Complexity traits and dynamics of tourism destinations

Ruggero Sainaghi
ruggero.sainaghi@iulm.it

Dipartimento di Economia, studi giuridici e aziendali, IULM University, Milan, Italy

Rodolfo Baggio
rodolfo.baggio@unibocconi.it

Master in Economics and Tourism, Bocconi University, Milan, Italy
and
National Research Tomsk Polytechnic University, Tomsk, Russian Federation

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Abstract

This paper is rooted in network science and contributes to filling two gaps, developing multiple case studies in order i) to measure the complex structure of tourism destination and ii) to explore its evolution over time, by mapping turning points. The findings put forward ten new analyses, allowing the research team to test two hypotheses: i) concerning the complex structure, the tendency of tourism destinations to remain far from the chaos threshold, ii) concerning turning points, the ability of different destinations to show also different evolution through time. The paper uses the Horizontal Visibility Graph Algorithm and applies it to a sample of ten tourism destinations in the second leading Italian tourism region per size: Trentino-Alto Adige. Findings confirm both hypotheses. Limitations and research implications are drawn.

Keywords

Complex systems; time series; horizontal visibility graph algorithm; turning points; multiple case studies.

1 Introduction

What is a tourism destination? This deceptive question for tourism literature has received many answers over time (Pearce, 2014). In this paper we focus on a supply perspective (Leiper, 1979, 1990), considering the fragmented structure of a tourism destination (Dredge, 1999; Flagestad & Hope, 2001) and the presence of many actors operating as “co-producers” (Sainaghi & De Carlo, 2016). In this sense, the destination can be described as a complex networked system, where local actors (public and private) and organizations are the nodes, and the relationships between them the links (Baggio, Scott, & Cooper, 2010). Both elements are crucial: nodes represent the "scattered" resources and services, the components of tourism products; relationships make it possible to "mobilize" these resources in order to create the destination's products (Haugland et al., 2011; Pearce, 1989). Nodes are local firms, private and public organizations, profit and non-profit companies, local DMOs; links are relationships between firms necessary to develop the business, but links also include broad personal relationships, such as family, friendship or trust between local actors (Sainaghi & Baggio, 2014). Relationships between local actors, both weak and strong ties (Burt, 1992), represent the source of social capital (Nahapiet & Goshal, 1998).

The ability of this network to enlarge, and modify nodes, on the one hand, and to create valuable new links between actors, on the other, makes it possible to build and renew the destination competitive advantage, developing new processes and attracting the interest of some targets (Leiper, 2000; Weaver & Oppermann, 2000). These links are very important to manage seasonality (Bar-On,1975, 1999; Butler, 2001; Cuccia & Rizzo, 2011; Parrilla, Font, & Nadal, 2007; Sainaghi & Canali, 2011; Sainaghi, 2010b). In fact local hotels more embedded in the network structure are also more able to increase their occupancy, especially during off-peak seasons (Sainaghi & Baggio, 2014). The social network analysis renews the stream of research describing the destination as a tourism district, or cluster (Dredge, 1999; Sainaghi, 2006). The presence of many local actors (the nodes) generates a population of SMEs typical of an industrial district (Bellandi, 1989; Becattini, 1989, 1990; Marshall, 1919, 1920).

This network representation is a useful way to investigate the structural and dynamic characteristics of a complex system (Baggio, Scott, & Cooper, 2010, 2011; Baggio, 2011; van der Zee & Vanneste, 2015). More generally, by complex system we mean here a "network made of a number of components that interact with each other, typically in a nonlinear fashion. Complex systems may arise and evolve through self-organization, [so] that they are neither completely regular nor completely random, permitting the development of emergent behavior at macroscopic scales" (Sayama, 2015, p. 3). In fact, the destination cannot be understood by breaking down the system into its constituent elements (Stevenson, Airey, & Miller, 2009), following a linear reductionist approach or a Newtonian perspective (Farrell & Twining-Ward, 2004; Faulkner & Valerio, 1995). As discussed in the literature review, some papers describe the complex structure of tourism destination, mainly using qualitative study or single quantitative case, on the one hand, and only a few of them analyze the network dynamics, on the other. The latter are primarily qualitative and based on single longitudinal case studies, quantitative approach, therefore, depicts a clear gap. This article contributes to filling both gaps, developing multiple case studies in order to measure the complex structure of tourism destination and to explore its evolution over time, by mapping turning points.

The rest of the paper is organized as follows. The next section contains an introduction of the main concepts of complexity and system evolution and the used model is presented. The methods and the data used in the empirical study are examined in section 3. Then a discussion of the outcomes and the implications along with the limitations and possible future developments is presented. The contribution proposes an application to multiple case studies represented by some leading Italian destinations in the Trentino-Alto Adige Region.

2 Destination as complex networked system

As suggested by some authors, articles should clarify their theoretical background (Morgan, 1997). This paper is rooted in network science and, following a growing research field, it describes the tourism destination as a network. Both concepts are discussed in this paragraph. A network is a set of interconnected nodes (Burt, 1992; Knoke & Kuklinski, 1982). In a tourism destination, nodes are usually represented by local actors, such as local firms, non-profit organizations, associations, DMOs, people (Sainaghi & Baggio, 2014). The network is viewed as a multi-actor structure, where different organizations have their own specific interests (Dredge, 2006; Barrutia & Echebarria, 2015). This broad set of actors is strongly connected, with the prime purpose of creating the entire tourism product, that is a basket of services (Murphy, Pritchard, & Smith, 2000), especially in the community model (Flagestad & Hope, 2001), where the destination supply is fragmented in hundreds of firms (d'Angella, De Carlo, & Sainaghi, 2010; Murphy, 2013). These connections are vital and, as demonstrated in some studies, are able to increase the social capital of local actors both in tourism (Minola, Campopiano, & Sainaghi, 2016; von Friedrichs Grängsjö & Gummesson, 2006) and in non-tourism network (Coviello, 2006). Usually leading companies, DMOs, local associations play a central role in the destination network, showing high centrality (Bornhorst, Ritchie, & Sheehan, 2010). Links between actors can be represented by business relationships (institutional, commercial, ownership) or by a personal link (family, friendship, trust) (Sainaghi & Baggio, 2014). The latter are very important, considering the limited geographical scope of a tourism destination (Pearce, 2014). Furthermore, the high involvement of local actors and people in destination planning and development increases the relationship between stakeholders (Beritelli, 2011; d'Angella & Go, 2009).

Given the relevance of destination as a network, this section proposes four aspects: i) the theoretical stream underling this paper, represented by social network analysis, ii) the non-linear relationships that link the destination actors, creating a complex system, iii) the evolution of the system over time (dynamicity) and iv) the method used in this paper to analyze the destination network.

2.1 Network science

As indicated in some studies, tourism networks represent a popular research stream in the last 20 years (Albrecht, 2013). Morrison, Lynch and Johns state in 2004: "tourism networks have been a relatively neglected area of academic study […] While there is growing interest in networks and partnerships, relatively little has been published with a specific tourism focus, and most of which does exist is of recent origin" (p. 197). Appendix 1 lists some papers appearing since 2000, reporting the descriptive variables later analyzed. The present work is not a literature review; the appendix has the goal to position this contribution in a wide and rising research stream, clarifying the theoretical background, the pros and cons of network approach, the main applications of network theory and the underlying concept of network.

The table reports 47 papers; more than half of them have been published since 2010. This wide corpus is unified by the use of social network analysis (SNA), sometimes combined with other theoretical approaches (i.e. cluster analysis, marketing, governance, sustainable tourism, etc.). In order to define what SNA is, some works cite Wasserman and Galaskiewicz (1994): SNA, instead of analyzing individual behaviors, attitudes and beliefs, focuses its attention on how these interactions constitute a framework or structure that can be studied and analyzed in its own right. Bhat and Milne explain that the focus of SNA "is not on a single person or organization nor is it on dyadic relationships but on the overall pattern of relationships which form the context in which all organizations function" (2008, p. 1131).

