector, such as professional adequacy, accessibility, and capacities of the hosting locations. ~~The core MICE industry is highly concentrated on cluster #3 and #5; cluster #3 includes Bologna, which the ICCA (2019) annual ranking identifies as the 46th convention destination in Europe (i.e., in Italy it is positioned behind Rome, Milan and Florence). Nonetheless, the numbers related to the convention offer and demand in Rimini, as well as in Modena and Reggio Emilia (all these destinations belong to #3), prove that these areas have the capacity to grow up and develop the MICE sector in line with Bologna, thanks to their proximities. Although the two clusters show different levels of specialization in terms of the MICE offer, according to the integration of other types of endogenous resources into the tourism services and a strategy of product diversification may increase the value of the local economies through the diversification of local supply. Then,~~

Formattato: Rientro: Prima riga: 1,27 cm policy makers at this cluster should further encourage the fusion of the heritage and cultural offer with the business and conference demand, and to sustain the improvement in the quality of the overall tourism offer towards highly professional standard.

Clusters #1 and #2 are in a developing phase of the MICE life cycle, basing their offer on firms whose core business is out of the conventions and being mainly localized in rural areas. Local policy makers should sustain a diversification strategy of the business and tourism offer by focusing on their environmental and the historical attractions, develop the accessibility to these areas and take advantages of the spill-over benefits of being located in the neighbourhood of the MICE core areas.

As suggested by Lee & Back (2005), events are strongly related to several physical facilities of the MICE sector, such as professional adequacy, accessibility, and capacities of the hosting locations. The joint analysis of the spatial distribution of convention supply and demand at the municipality level confirm previous findings. evidence that MICE activities are more intensive in areas where professional facilities and services (i.e., #3) and accommodation of high quality (i.e., #5) are present. Middle towns or rural areas (i.e., #1 and #2) mainly offer convention venues in hotels, IO, and UR; thus, they attract a minor part of the MICE demand. However, they have significant possibility to improve their positioning in the market owing to the proximity to the core MICE clusters.

In summary, the evidence gathered in this research highlights several regional cluster-based managerial implications and suggest the need to both: (i) a renovation of tourism management and governance based on the attractive potentialities of territorial and macro areasclusters, and (ii) a highly diversified destination marketing strategy to promote developments both in core strategic and in MICE developing areasclusters.

The study presents a few limits. The first concerns the absence of a temporal perspective of the analysis. Even if in this study we used novel and rich information of both the demand and supply convention industry, we cannot investigate the evolution of the phenomenon and the effects caused by the spatial agglomeration. Second, ~~Moreover,~~ for a full understanding of the clustering process of the MICE industry, the algorithm should include the main factors of an industrial cluster analysis, such as factor conditions, related and supporting industries, demand conditions, strategies and firm rivalry. These issues will be the focus of our future research.

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Table 1. MICE sector supply and demand in the Emilia-Romagna

		Small	CH	CC	BEC	IO	UR	Total
Supply								
Facilities	*nr*	108	332	11	21	297	352	1,121
	%	10%	30%	1%	2%	26%	31%	100%
Seats	*nr*	3,766	98,872	39,505	72,269	55,595	118,712	388,718
	%	1%	26%	10%	18%	14%	31%	100%
Demand								
Events	*nr*	3,380	30,163	1,049	1,270	8,747	8,464	53,072
	%	6%	57%	2%	2%	17%	16%	100%
Attendees	*nr*	71,790	1,933,264	609,273	603,227	794,845	821,452	4,833,851
	%	2%	40%	13%	12%	16%	17%	100%
Days	*nr*	55,261	2,489,780	1,068,505	1,162,805	854,882	850,511	6,481,744
	%	1%	38%	17%	18%	13%	13%	100%

Table 2. Moran'I tests for facilities and seat places

Facilities	I	E(I)	sd(I)	Z	p-value
Num. facilities	0.047	-0.003	0.031	1.582	0.057
KD - total	0.164	-0.003	0.034	4.877	0.000
KD – H	0.133	-0.003	0.034	3.980	0.000
KD - CC	0.105	-0.003	0.034	3.164	0.001
KD - BEC	0.104	-0.003	0.034	3.131	0.001
KD - IST	0.132	-0.003	0.033	3.955	0.000
KD - Small	0.107	-0.003	0.034	3.217	0.001
KD - UR	0.115	-0.003	0.034	3.456	0.000
Seat places	I	E(I)	sd(I)	Z	p-value
Num. Seat places	0.082	-0.003	0.031	2.769	0.003
KD - total	0.171	-0.003	0.034	5.082	0.000
KD – H	0.130	-0.003	0.034	3.891	0.000
KD - CC	0.106	-0.003	0.034	3.189	0.001
KD - BEC	0.104	-0.003	0.034	3.120	0.001
KD - IST	0.131	-0.003	0.034	3.919	0.000
KD - Small	0.105	-0.003	0.033	3.157	0.001
KD - UR	0.109	-0.003	0.034	3.275	0.001

