

THE SPATIAL PARAMETERS OF AGGLOMERATION ECONOMIES WITHIN THE URBAN STRUCTURE OF WROCLAW

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Abstract: The purpose of the article is an analysis of the effects of spatial parameters which play a key role in the studies of accumulated economic activities within the structure of urban space as well as answering the question how to measure spatial parameters within the urban structure. The spatial parameters are considered as a model of spatial organization of the urban structure, combining spatial forms of accumulated economic activities and the models of urban configurations. The author of the article uses the theory of space syntax. The studies of spatial parameters of accumulated advantages of economic activities were carried out for Wrocław.

Keywords: Agglomeration Economies, Spatial Proximity, Accessibility, Urban Spatial Structure, Space Syntax Theory, Wrocław

INTRODUCTION

Most cities throughout the world have dealt with wide developments and have faced new challenges in their urban structure as a result of economic growth, socio-cultural change and political transformation. These factors influence the configuration of urban spatial structure, sprawling over wide areas of the metropolitan region. As a result of this urban sprawl, the urban structure is transformed from a monocentric city concept, where the labor market and population density are concentrated in one main center (CBD), to a polycentric city concept which is based on the agglomeration economies of activities that are clustered in a main center and with sub centers around the whole city area.

The framework of these concepts of economic models used density of population and employment and clustering of agglomeration as a function of the distance to the main center and sub centers. Studies and debates have confirmed that a more effective measure of distance within the urban structure is accessibility. At the same time, all the approaches that studied accessibility didn't take into account the influence of the urban configuration on this spatial parameter.

From this perspective, the paper aims to study the effect of the spatial parameters which have a key role in investigating the agglomeration of economic activities within an urban spatial structure, and to investigate how to measure this spatial parameter within a configuration of the urban structure.

The research uses the methodology of space syntax theory as a configurational concept of urban spatial structure. This methodology analyzes the structural characteristics of an urban structure. The configuration of urban structure generates patterns of accessibility.

The research deals with the urban spatial structure of Wroclaw as a case study. The findings of the research confirm that the spatial parameters of agglomeration of economic activities can be shaped in Wroclaw as patterns of urban structures.

AGGLOMERATION ECONOMIES

Agglomeration refers to the clustering of economic activities at a particular location in urban space. It is widely accepted that economic activities are not located randomly but according to an economic rule. This clustering of economic activities together in urban space will create an economic force, also known as agglomeration economies force, and is a prerequisite for the survival and success of economic activities in an urban area (Maoh, Kanaroglou 2004).

Agglomeration Factors of External Scale Economies

According to Anas et al. (1998), the successful operation of economic activities is represented in the factors of external scale economies that influence the decision of locating and clustering economic activities, they are as follows (Anas et al. 1998):

- *Localization economies*: External scale economies between firms in the same industry, economies of localization cause cities to be specialized.
- *Urbanization economies*: External scale economies between firms across industries, economies of urbanization cause them to be diversified.
- *Inter-industry linkages*: External scale economies arise from transportation cost savings if two firms co-locate. Inter-industry agglomeration occurs through backward and forward linkages.

The benefits of agglomeration economies play a key role in the urban growth of the city structure, as was first highlighted in Marshall's (1920) benchmark theory. He argued that external economies such as labor market pooling, input sharing and technological spillovers enhance the productivity level of the city,

leading to economic growth (Marshall, 1920). From this perspective, the urban spatial structure of the city is affected by patterns of agglomeration as a result of clustering of economic activities in urban areas.

Agglomeration patterns of Urban Structure

The existence of economic activities within the urban structure of a city generates patterns of agglomeration. These patterns of agglomeration can be summarized, for the purposes of this paper, to four patterns, as follows:

- *Population*: The spatial distribution of population at certain locations within an urban area is generated by agglomeration economies. These urban locations have a high rate of job offers as well as good infrastructure and transportation networks. This pattern of agglomeration is shaped as a location with high concentration of population, as well as with high concentration of employment.
- *Labor Market*: The spatial concentration of employment at a certain location within an urban area can be generated by external scale economies (McMillen, McDonald 1998). According to the assumption that the concentration of employment is a proxy for concentration of a relevant labor market (Kutzbach 2009), there are several mechanisms by which thick labor markets contribute to economies of agglomeration. First, labor market pooling allows firms and workers to make better matches. Second, labor market pooling reduces risk for firms of being without a critical type of skilled labor, and for workers, of being without employment. Third, a concentration of human capital and skills may improve productivity across firms and industries and play a role in knowledge spillovers (Marshall 1920).
- *Firm locations*: A location well served by highways, rail lines, and so on, may attract many firms even when the firms have no interest in locating near one another. This line of reasoning suggests that an employment concentration may form near transportation centers (McMillen, McDonald 1998). An agglomeration economy is based on access to infrastructure shared by many firms. Transportation facilities, such as limited-access highways, waterways, railways, and airports, are subject to economies of scale. Therefore, a location near these facilities permits a firm to make use of scale economies to a greater degree. Firms will cluster near transportation facilities even if there are no direct benefits of locating near one another (McMillen, McDonald 1998).
- *Land value*: When economic activities agglomerate in space there will be competition for land, which drives up land costs and creates a centrifugal force in the region. Furthermore, economic activities will have to

compete for qualified labor and other inputs. On the output side, spatial competition is likely to be an important force as well. If a market in a certain region is saturated, it will be more difficult for new economic activities to get a foothold in that region (Sohn 2004).