The growing attention to SNA is related to some advantages that networks depict; reading the evidences reported in the appendix the main pros refer to: i) the destination view, ii) relationships between actors, iii) knowledge management, iv) performance. At the *destination level*, the SNA is able to represent the "total tourism product", offering a whole-of-destination view, considering relationships between destinations, coordinating policies and related actions, favoring local development (Albrecht, 2013; Bregoli et al., 2016; Del Chiappa & Presenza, 2013; Novelli, Schmitz, & Spencer, 2006; Shih, 2006; Sørensen & Fuglsang, 2014; van der Zee & Vanneste). Focusing on *actors*, networks are useful in managing stakeholders and collaboration, especially in the field of sustainable tourism, in building community capacity, coordinating policies and related actions, developing a collective vision, creating conformity, inclusion, cohesion, entrepreneurship, focusing on long-term relationships, creating social capital, favoring conflict management and resource sharing (Arnaboldi & Spiller, 2011; Bhat & Milne, 2008; Dredge, 2006; Paget, Dimanche, & Mounet, 2010; Presenza & Cipollina, 2010; Russell & Faulkner, 2004; Sainaghi & Baggio, 2014; Saxena & Ilbery, 2008; Von Friedrichs Grängsjö & Gummesson, 2006). SNA improves the ability to share and transfer *knowledge*, favoring innovation, inter-organizational learning, reducing the perceived risks for businesses (Baggio & Cooper, 2010; Breukel & Go, 2009; Denicolai, Cioccarelli, & Zucchella, 2010; Halme, 2001; Rodger, Moore, & Newsome, 2009; Saxena, 2005; Sørensen, 2007; Zehrer & Raich, 2010). Finally, concerning *performance*, relationships between operators decrease transaction costs, generate economies of scope and scale, improve competitive advantage, competitiveness and performance (both at business, destination and industry level) (Erkuş-Öztürk & Eradin, 2010; Erkuş-Öztürk, 2009; March & Wilkinson, 2009; McLeod, Vaughan, & Edwards, 2010; Miguéns & Mendes, 2009; Pavlovich, 2003; Von Friedrichs Grängsjö, 2003). This contribution explores this last topic (performance), proposing some synthetically measures relative to complex structure of tourism systems and able to trace their evolution over time. The weaknesses of SNA are considerably less than advantages and, as reported in the Appendix, they refer mainly to methodologies used, difficulties in collecting and analyzing data, or limitations related to a specific approach (such as quantitative and qualitative analysis based on a single year, that creates a "snapshot"). Not surprisingly, the strengths favored an application of SNA in many tourism fields, such as planning and development, knowledge management, innovation, collective and inter-organizational learning, stakeholder management, destination marketing, sustainable tourism, only to cite some relevant sub-fields.

Network articles can be subdivided according to the focus on business and policy network (Presenza & Cipollina, 2010; Del Chiappa & Presenza, 2013). The first provides "a useful framework for understanding the evolution of business networks, and as a corollary, product development, packaging and opportunities for further development" (Dredge, 2006, p. 270), while the second focuses on public-private relationships (Pforr, 2006). The Appendix shows the greater relevance of policy networks (roughly 60%). This contribution analyzes the destination system dynamics focusing on hotel performance (overnights), and therefore can be classified as a business network.

Depending on the methodological toolset, it is also possible to distinguish papers based on qualitative or quantitative approaches (Albrecht, 2013). More than half of the reported articles use qualitative evidence (57%), while the quantitative approach is less developed (36%); some contributions are conceptual (2%) or literature reviews (5%). The present paper develops a quantitative approach and explores the configuration of network, based on secondary data of local firms (as outlined later in the methodology section).

2.2 Destination as a complex system

Network scientists have revealed some interesting characteristics of tourism destinations, usually described as complex systems (Baggio, 2008; Miguéns & Mendes, 2009; Pavlovich, 2014; Russell & Faulkner, 2004). This complexity is synthesized in some traits of tourism networks, such as i) non-linear relationships (Laws & Prideaux, 2005), ii) self-organization behaviors (Kauffman, 1995; Nicolis & Prigogine, 1977), iii) emergence of modular structures (Newman, 2010), iv) robustness or fragility regarding some events (Lorenz, 1963). These characteristics are described in many previous articles – for example McKercher explains that "tourism functions in a non-linear, non-deterministic and dynamical manner, where tourism systems function in a manner akin to living ecological communities" (1999, p. 433); similarly Zahra and Ryan suggest "tourism development is often characterized by nonlinear spurts and interventions that are significant" (2007, p. 857) – and have some relevant implications not only for the understanding of tourism systems, but also in their analysis. Roughly half (45%) of classified papers (Appendix) refer to the complex structure of system, explicitly citing the complex theory and summarizing some complex attributes (such as those previously listed) (Miguéns & Mendes, 2009; Palmer, Montaño, & Sesé, 2006; Pavlovich, 2014) or simply remembering the complex structure that links local actors (Bregoli et al., 2016; Fadeeva, 2004a, 2004b; March & Wilkinson, 2009).

A complex system is composed of many interconnected elements, mainly represented by "co-producing" firms and organizations (Haugland et al., 2011). This system cannot be understood by breaking it down in its constituent parts, often analyzed using linear models (Stevenson, Airey, & Miller, 2009). For this reason, this study develops a non-linear approach, represented with a horizontal visibility graph (HVG), following described (Nuñez et al., 2012).

A complex dynamical system, in fact, is subject to some kind of evolution in which it may assume different configurations and pass through different states. Of interest in our case is that a system might start from a completely ordered and stable state and evolve to situations characterized by a complex behavior, or even to completely chaotic conditions where, essentially, long-term predictions are impossible because the uncertainty in determining precisely its initial state grows exponentially in time. Most of the real systems exist on the boundary between complexity and chaos: a situation called *edge of chaos*, where a system is in a condition of fragile equilibrium, on the threshold of collapsing into a rapidly mutable state, which may set off new dynamic phases (Baggio, 2008; Waldrop, 1992)

As suggested in the introduction, two themes are particular relevant: on the one hand the measurement of system complexity, and on the other, the ability to describe its evolution over time. The first goal can be achieved through a non-linear analysis of time series, calculating measures such as Lyapunov exponents, Hurst exponents, fractal dimensions, symbolic discretizations, and measures of complexity such as entropies or quantities derived from them (Kantz & Schreiber, 1997; Sprott, 2003). Basically, these methods focus on some unchanging characteristics of the system in a defined period of time, which should be long enough to create a time series with a large number of points (Zhang & Small, 2006). As described later, the HVG makes it possible to transform a time series (i.e. the overnight stays accounted by the lodging firms of one destination) into a network and therefore enables some technical measures to be calculated (Long, 2013; Sun, Wang, & Gao, 2016). The tourism literature reported in the Appendix lists 21 papers suggesting the importance of SNA in order to consider the "non-linear" relationships that tie nodes (Palmer, Montaño, & Sesé, 2006) or explicitly refer to the complex and chaotic structure of tourism destination (Bhat & Milne, 2008). However, eleven studies examined are qualitative (Bhat & Milne, 2008; Bregoli et al., 2016; Fadeeva, 2004a, 2004b; March & Wilkinson, 2009; McLeod, Vaughan, & Edwards, 2010; Morrison, Lynch, & Johns, 2004; Paget, Dimanche, & Mounet, 2010; Pavlovich, 2014; Russell & Faulkner, 2004) or conceptual (Zehrer & Raich, 2010). Furthermore, quantitative studies (10 papers) use a primarily single case approach (Baggio & Cooper, 2010; Baggio & Sainaghi, 2011, 2016; Baggio, 2008; Baggio, Scott, & Cooper, 2010; Miguéns & Mendes, 2009; Palmer, Montaño, & Sesé, 2006; Sainaghi & Baggio, 2014) or 3 cases (Baggio & Del Chiappa, 2013; Del Chiappa & Baggio, 2015), reducing generalizability. Focusing on these quantitative studies, empirical findings suggest, on the one hand, the complexity of the structure of the tourism destination, but, on the other, the absence or the marginal relevance of any chaotic situation. For example, Baggio & Sainaghi conclude their analysis based on the Milan case by stating: “the system has a definite tendency towards a chaotic state, but this tendency is not too accentuated” (2011, p. 853). Similar conclusions are found in other single case studies (Baggio & Sainaghi, 2016; Baggio, Scott, & Cooper, 2010; Baggio, 2014; Scott, Baggio, & Cooper, 2011). Based on these findings, the following hypothesis will be tested:

H1. Tourism systems are complex but their structure is usually stable and far from chaotic.

2.3 Dynamics of complex systems

A central topic in studying the dynamics of a complex system is the analysis of the network evolution over time, which is mainly due to the variability of links between nodes (Glückler, 2007; Gulati, 1999). In order to grasp this dynamism, Pavlovich (2014) suggests the relevance of three concepts concerning tourism destinations: non-linearity, collaboration and wholeness. The system dynamics is “anti-hierarchy”, non-linearity and self-generation creates plural pathways, described as a “rhizomic”, using Deleuze’s (1991) language. These characteristics explain the conclusions of Lundtorp and Wanhill after a century-long time series analysis: “it has not been possible to generate a plausible function able to explain the erratic growth […] There are too many shift factors in the data to find any plausible generating process within the scope of life cycle theory” (2001, pp. 961-962). Cole explicitly suggests considering “the chaotic behavior of individual destinations” (2009, p. 690).

