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Lost in translation, found in entropy: An exploratory data analysis of latent growth factors in a Mediterranean city (1960–2010)

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ABSTRACT

Relating urban form and functions for the various typologies of metropolitan regions is an intriguing area of research. Mediterranean cities offer a kaleidoscopic overview of different urban forms (dominated by compact and dense settlements) and functional patterns at the local scale. The present study introduces an exploratory analysis of the long-term expansion (1960–2010) of a paradigmatic Mediterranean city (Athens, Greece) suspended between informality and planning, competitiveness and crisis. Going beyond the classical models investigating urban growth in developed countries, 17 socioeconomic and territorial indicators were analyzed by decade for each municipality within the study area to identify latent factors characterizing the recent phases of urban expansion. Our results point out the increased complexity of growth patterns that are shifting from a strictly mono-centric spatial organization to a more entropic and scattered model based on the dichotomy between the compact city and the neighboring dispersed suburbs. The methodology applied offers a comprehensive overview of the relationship between form and functions underlying post-war Athens' development and contributes to the understanding of urban complexity in the contemporary city.

Introduction

World urbanization, driven by population dynamics, economic specialization and technological change, was among the most striking phenomena of the last century (van den Berg, Drewett, Klaassen, Rossi, & Vijverberg, 1982; Brenner & Schmid, 2014; Cross, 1990). Different urban dimensions coexist, matching distinct functions and spatial structures (Kourtit, Nijkamp, & Reid, 2014). Disciplines interested in urban studies, including geography, sociology, planning and economics, have considered cities' expansion from distinct morphological and functional points of view. These analyses have often focused separately on the physical city environment – with spaces and forms seen from an operational (i.e. planning) perspective – and on the economic space – with urban functions interpreted according to specific spatial organization models (Neuman & Hull, 2009). The integration of these two perspectives is required for a better understanding of the transformations of urban forms and economic spaces in recent times (Parr, 2014).

Research linking form with functions has identified five major principles of organization of the urban space (agglomeration, accessibility, spatial interaction, hierarchy and competitiveness) to explain the nature, configuration and socioeconomic traits of cities in developed countries (Couch, Petschel-Held, & Leontidou, 2007). For a long time, a focus on 'location factors' related to the benefits that derive from the infrastructures, facilities and services present in the urban environment have resulted in 'agglomeration economies' (Klaassen, Molle, & Paelinck, 1981). Location factors are reflected in the principle of accessibility, the basis of the organization of urban space, which has arisen from the competition between economic activities to ensure the most advantageous locations (Fielding, 1982). The 'differential rent', or the price of the greater accessibility of an area, becomes an ordering principle of the distribution of assets in the urban space (Salvati & Carlucci, 2014).

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While Losch (1940) and Alonso (1964) studied the general aspects of the market for urban land and the location of residences and production activities, more complex models were introduced in recent times, considering the distance from the inner city as the most relevant variable shaping the socioeconomic urban structure (Aguilera-Benavente, Botequilha-Leitão, & Díaz-Varela, 2014; Chen & Partridge, 2013; Zhang, Su, Xiao, Jiang, & Wu, 2013; among others). At the same time, cities developed with the surrounding environment a complex network of bidirectional relationships that take place on multiple levels, including trade relations, commuting, the exchange of information, and collaboration between business, groups and individuals (Salvati, 2013). These networks organize themselves on the basis of gravitational fields, sensitive to the size of the spatial assets and their relative distance (Jacobs-Crisioni, Rietveld, & Koomen, 2014; Parr, 2014; Salvati & Gargiulo Morelli, 2014; among others). Starting from the seminal study by Christaller (1933), the central place theory identified a hierarchy of urban levels developing a model for their spatial distribution (Losch, 1940), the size of their market areas and the type of activities involved (Couch et al., 2007). The competitive advantages of a city indicate the factors that allow it to produce better goods and/or services than those produced by other cities or metropolitan areas (Alonso, 1964).

The Spatial Cycle Theory (SCT), introduced by Klaassen et al. (1981) and first adopted by van den Berg et al. (1982), provided a (static) interpretation of urban expansion with a regional-wide perspective, introducing the concepts of 'cycles' and 'transitions' and focusing both on urbanization patterns and processes (Couch et al., 2007). According to the SCT, the development of a region may be described using four phases: (i) urbanization, when settlements grow at the cost of their surrounding countryside, (ii) suburbanization, when the urban ring (commuter belt) grows at the cost of the urban core, (iii) counter-urbanization, when the population loss in the urban core exceeds the population gain in the outer ring, resulting in overall population decline, and (iv) re-urbanization, when the core city re-attracts population while suburbs continue to experience decline.

