



Research Paper

How did urban polycentricity and dispersion affect economic productivity? A case study of 306 Chinese cities

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ABSTRACT

This article aims to assess the impacts of urban spatial structure on economic productivity. Drawing upon detailed gridded population data of 306 Chinese cities at the prefecture level and above, we identify their urban (sub)centers through exploratory spatial data analysis, construct indicators to measure their degrees of polycentricity and dispersion, and model the impacts of spatial structure on urban productivity. A regression analysis reveals that economic productivity is significantly associated with urban spatial structure. Conditioning on other factors, higher degrees of dispersion are associated with lower level of urban productivity whereas the effects of polycentricity depend on urban population density. Less densely populated cities are likely to have higher productivity levels when they are more monocentric, while urban productivity of cities with high population density tend to benefit from a more polycentric structure. The paper concludes with spatial planning implications.

1. Introduction

The link between urban spatial structure and economic performance of cities has long been explored in urban studies and planning. Early academic interest in urban form and function can be dated to Greek philosophers such as Aristotle and Plato, who were concerned with the optimum city size for social and political interactions. Recent urban theories have in various ways contemplated that how urban form could affect economic competitiveness, social cohesion, and environmental sustainability of cities (Anas, Arnott, & Small, 1998; Fujita & Thisse, 2002; McMillen, 2001; Meijers & Burger, 2010; Xiao, Orford, & Webster, 2016). For example, commenting on the nexus between urban (economic) processes and land use patterns, Storper and Scott (2016: 1116) argue that “cities are everywhere characterized by agglomeration involving the gravitational pull of people, economic activities, and other relate into interlocking, high-density, nodal blocks of land use”.

This paper examines two main dimensions of urban spatial structure (Meijers & Burger, 2010). The first concentration-dispersion dimension concerns whether and to what extent population and economic activities are clustered in urban centers (Tsai, 2005). The second polycentricity-monocentricity dimension explores whether and to what extent an urban system is organized around a single urban core or a number of proximate and functionally integrated subcenters (Green, 2007). Importantly, the relevance of these two dimensions is reinforced

by the fact that they have attracted considerable interest from policy makers and urban planners and have been translated into a range of normative plans and policies (Brezzi & Veneri, 2015; Harrison & Hoyler, 2015; Masip-Tresserra, 2016). For example, ‘suburbanization’ and ‘compact cities’ movements in the American context often have urban dispersion and concentration as the ideal-typical situation, respectively (Ewing, Hamidi, Grace, & Wei, 2016). Similarly, substantive causal power is attached to polycentric urban patterns envisioned in various plans, ranging from ‘planned polycentrism’ in Tokyo to European Spatial Development Perspective (ESDP; Davoudi, 2003; Sorensen, 2001; Veneri & Burgalassi, 2012). Most relevant to our purpose here, the drive to foster economic development by shaping (polycentric) urban form is (re)gaining momentum in China (Cheng & Shaw, 2017) and highlighted in two recent high-profile spatial plans. In Northern China, an entire new city Xiong’an is being planned and built to serve as a new growth pole in the Beijing-Tian-Hebei city-region in April 2017 (Xinhuanet., 2017). In Southern China, the vision for a ‘world-class’ multi-centered city-region in the Guangdong-Hong Kong-Macau Big Bay Area was announced by the Chinese Premier Li Keqiang at the National Congress in March 2017.

This analysis hopes to expand our understanding of these two key dimensions of urban spatial structure. First, while the relationship between urban form and economic performance has been examined in the North American and European contexts (Anas et al., 1998; Meijers &

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Burger, 2010; Veneri & Burgalassi, 2012), relatively less is known about urban spatial structures and their economic impacts in China, which features distinct institutional, social, and political organizations of economic activities (Zhang, Sun, & Li, 2017). Second, studies of urban spatial structure in China were often plagued by the lack of consistent definitions and robust dataset, however recent development in urban data might open new research opportunities (Liu & Wang, 2016). Third, a case study in China will provide nuanced understandings of the relation between urban form and function, as existing theories are largely developed in the European and North American contexts (Liu, Derudder, & Wang, 2017). This is also consistent with Wu's (2016: 338) call for using Chinese cities as a “laboratory to observe planetary urbanization”.

This study adopts a spatial statistical approach to measuring urban spatial structure in Chinese cities and exploring its impacts on urban economic performance. We focus on two key dimensions of urban spatial structure: the monocentricity-polycentricity dimension and the concentration-dispersion dimension (Anas et al., 1998). Following Meijers and Burger (2010), we use labor productivity as a proxy for economic performance. We begin by reviewing how urban polycentricity and dispersion are defined and the relationship between urban form and economic performance. The next section describes data and methodologies. This includes a new approach to identifying (sub)centers within individual cities using gridded population data. Based upon empirical results, we then analyze the impacts of polycentricity and dispersion on urban productivity. We conclude with implications for planning and policy as well as suggestions for further analysis.