It is possible to identify discontinuities in the destination network, focusing on the various turning points (Coshall, 2000). The latter represent “breaking through” in a time series, when one phase finishes and a new one starts. To identify turning points it is necessary to group similar data and to identify communities characterized by a similar structure. The concept of community is common, and is linked to the classification of various objects in categories for the memorization and retrieval of information. From this point of view the notion of community is general and, depending on the context, can be considered as synonymous with module, class, group, cluster (Radicchi et al., 2004). Qualitatively, a community is defined as a subset of nodes within the graph with denser connections than the other nodes in the network (Clauset, Newman, & Moore, 2010). The detection of the community structure in a network is generally intended as a procedure for mapping the network into a tree.

Based on these considerations, the analysis of system dynamics is a relevant topic. Sixteen studies reported in the Appendix refer to this theme; 12 of them are qualitative or theoretical and based primarily on single case studies. Empirical findings usually identify some phases (Bhat & Milne, 2008; Pavlovich, 2003, 2014; Rodger, Moore, & Newsome, 2009; Russell & Faulkner, 2004) and are clearly rooted in the destination life-cycle model (Butler, 1980) (Zehrer & Raich, 2010). Not surprisingly, Beaumont and Dredge (2010) state that “research tends to be case study specific” (p. 9). Quantitative papers are few (4 reported in the Appendix) and only one depicts a methodology able to identify turning points, dividing the destination dynamics in some phases (Baggio & Sainaghi, 2016). All these factors lead us to formulate the following hypothesis:

H2. Each destination tends to show different turning points.

2.4 Assessing the main dynamic characteristics of a complex system: the visibility graph approach

Different methods can be used (see section 2.2) to assess the complexity or chaotic characteristics of a system. These techniques have in common that they measure certain observable quantities (state variables) of the system under study, able to render the main dynamically invariant properties. From a practical point of view, however, their application requires relatively sophisticated algorithms that, to work best, rely on large amounts of data that are not very common in the tourism domain, and their usage and the interpretation of the results may prove to be a difficult task (Baggio & Sainaghi, 2011).

Recently, new methods have been proposed for assessing the general dynamic characteristics of a complex system by using a time series of observations and transforming it into a network. The idea is that it is possible to devise a simple algorithm that transforms a time series into a different mathematical object, a graph (network). Then by employing the well-established and powerful methods of network science (da Fontoura Costa et al., 2007; Newman, 2010) it is possible to verify which properties of the original object are conserved, transformed, or inferred about one of the representations by examining the other.

One very simple, conceptually and computationally, and efficient method is the horizontal visibility graph (HVS) algorithm (Lacasa et al., 2008; Lacasa & Toral, 2010; Luque et al., 2009; Nuñez et al., 2012; Ravetti et al., 2014; Baggio & Sainaghi, 2016; Wang, Li, & Wang, 2012; Zhang & Small, 2006). It has been shown that the time series structure is inherited in the associated graph, so that periodic, random, and fractal series map into networks with different topologies (random exponential or scale). The HVG transforms a time series of N values into a network of N nodes. In this graph, every node corresponds, in the same order, to series data; two nodes are connected if visibility exists between the corresponding data, i.e., if there is a straight line connecting the series data, provided that this "visibility line" does not intersect any intermediate data height. Formally, it is possible to establish the following visibility criteria: if two arbitrary data values (t_a, y_a) and (t_b, y_b) have visibility, consequently they will become two connected nodes of the associated graph, if any other data (t_c, y_c) placed between them fulfills:

$$Y_c < y_b + (y_a - y_b)\frac{t_b - t_c}{t_b - t_a}$$

Lacasa et al. (2008) suggest that the graph associated to a time series is always: i) *connected*: each node sees at least its nearest neighbors (left and right); ii) *undirected*: the way the algorithm is built up, there is no direction defined in the links; iii) *invariant under similar transformations* *of the series data*: the visibility criterion is invariant under rescaling of both horizontal and vertical axes, and under horizontal and vertical translations.

The HVG has received much attention, since it has been shown that certain series characteristics (including periodicity, fractality or chaoticity) are captured by the algorithm and translated in the associated visibility graph (Luque et al., 2009), opening up the possibility of building bridges between time series analysis, nonlinear dynamics, and graph theory. Accordingly, several works applying this algorithm in several contexts ranging from geophysics (Elsner, Jagger, & Fogarty, 2009) or turbulence (Liu, Zhou, & Yuan, 2010) to physiology (Shao, 2010) finance (Yang et al., 2009) or tourism (Baggio & Sainaghi, 2016) have started to appear. A given series maps into a graph with an exponential degree distribution $P(k) \sim \exp(-\lambda k)$, where $\lambda < \ln(3/2)$ characterizes a chaotic process whereas $\lambda > \ln(3/2)$ characterizes a correlated stochastic one. The frontier $\lambda_c = \ln(3/2)$ corresponds to the uncorrelated situation and can be calculated analytically (Luque et al., 2009); thus the method is well grounded.

This can be well interpreted as the boundary that separates stable or complex behaviors from a chaotic state. In other terms, systems exhibiting λ values close (but higher) to the threshold value λ_c may be considered as being at the edge of chaos (see section 2.2).

As said above, the dynamics of a system can be represented by measuring some outcome at regular intervals, therefore the choice of the quantities to be used is an important point. There is a long tradition (starting with Butler, 1980) to consider the observed movements of tourists as an indicator of the evolution of a tourism system. Both arrivals and overnight stays have been and can be used for our purposes. Between the two, the number of nights spent in a destination is the most interesting quantity as it may be seen as the result of the interactions among many of the system's components: the demand side (tourists), the supply side (infrastructures available to visitors) plus a number of internal and external economic factors (see for example: Ferro Luzzi & Flückiger, 2003), so that measurements of the days spent by tourists can be taken as a meaningful representation of the system.

In fact, as some of the contributions reported in the Appendix (e.g. Baggio, 2008; Baggio & Sainaghi, 2016; Sainaghi & Baggio, 2014) show, overnight stays are a determinant of destination demand which is influenced by the perceived characteristics of the destination and, rather obviously, strongly related to tourist spending (Sainaghi, 2012). The relevance of overnights is also confirmed in many papers rooted in destination management (Beritelli & Laesser, 2014; Goncalves & Ratsimbanierana, 2012; Steiger, 2011).

3 Materials and methods

The empirical analysis focuses on Italy, the fifth country in terms of international tourism flows in the UNWTO statistics (UNWTO, 2016). Italy collected 50.7 million international arrivals in 2015, with an average increase of 4.4%, the second most relevant increase in the top 5 destinations. Furthermore, Italy appears in the top 10 destinations in terms of receipts. After selecting the country, in order to operationalize the HVG, the research team should collect monthly secondary data from some Italian destinations. The Italian tourism policy is based on a regional approach, and for this reason data collection focuses on this administrative level. The first Italian destination in terms of overnights is the Veneto Region, but unfortunately the regional statistical office was able to deliver "only" 216 months of data (18 years), while Trentino-Alto Adige (the second Region) has a longer time series (336 months, 28 years, from 1987 to 2014). For this reason multiple case studies (Eisenhardt, 1989; Halinen & Törnroos, 2005; Yin, 1994, 2009) are based on this Region (figure 1).

As reported in the Appendix, roughly 70% of papers use a single year approach, creating a "snapshot" of the destination network; 13 papers use a longitudinal approach but 9 of them (69%) are qualitative or literature reviews. There is an evident lack in longitudinal quantitative studies. As suggested by Barrutia and Echebarria, "longitudinal studies […] provide additional insights" (2015, p. 230); similarly Albrecht (2013) argues in her review of tourism network studies in favor of a research agenda with more longitudinal researches. Furthermore, the majority of papers (55%) use single case studies, while others (26%) are based on two or three cases. Excluding literature reviews and conceptual papers (9%), only 11% use multiple case studies, 2 of which are quantitative studies.

Figure 1. Sample and benchmark

The study focuses on the various top Trentino-Alto Adige tourism destinations, defined as places collecting at least 1 million overnights. Data collected is represented by monthly overnights articulated by domestic and international markets. The study identifies eight destinations (Canazei, Pinzolo, Riva del Garda, Badia, Castelrotto, Merano, Scena, Selva di Val Gardena) plus the total of the two provinces composing this region: Trento (ProvTN) and Bolzano (ProvBZ). This region is mainly active in lake, cultural and alpine tourism (also due to the presence of the renowned "Dolomiti Superski", one of the largest integrated ski districts in the world, comprising 12 areas, and 1,200 km ski tracks over 3,000 km^2).