Spatial Forms of Agglomeration Economies

Spatial forms of agglomeration economies play a key role in the establishment of economic activities within the urban structure of the city. In this study, two spatial forms of agglomeration economies can be outlined, they are as follows:

- *Proximity*: Geographically, proximity can be defined as a spatial parameter to minimize distances between objects (economic activities within one agglomeration economy). This is a factor in the localization of firms and households (Rallet, Torre 2005). Proximity occurs when economic activities enjoy cost advantages from locating near one another. Proximity to other economic activity may lower production costs by simplifying personal transport or may help customers reduce their shopping costs. The initial location of a suburban sub-center may be the result of access to the transportation network, but this added agglomeration economy can provide an independent motivation for the location of economic activity. If proximity to other economic activities lowers costs, then an economic activity may bid more for sites in suburban sub-centers, independent of the other advantages of the sub-center location offers (McMillen, McDonald 1998).
- *Accessibility*: accessibility can be defined as the topological distance connecting an economic activity to another one situated in a different agglomeration within the urban structure of the city. In other words, it is a parameter of urban space allowing objects (goods, productions, people, information etc.) to move from their original location to their destination within the urban structure.

According to the monocentric and polycentric economic concepts of urban spatial structure, population, employment, and high land values are concentrated in the main center and that economic activities are agglomerated in the main center and sub-centers. The framework for these economic models uses density of population and employment, and clustering of agglomerations as a function of the distance to the main center and sub centers. Studies and debates have confirmed that a more effective measure of distance within the urban structure is the spatial parameters; accessibility and proximity. At the same time, all the approaches that have studied accessibility and proximity haven't taken into account the influence of the urban configuration on these spatial parameters (Saeid 2009).

SPACE SYNTAX METHODOLOGY

The study aims to use space syntax methodology as an analytical tool to investigate and explain the influence of the urban configuration on the spatial parameters of agglomeration economies (accessibility patterns). The concepts and principles of space syntax can be found in detail in the debates and literatures on this theory (Hillier, Hanson 1984; Hillier et al. 1987; Hillier et al. 1993; Hillier 1996; Jiang, Claramunt 1999; Jiang, Claramunt 2002; Jiang, Klarqvist 2000). To understand the accessibility patterns within the urban structure, the study deals with the structural characteristics of an urban system.

Structural Characteristics

The structural characteristics of an urban system can be measured by the core. The core is the most important deep structure of the urban network and it will vary from one settlement to another. The core of a settlement is 5%, 10% or 25%, depending on what is to be shown, of the total values of the measure.

- *The global integration core:* The global integration core is represented by 10% (or 5% or 25%) of the highest values from the total values of global integration of axial lines for the axial map of an urban system (Hillier, Hanson 1994).
- *The global choice core:* The global choice core is represented by 10% (or 5% or 25%) of the highest values from the total values of global choice of axial lines for the axial map of an urban system (Peponis et al. 1989).
- *The local integration core:* The local integration core is represented by 10% (or 5% or 25%) of the highest values from the total values of local integration of axial lines for the axial map of an urban system (Hillier, Hanson 1984).

Accessibility Patterns

There are two patterns of accessibility that can be derived from the measurement of the cores of urban systems. These patterns of accessibility impact on the concentration and distribution of economic activities, the labor market and property values (Saeid, Masztalski 2009). They are as follows:

- *Local accessibility:* The pattern of local accessibility can be shaped by the local integration core, which is described as the local closeness centrality measure of the urban network. This pattern minimizes the distances from all origins to all destinations, which are presented as compact and convex local structures within the whole urban structure.

- *Global accessibility*: The pattern of global accessibility can be shaped by the global choice core which is described as the global intermediate centrality measure of the urban network. This pattern minimizes the distances from one origin to one destination. It is presented as a global structure of long lines connecting the local structures (as parts) between themselves and within the whole urban structure.

WROCLAW (CASE STUDY)

Wroclaw is one of Poland's most dynamic cities. It has a multicultural history and a tradition of openness. It has about 634,000 inhabitants (with over 1.1 million in the agglomeration). It is the capital of the province of Lower Silesia, a rapidly growing region in the southwest of Poland (OECD, 2008). Wroclaw is situated strategically between Prague, Warsaw and Berlin; it boasts a developed transportation infrastructure that connects the metropolis with the whole of the continent and beyond.