Table 3. Clustering solution based on D0: KD index and conference supply by category and cluster

Cluster	*Obs*	*Variable*	*KD*	*sd(KD)*	*Small*	*CH*	*CC*	*BEC*	*IO*	*UR*	*Total*
A	40	Facilities	0.839	0.067	6	44	2	1	50	39	142
		Seats	1.192	0.122	160	22,431	5,350	7,000	8,799	11,542	55,282
B	88	Facilities	1.366	0.053	8	25	0	1	0	84	118
		Seats	1.412	0.058	269	4,460	0	700	0	24,809	30,238
C	106	Facilities	2.000	0.000	0	0	0	0	0	0	0
		Seats	2.000	0.000	0	0	0	0	0	0	0
D	55	Facilities	0.509	0.202	86	263	9	19	205	229	811
		Seats	0.747	0.194	3,042	71,981	34,155	64,569	40,584	82,361	296,692
E	42	Facilities	1.514	0.124	8	0	0	0	42	0	50
		Seats	1.752	0.094	295	0	0	0	6,212	0	6,507

Table 4. Constrained clustering solution: KD index, conference supply by category, and demand by clusters

Cluster	*Obs*	*Zeros*	*Variable*	*KD*	*Sd(KD)*	*Supply*							*Demand*	
						Small	*CH*	*CC*	*BEC*	*IO*	*UR*	*Total*	*Events*	*Attendees*
#*1*	48	2	Facilities	1.123	0.401	15	42	1	3	34	65	160	5,329	471,770
			Seats	1.278	0.314	549	9,190	2,275	5,290	9,192	17,552	44,048		
#*2*	109	1	Facilities	1.304	0.31	12	31	0	1	65	69	178	5,129	573,406
			Seats	1.467	0.267	392	10,520	0	700	9,831	20,935	42,378		
#*3*	63	12	Facilities	1.045	0.574	60	201	8	13	112	141	535	33,097	2,577,310
			Seats	1.225	0.503	2,136	58,145	30,200	53,415	21,781	55,441	221,118		
#*4*	78	73	Facilities	1.925	0.314	0	8	0	1	10	12	31	1,574	324,273
			Seats	1.94	0.248	0	4,315	0	6,000	2,987	4,114	17,416		
#*5*	33	18	Facilities	1.371	0.755	21	50	2	3	76	65	217	7,955	887,092
			Seats	1.479	0.637	689	16,702	7,030	6,864	11,804	20,670	63,759		

Figure 1. The map of the clustering solution by means of D_0 (upper-left side) and constrained solution (lower-right side)

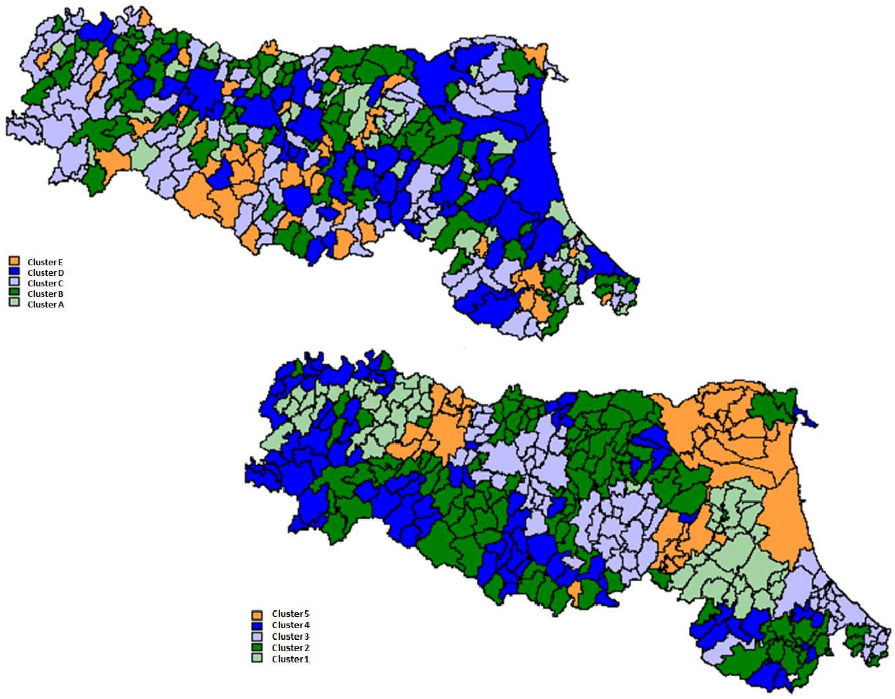

Figure 2. Demand distribution by categories and clusters