Following the HVG methodology, the time series were transformed into networks, and so structural characteristics and turning point were calculated. Concerning the first analysis, the research team measured the degree distributions (da Fontoura Costa et al., 2007). In order to favor the comparability between the present work and previous studies, findings include the evidences of Livigno (Baggio & Sainaghi, 2016) and includes (as a reference) some theoretically relevant series, such as: i) a random series (Rnd), ii) a random Brownian motion (fBm) (Hurst exponent covers 0.5), iii) a logistic map (Lgst) and iv) a Lorenz equation (Lrnz). The process was repeated ten times, thus taking into account the randomness of the generation, and all the results were averaged.

Concerning turning points, the modularity analysis can be calculated using different methods (Fortunato, 2010). Modularity is a property of a network and a specific proposed division of that network into communities (Kernighan & Lin, 1970). It measures whether or not the division is a good one, in the sense that there are many edges within communities but only a few between them (Newman & Girvan, 2004). In literature there are many proposed methods, such as Kernighan and Lin (1970), spectral partitioning (Fiedler, 1973), hierarchical clustering (Pothen, Simon, & Liou, 1990), but they all usually perform well for specific types of problems, and perform poorly in more general cases (Newman, 2004). Furthermore, some methods are complex and require considerable time to identify communities. The algorithm proposed by Clauset, Newman, and Moore (2004) resolves these problems, and, given its simplicity and lower "computational costs", was implemented in this study. This method identifies the different groups by calculating the following modularity index:

$$Q = \sum_i (e_{ii} - a_i)^2$$

where e_{ii} is the fraction of edges in the network between any two nodes in the module i, and a_i is the total fraction of links originating from it and connecting nodes belonging to different ones. Q is a normalized quantity, and it assumes values from 0 to 1, where 0 means absence of modules, and 1 means a perfect division into completely separated groups.

4 Findings

Empirical results are analyzed in four separate paragraphs: one dedicated to the complex structure of tourism destinations, one to the identification of turning points, one to the analysis of seasonality and one tracing some implications in terms of policy.

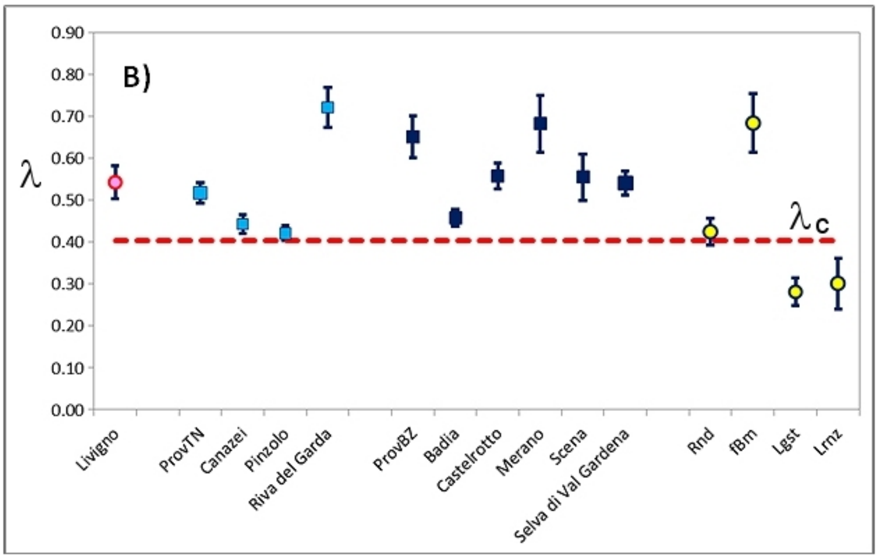
4.1 Complex structure

In order to measure the complex structure of the analyzed tourism destinations, the exponent λ of degree distribution was calculated. The figure (2.A) reports the value of the exponents (drawn in figure 2B), comparing the Trentino-Alto Adige top destinations with the Livigno case (benchmark) and the four reference networks (Rnd, random; fBm, Brownian motion; Lgst, logistic map; and Lrnz, Lorenz equation). As described in sections 2.2 and 2.4, values well above the threshold line (λ_c) indicate systems with relatively stable or moderately complexity characteristics. Moving closer to the line a system gets closer to an edge of chaos condition, while values below the threshold signal chaotic states (the lower the value the higher the chaoticity).

Figure 2. Degree distribution exponents

A)

	Exp	Std_err
Livigno	0.54242	0.04007
ProvTN	0.51691	0.02536
Canazei	0.44247	0.02207
Pinzolo	0.42072	0.01796
Riva del Garda	0.72081	0.04803
ProvBZ	0.65095	0.05024
Badia	0.45827	0.02005
Castelrotto	0.55718	0.03154
Merano	0.68184	0.06739
Scena	0.55444	0.05560
Selva di Val Gardena	0.53999	0.02883
Rnd	0.42499	0.03194
fBm	0.68388	0.07002
Lgst	0.28100	0.03332
Lmz	0.30086	0.06040

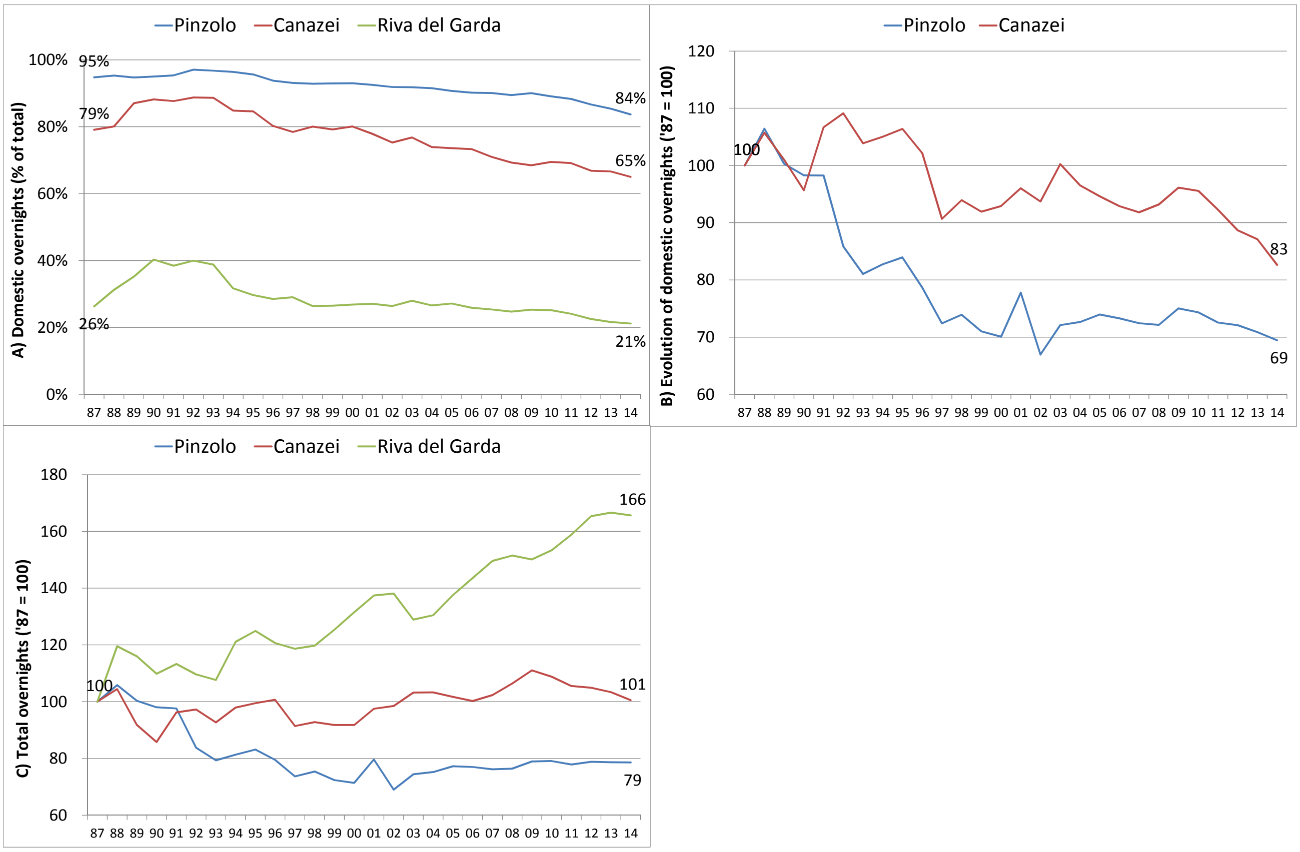


The eight new destinations (three from Trento and five from Bolzano) depict values of exponents ranging from 0.42 (Pinzolo) to 0.72 (Riva del Garda). The graph (figure 2.B) suggests that all the cases are above the dotted horizontal line, the chaos threshold. Similarly the two additional cases represented by the total of the provinces (ProvTN for Trento and ProvBZ for Bolzano) confirm this positioning: both are significantly above the horizontal chaos line. Focusing attention on exponents, and considering the 11 cases reported (Livigno included), only one destination (Pinzolo) is close to the chaos threshold, while 10 destinations (variously defined) are more or less further away from this boundary. These evidences support the first hypothesis: tourism destinations are complex systems but normally do not show (excessive) chaotic traits.