2. Literature review

2.1. Urban spatial structure: polycentricity-monocentricity and concentration-dispersion

Despite recent growing popularity of the concept of polycentricity for both scholars and policymakers, the concept itself remains ambiguous and stretched (Burger & Meijers, 2012; van Meeteren, Poorthuis, Derudder, & Witlox, 2016). Polycentricity could have different meanings from different analytical perspectives (e.g., morphological and functional polycentricity) and at various geographical levels, although van Meeteren et al. (2016) suggest that the studies on polycentricity at the intra-city, inter-city and inter-regional scales can be related (Li & Phelps, 2016). The intra-city or intra-urban scale is where the concept of polycentricity theoretically originates. Polycentricity was put forward in response to the increasing difficulties of Burgess's (1925) monocentric model in explaining spatial realities such as the growth of suburbs (Phelps, 2010) and edge cities (Lee, 2007). Regardless of the dimension at which polycentricity is analyzed, polycentricity generally refers to the extent to which the ‘importance’ of centers (cities) is evenly distributed (Fig. 1). The ‘importance’ could be approximated by population, employment population, and gross domestic product (GDP) in morphological terms or external linkages of people flows and information exchanges in functional/relational terms (Green, 2007).

The concentration-dispersion dimension of urban spatial structure, on the other hand, refers to the degree to which the population is clustered or concentrated in urban (sub)centers (Lee & Gordon, 2007). The concentration-dispersion dimension is associated with the monocentricity-polycentricity dimension as both the degrees of dispersion and polycentricity depend on the number of residents in urban (sub)centers. However, the two dimensions are distinctive and not necessarily changing in the same direction (Fig. 1; Meijers & Burger, 2010). For instance, a dispersed polycentric urban structure could result from high-level evenness of population distribution among urban (sub)centers with low-level concentration of population in these (sub)centers (i.e., population is dispersed over non-center areas of a city).

2.2. Urban spatial structure and economic productivity

The debate on the impacts of the two dimensions of urban spatial structure on economic performance has been largely associated with the (relative) proportion of agglomeration economies and diseconomies in urban centers. Scott and Storper (2015) argue that all cities can be understood within a theoretical framework combining the dynamic process of agglomeration/polarization and the interactive process of land uses. From a micro-economic perspective, the concentration of people and firms in urban (sub)centers could enhance urban productivity through the dynamics of sharing, matching, and learning (Duranton & Puga, 2004). For instance, agglomeration economies and therefore improved economic productivity could emerge from the concentration of people in urban (sub)centers, due to human capital externalities and skill complementarities which has been analyzed in recent studies (Fujita & Thisse, 2002; Krugman, 1991; Liang & Lu, 2017). Furthermore, the economies of scale in providing public services and infrastructures can only be achieved when there is a considerable amount of people in urban (sub)centers. Following this line of thinking, a more concentrated distribution of population means larger urban (sub)centers and therefore greater economic outputs, everything else being equal. However, too much concentration of people in urban (sub)centers could also cause agglomeration diseconomies, which has driven many scholars to find a theoretically optimal size of cities (Ciccone & Hall, 1993). That being said, discouraging the concentration of people in urban (sub)centers would not necessarily enhance economic performance of certain cities and has been criticized by some scholars (Lu, 2017). Overall, the relationship between size of urban centers and economic productivity remains debatable. For example, Frick and Rodríguez-Pose (2016) suggest that such relationship may vary between developed and developing countries.

To mitigate the impacts of agglomeration diseconomies arising from too much concentration in urban (sub)centers, a polycentric structure which emphasizes balanced distribution of population among urban (sub)centers has been regarded as an effective approach (Fujita & Thisse, 2002; Krugman, 1991). More specifically, it is argued that polycentricity could improve urban productivity at least by reducing transaction costs within cities such as traffic congestion (Sun, Tu, Shi, & Guo, 2013; Zhang et al., 2017) and by “borrowing” size among urban (sub)centers (Phelps & Ozawa, 2003). This is consistent with Phelps's (2004) observation that, while agglomeration and external economies are usually conceived at the local scale, agglomeration at the regional scale arises with the emergence of new transport, communication and production technologies/models (Phelps, 2004; Duranton & Puga, 2004). In this context, Randstad, the Netherlands, and Rhine-Ruhr, Germany are often cited as archetypal examples of such polycentric urban development, where proximate but distinct urban centers function as a whole (Green, 2007). Taken together, cities with larger (sub)centers and a more balanced distribution among these (sub)centers are often conceived to be more productive.

However, empirical analysis does not always support these theoretical conjectures. For instance, Lee and Gordon (2007) find no statistically significant evidence regarding the role of decentralization (polycentricity or monocentricity) in affecting job growth in US metropolitan areas (MAs) while the role of dispersion is found to be dependent on metropolitan size. Meijers and Burger (2010), however, find that polycentricity contributes to labor productivity of US MAs especially those with smaller size while the impact of dispersion is insignificant. Outside the US, Veneri and Burgalassi (2012) observe a positive relationship between polycentricity (both morphological and functional) and level of productivity through an investigation of Italian NUTS-2 regions. In other words, empirical studies on the economic effects of urban spatial structure remain inconclusive.

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