According to these principles, Fielding (1982), Champion (1989) and Cross (1990), among others, pointed out that urbanization should not be considered a unidirectional (and linear) process. Non-linear dynamics were commonly observed in urban systems as being influenced by path-dependent, direct factors and latent causes linking city form and functions (see Portugali, 2000; Pumain, 2005; Salvati, Sateriano, & Bajocco, 2013; Scott, Carter, Reed, Stonyer, & Coles, 2013 and references therein). Forrester (1970) conceptualizes cities as complex systems of interacting industry, housing, and people represented by variables and flows. Although being a-spatial, Forrester's model focuses on integrated socioeconomic aspects and refers explicitly to the concept of 'urban complexity'. At the same time, Kingsley and Enders (1975) applied the notion of entropy to settlement expansion in order to explain processes of growth that are not reflected in the classical urban gradient. Two decades later, Batty and Longley (1994) introduced the concept of 'fractal cities'. Berry (2005) definitely contributed to the debate perceiving cities as spatial systems, viewing the urban theory as one aspect of the General Systems Theory. Literature centered on both complex urban systems, fractal cities and entropy-based approaches grew rapidly in the last decades (see, among others, Allen, 1997; Anderson, Arrow, & Pines, 1988; Bura, Guerin-Pace, Mathian, Pumain, & Sanders, 1996; Page, Parisel, Pumain, & Sanders, 2001 for complex systems and Cabral, Augusto, Tewolde, & Araya, 2013; Encarnação, Gaudiano, Santos, Tenedório, & Pacheco, 2013 for entropy-based approaches).

Based on these premises, classical econometric approaches that interpret urban growth based on economic theory, modeling causal interactions between key socioeconomic variables (such as value added, workers' specialization, land prices) can produce misleading results when applied to complex systems, characterized by urban scattering and cross-scalar functional relations reflected in unpredictable feedback between morphology, social structures and economic activities (Batty & Longley, 1994; Portugali, 2000; Pumain, 2005). This reflection is particularly relevant in case of urban areas characterized by suburbanization-driven settlement dispersion and polycentric development altering the typical mono-centric spatial organization of regions in both affluent and emerging countries (Neuman & Hull, 2009; Parr, 2014; Polyzos, Minetos, & Niavis, 2013; Serra, Vera, Tulla, & Salvati, 2014).

According to Brenner and Schmid (2014) "(…) the ideological dimension of urbanization requires sustained analysis and deconstruction by critical urban theorists, especially under conditions in which entrenched formations of sociospatial organization are radically reorganized to produce new landscapes of urbanization whose contours remain blurry, volatile and confusing, and are therefore particularly subject to fetishized forms of narration, representation and visualization". In this sense, exploratory data analyses, when applied to a set of appropriate indicators over a sufficiently long period of time, can detect – better than other quantitative approaches – the relationship between morphological and functional variables (Salvati et al., 2013).

These variables are strongly dependent on the interplay between socioeconomic and territorial indicators in the Mediterranean region and, possibly, in other urban contexts. Salvati and Gargiulo Morelli (2014) pointed out the variety of urban forms, economic structures, social contexts and landscapes found in the Mediterranean region. Although northern Mediterranean cities may have their own territorial attributes, each has a number of socioeconomic traits that have made these cities uniquely Mediterranean but not uniform entities (Salvati, 2013). In such a context, urban growth cannot be explained solely by common rules but follows place-specific paths based on the long-established interplay among a number of factors that shape economic relationships and reflect peculiar morphologies and socio-spatial structures (Salvati, 2014).

The present study proposes a rethinking of the recent growth of a large Mediterranean urban region (Athens, Greece) by applying an exploratory data analysis to a wide set of morphological and functional indicators collected every decade between 1960 and 2010. Athens, 'placed at the periphery of the advanced world' (Souliotis, 2013), is considered a prototype of Mediterranean urban areas suspended between planning and informality, competitiveness and crisis, social segregation and mixed land-uses. Previous work exploring Athens' urban complexity demonstrated that traditional, linear and deterministic approaches, including the SCT, overestimate the importance of certain factors (Salvati, 2014), providing a biased picture of the overall urbanization process at the regional scale. For instance, while counter-urbanization in the United States and Northern Europe has frequently been associated with upper- and middle-class mobility, in Athens this phenomenon could be defined as 'crisis counter-urbanization', triggered by urban decay (unemployment, crime rates, economic deprivation) and enhanced by the benefits of available housing and extended family networks (Gkartios, 2013). Our study demonstrates that long-established, latent factors are important to grasp the complexity of Mediterranean urban systems.