A second consideration refers to the tourism positioning in our sample. It is not the goal of this paper to discuss in detail the situation of single cases analyzed; however it is interesting to note some characteristics of the destinations close to the chaos threshold. Focusing attention on the first three destinations located in the Trento province (Canazei, Pinzolo and Riva del Garda), the first two show the lowest values of the exponent, while the third (Riva del Garda) the highest. In order to formulate a possible explanation for this very differentiated situation, it is interesting to consider the destination positioning in terms of contribution between domestic and international clients. Pinzolo and Canazei are alpine destinations with a clear double seasonality (summer and winter). For both these places, summer accounts for a lower percentage (Pinzolo 47%, 1987; Canazei 44%, 1987), while winter is the prominent season (Pinzolo 52%, 1987; Canazei 55%), other months (May, October and November) represent the remaining overnights (roughly 1%). Riva del Garda is a lake destination and overnights are mainly concentrated in summer (76%, 1987). As reported in figure 3.A, Canazei (65%-79%) and Pinzolo (84%-95%) are strongly positioned in the Italian market, while Riva del Garda (21%-26%) attracts more international overnights. Unfortunately, the evolution of domestic overnights, reported in figure 3.B, is negative and registers a decrease of 17% (index equals 83) for Canazei and 31% (index equals 69) for Pinzolo. This positioning generated a negative evolution of total overnights (figure 3.B) for Pinzolo (-21%, index equals 79), while it is stable for Canazei (+1%) and very positive for Riva del Garda (+66%). It is evident that Pinzolo must profoundly rethink its positioning in order to stop this progressive erosion of its overnights, which showed their absolute value decrease from 2.2 (1987) to 1.7 million (2014).

The exponent correctly positions this destination close to the chaos threshold. Also the Canazei evolution depicts some inconsistencies, mainly represented by a strong focus on the domestic market, showing a negative evolution. However, Canazei was able to increase its international overnights, accounting for only 21% in 1987, but rising to 35% in 2014. This partial turnaround assured a stability of total overnights (+1%). In this case the exponent reveals a value (0.44, figure 2.B) that positions Canazei neither closer, nor further from the chaos threshold. Differently, the Riva del Garda positioning appears solid and able to stimulate a major long term development (+66%); the exponent (0.72) reflects this very positive evolution. Furthermore, reading the evolution per season, Pinzolo shows a strong reduction in the summer overnights (-35%), while winter remained more stable (-9%), increasing the monthly seasonality. In the case of Canazei, summer remains more stable (-7%), while winter registered an increase (+6%). Finally, Riva del Garda accounts an important rise during all the seasons, especially in winter (+113%) and in the "third season" (May, October and November) (+113%), while summer (the core season) increased by 42%. This evolution favors a reduction in the seasonality. The relationship between exponent and seasonality is analyzed in section 4.4.

Figure 3. Evolution of domestic and total overnights in Trentino destinations.



Lastly, the empirical findings suggest that the agglomerate of destinations ProvTN and ProvBZ reflects an intermediate exponent value. It is important to clarify that the two Provinces include many places. In fact, the three Trentino destinations represent 15% (2014) of the Province overnights (ProvTN) and the five Bolzano destinations account for 19% (2014) of ProvBZ. The two Province totals suggest that a basket of destinations tends to account for a total exponent (0.51 for ProvTN and 0.65 for ProvBZ) sufficiently far from the chaos threshold. The amount could be a qualitative measure of the entire tourism positioning.

4.2 Turning points

Figure 4 reports turning points for the 10 cases analyzed and for Livigno. The picture is divided into four parts: the first (4.A) reports modularity, which indicates the coefficient able to identify communities; the higher the value, the higher the definition (clearer separation) of the different clusters. This section also includes an indicator of seasonality, based on the Gini index. This is a widely used metric for assessing the statistical dispersion of the values in a sample, and is used as a measure of inequality. Here higher values of the Gini index signal a higher rate of seasonality (Wanhill, 1980). Figure 4.B focuses on the total benchmarks of Livigno and of the Provinces of Bolzano and Trento; the third section (4.C) reports the three Trentino cases, while the fourth (4.D) focuses on the five Bolzano destinations.

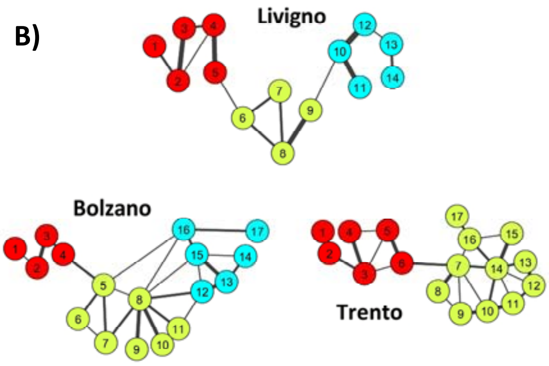
Before describing the evolution, it is useful to clarify the meaning of numbers in figure 4.B, 4.C and 4.D. They do not represent single years but groups of months with a similar structure. For this reason, the number can vary when comparing the different destinations: for example in the three Trentino cases (4.C), Pinzolo counts 13 points, but Riva del Garda 19. These differences also appear in the five Bolzano locations (4.D), moving from 10 points for Badia to 19 points for Scena. A second clarification concerns colors (4.B, 4.C, 4.D): to facilitate the identification of communities (groups of similar vertices in the time series), the research team shows differently colored data characterized by a similar structure. Turning points appear when a community "finishes" and another one starts. In some destinations it is relatively simple to identify these communities, as in the case of the two provinces and for Livigno (4.B). In others, boundaries are not very clear and patterns are confused, for example in the case of Selva di Val Gardena (4.C).

Having clarified the structure of figure 4, it is now possible to make some comments for each block. Concerning modularity (4.A), the 10 cases show very similar values, ranging from 0.83234 (Canazei) to 0.86482 (Scena). These coefficients suggest a high modularity, which implies the possibility to identify different communities. The amount is in line with the Livigno case (0.87876). The second indicator (Gini seasonality) shows some important differences between the destinations. Reasonably, the two province totals depict the lowest values (39.079 ProvTN and 28.088 ProvBZ), given the presence of different places characterized by different seasonality. In contrast, single cases register higher seasonality, with the peak for Badia (49.226) and the lowest amount for Merano (31.141). Concerning this last case, it is important to note that Merano is a cultural city, also involved in alpine tourism and therefore this destination has a longer seasonality and, consequently, a lower Gini value. In contrast, Badia is strongly positioned as a winter destination (61% of overnights are made in this season in 1987, a value that remains stable over the years); therefore the weight for summer is considerably lower and this increases the Gini index.

The three pictures (4.B, 4.C, 4.D) depict turning points. Together with the modularity and Gini seasonality indices, the pictures show the modules uncovered (the nodes in the small networks) and how they further group (colors in the figure online). These groups are interesting as they represent periods with similar dynamic behavior separated by turning points (for clarity Table 1 contains the numbers of the modules identified as turning points and the corresponding years). Focusing attention on the eight single cases, the absence of similar patterns is evident. In a few cases there are similar structures over a limited period of time (i.e. Badia, Castelrotto and Merano at the beginning, figure 4.D), but the time series tend to show very different evolutions, and, more importantly, turning points appear in different periods of time, although with some similarity due to the geographical and political similarity of these destinations. These evidences make it possible to confirm the second hypothesis: evolutionary patterns of different destinations are different and show different turning points, both in absolute value and in periods.

Figure 4. Turning points

Cases - A)	Modularity	Gini seasonality
Livigno	0.87876	48.532
ProvTN	0.85444	39.079
Canazei	0.83234	48.033
Pinzolo	0.83263	48.011
Riva del Garda	0.85798	42.234
ProvBZ	0.85412	28.088
Badia	0.84219	49.226
Castelrotto	0.84260	36.677
Merano	0.85177	31.141
Scena	0.86482	40.724
Selva di Val Gardena	0.84695	47.842



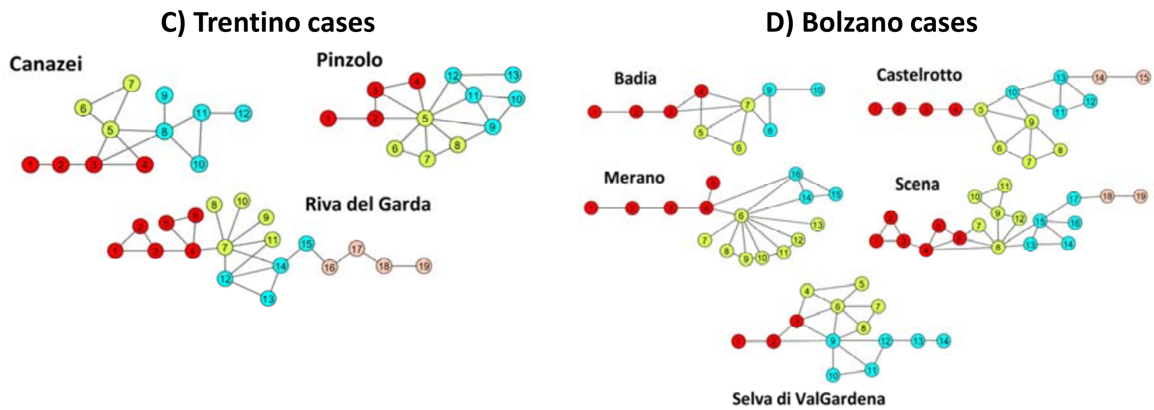


Table 1 Turning points identified (no. of module and years)

	Modules no.	Years
Livigno	6, 10	1981, 1996
Province of Bolzano (ProvBZ)	5, 12	1991, 2003
Badia	5, 8	1995, 2005
Castelrotto	5, 10, 14	1991, 2003, 2011
Merano	6, 14	1996, 2010
Scena	7, 13, 18	1994, 2003, 2010
Selva di Val Gardena	4, 9	1992, 2004
Province of Trento (ProvTN)	7	1995
Canazei	5, 8	1995, 2003
Pinzolo	5, 9	1994, 2003
Riva del Garda	7, 12, 16	1995, 2002, 2008

Concerning the two cases previously analyzed, *Pinzolo* shows three different stages separated by two turning points. The first period (1987-1994) is characterized by a reduction in overnights (-19%), triggered both by summer (-10%) and winter (-26%) and mainly concentrated during the years 1992-1993. In 1994 the destination registers a small rise (+2%). Since 1994 a new phase begins that ends in 2003. Regarding the second period, the years 1995-2003 are characterized by a small reduction in overnights (-10%) but, in terms of seasons, winter shows a rise (+5%), while summer registers a strong reduction (-26%). Finally, during the third period (2004-2014) the destination records an increase (+5%) mainly driven by the winter season (+11%) but, for the first time, summer remains relatively stable (-4%).

Riva del Garda depicts four phases, separated by 3 turning points. The first period (1987-1995) shows an intensive increase of overnights (+25%); summer is the core season (69% in 1995) but international clients, while generating the majority of overnights, registers a reduction (from 74% in 1987 to 70% in 1995). The second phase (1996-2002) is characterized by a rise in overnights, but at a slower pace than before (+14% compared to +25%). The detail between national and international clients suggests an important change: Italian overnights account for a small increase (+6%) compared foreigners (+18%). Furthermore, remembering the strong focus of Riva del Garda on summer, the development during the second period is centered more on winter (24%). In the third phase (2003-2008) the development is more intense (+18%) and more centered on summer (+16%); furthermore the distance between the increase of domestic overnights (4%) and foreigners (23%) is more evident. Synthetically, this third phase is characterized by strong increase, triggered by summer and international clients. Finally, the last phase (2009-2014) shows the lowest increase (+10%) and winter, for the first time, substantially records a stability (2%). The Italian market registers an important reduction (-8%) compensated by a strong increase in international clients (+16%). In 2014 79% of overnights are generated by foreigners, the highest value registered in the whole time series.

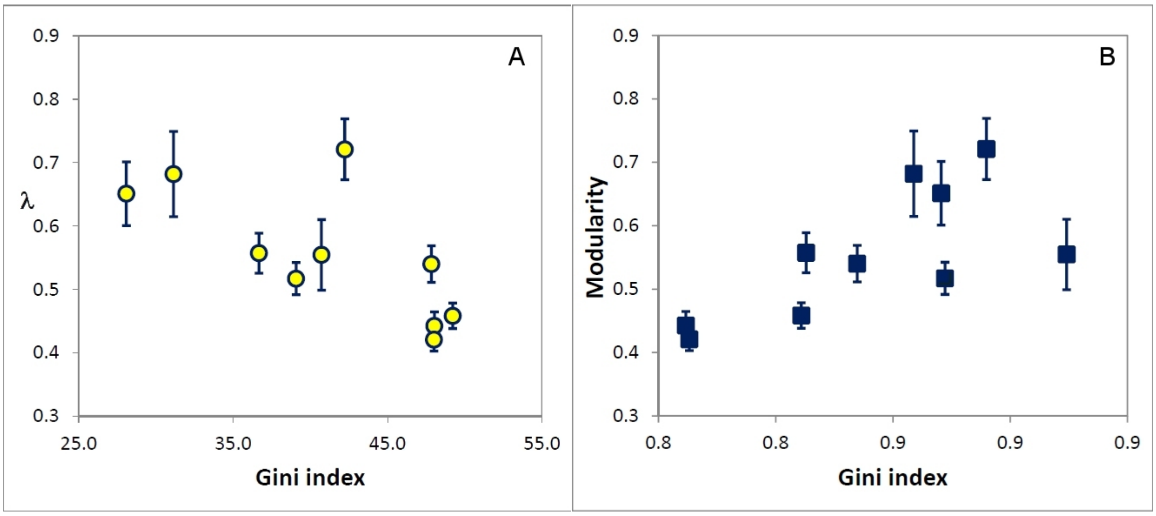
This description suggests that turning points identified by HVG methodology are probably different from those proposed by the life-cycle model. In fact, in the case of Riva del Garda the four phases are all characterized by a rise in overnights (1987-1995: +25%; 1996-2002: +14%; 2003-2008: +18%; 2009-2014: +10%). The proposed methodology appears to be more "sensitive", more "fine-grained" to identify turning points and therefore different phases.

4.3 The role of seasonality

From the results of the analysis, seasonality seems to play a role in both the assessment of the "complexity/chaoticity" and of the modularity decomposition (and hence of the determination of the turning points) of the different systems examined. Figure 5 shows the exponent λ (panel A) and the modularity index (panel B) plotted versus the seasonality level (rendered with the Gini index).

It is clear to see that a correlation exists in both cases. A linear correlation of -0.71 is found for the exponent-Gini case and of 0.69 for the modularity-Gini case, even if a closer examination may suggest some kind of non-linear relationship. It is reasonable to think that a higher diversity in the seasonal components is a symptom of a richer dynamics for the system, which tends to make it less stable (closer to the edge of chaos) and, as a consequence, having better separated dynamic phases (more modules and more turning points). However, given the limitations of this study (see section 5.1) we can here only present this conclusion as a conjecture. We are supported in this statement also by other studies (see e.g. Keeling et al., 2001; Nguyen et al., 2008) assessing the influence of strong seasonalities in determining a non-linear complex behavior of some phenomena. Also, the question whether seasonality alone justifies the dynamic behavior, or whether other factors should be taken into account cannot be answered simply with the data available in this study, and more work is needed to clarify this point.

Figure 5. The role of seasonality



4.4 Policy implications

This study analyzes two aspects of tourism networks: their structure as complex systems (§4.1) and their evolution over time (§4.2).

Results related to the first point have some relevant policy implications: they stimulate a profound rethinking and development of destination performance measurement systems, and, on the other hand, suggest favoring a more holistic view of the tourism destination.

As described in §4.1, the proposed exponent is able to show both the complex structure of a tourism system but also depicts the "quality" of the destination positioning, considering its ability to differentiate markets and segments and to manage seasonality. Destination structures characterized by strong relationships to a single market (such as the case of Pinzolo) depict an exponent close to the chaos threshold, while places able to intercept different markets (such as Riva del Garda) count higher values, far from chaoticity. The exponent can integrate the destination performance measurement systems, favoring the enrichment of non-linear indices. In fact, current performance measurement systems are often anchored to past-oriented values and mainly composed by operational and financial indices of local firms (Sainaghi, 2010a; Sainaghi, Phillips, & Corti, 2013; Sainaghi, Phillips, & Zavarrone, 2017). The exponent is able to measure the distance from the chaos threshold, an important indicator for both destination managers and local firms. As is known, entrance into the chaos area (values of λ close to the threshold line) tends to favor unpredictable structural changes in the system, such as "bifurcation" points (Thietart & Forgues, 1995), where the destination moves to new patterns. The chaos threshold is characterized by unpredictability and therefore can both introduce a Schumpeterian creative destruction or simply lead to the dispelling of the accumulated resources and destination capabilities, accelerating the destination decline. Traditional indices can surely register destination difficulties, but are not able to measure the entrance in the threshold of chaos.

A second implication, suggested by the complex structure of tourism destination, refers to the system itself. If the destination product is usually perceived in unitary terms by final clients (Haugland et al., 2011), destination managers and policy makers tend to abandon this holistic approach and to divide the system into its components. Findings show the unitary structure of destination supply and, consequently, the importance of destination policies. The latter should be rooted in a vision that, on the one hand, focuses on the complexity and, on the other, considers the deep relationships linking different local actors. The two province totals (ProvTN and ProvBZ) have some implications for the aggregation of many local places in order to create "regional" destination, as is very common in practice. As suggested by the exponent, this process tends to create an average value, which is, more or less, a complex mean of the local exponents. Reasonably, the total exponent is far from chaos (as findings confirm) and this can wrongly be regarded as a good regional positioning. But this conclusion can hide local situations close to the chaos threshold, requiring considerable care in using averages in tourism, as suggested by some previous studies (i.e. Enz, Canina, & Walsh, 2001).

Lastly, turning points can support the processes of destination planning and management. Many studies identify patterns, phases or stages in the destination development (i.e. Butler, 1980, 2005a, 2005b; d'Angella, De Carlo, & Sainaghi, 2010; Dredge, 2006; Pavlovich, 2003; 2014; Russell & Faulkner, 2004), however the identification of turning points is always difficult and mainly based on a qualitative approach. The presented methodology helps destination managers to straightforwardly identify communities. Based on the deep knowledge of the system, policy makers can identify the key strategic characteristics of each phase or pattern and understand the factors that have favored entrance into a new phase. Furthermore, this knowledge can help to plan future strategies and visions and to perceive the most relevant factors able to guide the evolutionary trend of the destination system. Some implications emerge also from the regional level of planning and management. As previously suggested, the aggregation of many local places in order to build provincial or regional exponents may lead to the well-known problem of "inaccurate averages in tourism" (Enz, Canina, & Walsh, 2001). This point has many implications for regional planning, suggesting that the strategic positioning of destination should primarily be designed at local level.

5 Conclusions

This article contributes to filling two gaps: developing multiple case studies in order to measure both the complex structure of a tourism destination and to explore its evolution over time, by mapping turning points. Findings propose ten new analyses (eight single destinations and two provincial totals) and allow the research team to test two hypotheses: i) concerning the complex structure, the tendency of tourism destination to remain far from chaos threshold, ii) concerning turning points, the ability of different destinations to also show different evolution through time. Empirical evidences have confirmed both hypotheses. In fact, all the ten exponents are higher than the chaos area and only one destination is close to it. Furthermore, different destinations depict different turning points, both considering when the evolution appears and how many phases characterize the evolution.

Based on these new evidences, some theoretical and empirical conclusions are drawn. At the theoretical level, this paper confirms, on the one hand, the complex structure of tourism destinations, but, on the other, it confirms its tendency to remain far from the chaos area and to show robustness. The implications for future researchers are important, confirming the necessity to overcome an atomistic approach that exceeds the destination complexity by cutting it in its components, as confirmed in some previous studies (Pavlovich, 2003, 2014). Furthermore, findings suggest a negative correlation between seasonality and the exponent λ, which means, the higher the demand fluctuation, the higher the probability that the destination may enter the chaos threshold. Given the limited number of cases (see section 5.1) we can here only present this conclusion as a conjecture.

Empirical findings depict the presence of turning points in the ten analyzed cases, confirming the relevance of phases or patterns in the evolution of the destination, a topic very relevant for destination management literature and for social network analysis. These results suggest articulating the destination management frameworks including different stages, but, on the other hand, they suggest extreme prudence in identifying rigid patterns between them. In fact, as suggested by empirical findings, turning points of different destinations are also different, both in terms of when they appear and in terms of the number of shifts. This paper contributes by proposing a methodology able to identify phases and turning points, as in the cases analyzed in the findings section. This is a theoretical and methodological innovation, given, on the one hand, the limited number of longitudinal studies exploring this topic (as reported in the Appendix) and, on the other, the considerable efforts necessary to develop a longitudinal qualitative study. The goal of this paper is not to identify the analytical causes (triggering events) able to introduce the destination in a new phase; however empirical findings suggest the relevance of seasonality. In fact, the higher the Gini index (demand fluctuation), the higher the modularity and therefore the probability of the system crossing a turning point. As previously stated, this conclusion needs caution and requires new evidences to be confirmed. The phases identified by the HVG methodology appear to be more "fine-grained" that those usually proposed by the life-cycle model, as the two analyzed cases depict. This paper can contribute to creating a "bridge" between social network science and life-cycle theory.

The study has some practical implications. The HVG can be used to integrate the actual destination performance management systems with the aim to introduce indices related to the system complex structure (exponent λ) and its modularity. The first indicator is useful to measure the distance to the chaos threshold, while the second (modularity) can help destination management to understand the different phases cross by the system, identifying (and managing, if possible) triggering events. In both cases the seasonality plays a relevant role. In this perspective, destination managers have the responsibility to design strategies able to maintain the system stability, primarily favoring market differentiation and reducing seasonality. They should always remember that different patterns require different strategies (as suggested by the two cases analyzed previously in the findings section), and therefore the destination strategy should be flexible over time.

5.1 Limitations and further research

This study has three main limitations: i) it focuses on top destinations, ii) the eight cases (excluding the two provincial totals) are rooted in the same geographical area, iii) the study does not explain the factors influencing both exponent and turning points.

The first limitation refers to the focus on top destinations, defined in this study as each place accounting for at least one million overnight stays. This choice can have some implications regarding both the complex structure (exponent) and its evolution (turning points). In fact, the largest destinations are, reasonably, more structured and therefore more able to manage the system, attracting talents in local firms, organizations and DMOs. This can have some major impacts on the system's robustness and on maintaining the network far from chaos; the opposite may happen for small destinations. All the destinations belong to the same geographical area (the Trentino-Alto Adige Region) and therefore share some similarities, such as attracted targets, quality positioning, some shared products (i.e. the Dolomiti Superski), similarity in seasonality, a common provincial strategy and similar administrative structures. All these factors can have an impact on both the system complexity and its evolution over time. Lastly, this work measures the exponential degree distribution and turning points but does not explore factors influencing the distance from the chaos area (exponents) and the work does not research events which influence the passage through phases (turning points). Some insights emerge, for example the relevance of market concentration and diversification or the role played by seasonality; however the paper does not offer a full explanation regarding "determinants" of exponents and turning points. Furthermore, the suggested correlation between seasonality complex structure (exponent λ) and its modularity requires additional cases in order to be generalized.

These three limitations may inspire a new research agenda, able to design new studies exploring top and non-top destinations, on the one hand, and developing a broad sample constituted by cases pertaining to different geographical areas, on the other. Furthermore, it is important to identify determinants of exponents and turning points, which requires more in-depth case studies and the integration of quantitative and qualitative analysis. Finally, in order to understand the overlapping between the turning points and phases identified by the HVG methodology and those proposed by life-cycle model, it could be interesting to apply this tool to some cases analyzed with the lenses of the second theoretical model.

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Appendix 1. Literature review

#	Paper	Type of paper	Theory	Type of network	# of cases	Main topic	# of year	PROS	CONS	Complex structure	Dynamics of networks
1	Albrecht (2013)	QLTV	SNA	Policy networks	1	Sustainable tourism	1	1) Managing stakeholders; 2) understanding the "total tourism product"; 3) whole-of-destination view	1) Neglecting characteristics of individual actors, 2) "snapshots"	N.A.	x
2	Arnaboldi & Spiller (2011)	QLTV	SNA & ANT	Policy networks	1	Stakeholder management	1	1) innovation, 2) managing stakeholders	N.A.	N.A.	x
3	Baggio & Cooper (2010)	QTTV	SNA	Policy networks	1	Knowledge management	1	1) Knowledge sharing and trasfer, 2) competitiveness	N.A.	x	x
4	Baggio & Del Chiappa (2013)	QTTV	SNA	Business networks	3	ICT	1	1) Non-linear relationships	N.A.	x	x
5	Baggio & Sainaghi (2011)	QTTV	SNA	Business networks	1	Complex systems	50	1) Non-linear relationships	A long time-series are required	x	N.A.
6	Baggio & Sainaghi (2016)	QTTV	SNA	Policy networks	1	Complex systems	50	1) Non-linear relationships	Longidutinal data	x	x
7	Baggio (2008)	QTTV	SNA	Business networks	1	Complex systems	51	N.A.	N.A.	x	x
8	Baggio, Scott, & Cooper (2010)	QTTV	SNA	Policy networks	1	Stakeholder management	1	1) Non-linear relationships	N.A.	x	x
9	Barrutia & Echebarria (2015)	QLTV	SNA & ST	Policy networks	1	Sustainable tourism	1	1) Managing stakeholders, 2) obtain and share resources	N.A.	N.A.	N.A.
10	Beaumont & Dredge (2010)	QLTV	SNA & govern.	Policy networks	3	Stakeholder management	1.5	1) Coordination of policies and related actions	N.A.	N.A.	N.A.
11	Benckendorff & Zehrer (2013)	Lit. Rev.	SNA	Research networks	N.A.	Research clusters	15	N.A.	N.A.	N.A.	N.A.
12	Bhat & Milne (2008)	QLTV	SNA	Policy networks	1	Destination marketing	5	1) knowledge sharing and transfer, 2) focus on long-term relationships, 3) innovation, 4) less perceived risk	N.A.	x	x
13	Bregoli et al. (2016)	QLTV	SNA	Business networks	3	Stakeholder management	1	1) Understanding the "total tourism product"; 2) holistic and effective destination brand positioning	N.A.	x	x
14	Breukel & Go (2009)	QLTV	SNA & marketing	Business networks	1	Knowledge management	1	1) Knowledge sharing and trasfer	N.A.	N.A.	N.A.
15	Del Chiappa & Baggio (2015)	QTTV	SNA	Policy networks	3	Smart tourism destinations	1	1) knowledge transfer, sharing and diffusion	N.A.	x	N.A.
16	Del Chiappa & Presenza (2013)	QTTV	SNA	Policy networks	1	Stakeholder management	1	1) Understanding the "total tourism product", 2) managing stakeholders, 3) knowledge sharing and transfer, 4) innovation and competitiveness	N.A.	N.A.	N.A.
17	Denicolai, Cioccarelli, & Zucchella (2010)	QTTV	SNA & RBV	Policy networks	1	Core-competencies	1	1) Knowledge sharing and trasfer, 2) inter-organizational learning, 3) competitive advantage	N.A.	N.A.	N.A.
18	Dredge (2006)	QLTV	SNA & cluster	Policy networks	1	Planning and development	30	1) Innovation, 2) community capacity building, 3) knowledge sharing and transfer	1) Lack definition & methodology, 3) snapshot	N.A.	x
19	Erkuş-Öztürk & Eradin (2010)	QTTV	SNA, govern. & ST	Policy networks	1	Sustainable tourism	1	1) Transaction costs, 2) economies of scale and scope, 3) conflict management, 4) coordination of policies and related actions, 5) inclusion	N.A.	N.A.	N.A.
20	Erkuş-Öztürk (2009)	QTTV	SNA & cluster	Business networks	12	Networks and firm size	1	1) Competitive advantage, 2) transaction costs, 3) external economies of scale and scope, 4) innovation, 5) coordination of policies and related actions	1) Costs involved in networking relations, 2) difficulties in establishing harmony	N.A.	N.A.
21	Fadeeva (2004a)	QLTV	SNA & ST	Policy networks	8	Sustainable tourism	1	1) Sustainability, 2) risk shearing	N.A.	x	x
22	Fadeeva (2004b)	QLTV	SNA & ST	Policy networks	2	Sustainable tourism	1	1) Innovation, 2) time-efficient, 3) conflict management, 4) performance	N.A.	x	N.A.
23	Halme (2001)	QLTV	Organiz. learning	Policy networks	6	Learning management	1	1) Inter-organizational learning, 2) knowledge sharing and transfer	N.A.	N.A.	x
24	March & Wilkinson (2009)	QLTV	SNA	Policy networks	1	Stakeholder management	1	1) Economies of specialization, 2) knowledge sharing and transfer, 3) innovation, 4) improve performance	N.A.	x	N.A.
25	McLeod, Vaughan, & Edwards (2010)	QLTV	SNA & KM	Business networks	3	Knowledge management	1	1) Knowledge sharing and trasfer, 2) social capital, 3) firm performance, 4) Inter-organizational learning, 5) innovation	N.A.	x	N.A.

Appendix 1. Literature review (continued)

26	Miguéns & Mendes (2009)	QTTV	SNA	Policy networks	N.A.	International tourism	1	1) Competitive advantage	N.A.	x	N.A.
27	Morrison, Lynch, & Johns (2004)	QLTV	SNA	Policy networks	10	Network management	1	1) Learning and exchange, 2) business activity, 3) community	N.A.	x	N.A.
28	Nash (2006)	QLTV	SNA	Policy networks	3	Causal network methodology	1	N.A.	N.A.	N.A.	N.A.
29	Novelli, Schmitz, & Spencer (2006)	QLTV	SNA & cluster	Policy networks	1	Innovation management	1	1) Innovation, 2) local development	N.A.	N.A.	N.A.
30	Paget, Dimanche, & Mounet (2010)	QLTV	SNA & ANT	Business networks	1	Innovation management	1	1) innovation, 2) managing stakeholders	N.A.	x	N.A.
31	Palmer, Montaño, & Sesé (2006)	QTTV	ANN	Business networks	1	Forecasting	15	1) Non-linear relationships	N.A.	x	N.A.
32	Pavlovich (2003)	QLTV	SNA	Policy networks	1	Network evolution	114	1) Competitive advantage,	N.A.	N.A.	x
33	Pavlovich (2014)	QLTV	SNA	Policy networks	1	Network evolution	114	N.A.	N.A.	x	x
34	Pforr (2006)	QTTV	SNA	Policy networks	1	Planning and development	1	N.A.	N.A.	N.A.	N.A.
35	Presenza & Cipollina (2010)	QTTV	SNA	Business networks	2	Stakeholder management	1	1) Conformity, inclusion, cohesion, 2) innovation, 3) knowledge sharing and transfer	N.A.	N.A.	N.A.
36	Rodger, Moore, & Newsome (2009)	QLTV	SNA & ANT	Policy networks	1	Stakeholder management	10	1) innovation, 2) managing stakeholders	N.A.	N.A.	x
37	Russell & Faulkner (2004)	QLTV	Complex theory	Policy networks	2	Entrepren.	100	1) Enterpreneurship	N.A.	x	x
38	Sainaghi & Baggio (2014)	QTTV	SNA	Business networks	1	Social capital	1	1) Social capital, 2) improve performance	Diffulties to map the destination network	x	N.A.
39	Saxena & Ilbery (2008)	QLTV	SNA	Policy networks	3	Integrated rural tourism	1	1) Obtain and share resources, 2) cooperative actions, 3) collective vision, 4) knowledge sharing and trasfer	N.A.	N.A.	N.A.
40	Saxena (2005)	QLTV	SNA & marketing	Policy networks	1	Destination marketing	1	1) Knowledge sharing and trasfer, 2) competitive advantage	N.A.	N.A.	N.A.
41	Shih (2006)	QTTV	SNA	Business networks	16	Drive tourism	1	1) Multidestination trip	N.A.	N.A.	N.A.
42	Sørensen & Fuglsang (2014)	QLTV	SNA	Business networks	3	Innovation management	1	1) Innovation, 2) knowledge sharing and transfer, 3) competitive advantage	N.A.	N.A.	x
43	Søreson (2007)	QLTV	SNA & agglomer.	Business networks	2	Innovation management	1	1) Innovation, 2) knowledge sharing and transfer	N.A.	N.A.	N.A.
44	van der Zee & Vanneste (2015)	Lit. Rev.	SNA	Research networks	N.A.	Research clusters	15	1) Understanding the "total tourism product", 2) whole-of-destination view, 3) improve performance, 4) competitiveness, 5) knowledge sharing and trasfer, 6) Inter-organizational learning, 7) innovation	N.A.	N.A.	N.A.
45	Von Friedrichs Grängsjö & Gummerson (2006)	QLTV	SNA & cluster	Business networks	1	Destination marketing	1	1) Competitiveness, 2) social capital	N.A.	N.A.	N.A.
46	Von Friedrichs Grängsjö (2003)	QLTV	SNA	Business networks	1	Destination marketing	5	1) Competitiveness	N.A.	N.A.	N.A.
47	Zehrer & Raich (2010)	Concet.	SNA	Policy networks	N.A.	Network evolution	N.A.	1) Transaction costs, 2) inter-organizational learning, 3) knowledge sharing and trasfer	N.A.	x	x

Legend: QLTV = Qualitative; QTTV = Quantitative; SNA = Social Network Analyss; ANT = Actor-Agent Theory; ANN = Artificial Neural Network; ST = Sustainable Tourism; KM = Knowledge Management; RBV = Resource-Based View