Fifteen years into the economic transformation, the agglomeration has moved away from its traditional communist-era manufacturing base. At present, the following industries are the key drivers of the economy: information technology, financial services and automotive production. However, recent homegrown and international hi-tech investments mean that the agglomeration's competitiveness will be increasingly determined by knowledge and innovation. The Wroclaw agglomeration is one of diverse landscapes and varied natural resources. Situated in the fertile Odra River valley at the edge of the Sudetes Mountains, the area offers favorable conditions for carrying out a variety of investments (ARAW, 2009).

Wroclaw has the densest road network in Poland, which has promoted the dynamic progress of the region. This network is well connected with the existing pan-European motorway system. The city's strategic location is enhanced by many international transport routes running across Wroclaw, including the so called "3rd Pan-European Transport Corridor". Three major Wroclaw bypass routes are slated for completion in the next period: the Wroclaw Bypass, the Inner Wroclaw Ring Road and the County Bypass (ARAW, 2009).

SPATIAL ANALYSIS OF WROCLAW'S URBAN STRUCTURE

The urban structure of Wroclaw was selected as a case study to analyze and investigate the spatial parameters of agglomeration economies. Since the paper uses space syntax theory as a research methodology, the syntactic properties of Wroclaw's urban structure are explained in more detail in a forthcoming paper

(Saeid 2010). The results of that paper will show that the values of the spatial characteristics of Wrocław's urban structure should be calculated within a regionally limited radius zone. Then the values within the metropolitan region could be used for the administration boundary of the city (Saeid 2010). Additionally, the agglomeration economies could be split artificially by the administrative boundary (Cuillain 2006). From this perspective, the spatial analysis of the structural characteristics of Wrocław are derived from the spatial analysis of the Wrocław metropolitan region limited by a radius zone.

Structural Characteristics of the Wrocław Region

The study deals with two measures of structural characteristics, the local integration core and the global choice core. The local integration core shapes the local accessibility patterns of local urban structures of the Wrocław region, which minimizes the distances from all origin-locations to all destination-locations within each local urban structure, as shown in Fig. 1.

Meanwhile the global choice core, shapes the pattern of global accessibility of the whole urban structure of the Wrocław region, as shown in Fig. 2. This pattern of global accessibility connects the main center of Wrocław and the edges of the region (the limited radius zone) by the shortest possible routes, as well as through the local urban structures within the whole urban structure of the Wrocław region.

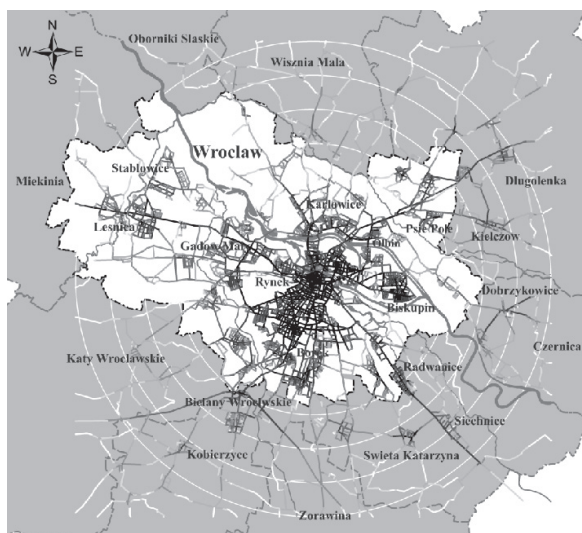


Fig. 1. The Local Integration Core (Local Proximity Pattern) of Wrocław's Urban Structure



Fig. 2. The Global Choice Core (Global Accessibility Pattern) of Wrocław's Urban Structure

Spatial Parameters of Agglomeration Economies

In this study, the spatial parameters of agglomeration economies can be considered by combining the spatial forms of the agglomeration concept and the accessibility patterns of the configuration concept to local proximity and global accessibility.

Figure 1 shows the local proximity of agglomeration economies within the urban structure of Wrocław's administrative region that are formed in the city center (Rynek), Lesnica, Stabłowice, Gadow Mały, Karłowice, Psie Pole, Olbin, Biskupin and Borek. At the same time the urban structure of Wrocław is tightly interwoven with the local agglomeration locations that are formed by the administrative boundary of Wrocław, such as, Bielany Wrocławskie, Radwanice, Siechnica, Dobrzykowice, Kiełczów and Długoleka. These local agglomeration locations (inside and outside the administrative boundary of Wrocław) are connected by a pattern of global accessibility.

CONCLUSIONS

In this paper, there are two important patterns: that within the urban spatial structure of the city, which can be shaped by the spatial parameters of agglomeration economies; and local proximity and global accessibility. These two

spatial parameters are derived from combining the spatial forms of agglomeration of economic activities and the accessibility concepts of the urban configuration model (space syntax theory).

Local proximity is shaped by a pattern of local structures that minimize the geographic distances from all origin-locations to all destination-locations. These locations are the sites for the agglomeration of economic activities. Local proximity is presented as backward and forward linkages between the locations of economic activities. At the same time, it occurs as a factor of localization of agglomeration economies. Global accessibility is shaped by a pattern of global structure which connects local structures. The global accessibility was presented as backward and forward linkages between clusters of economic activities and is a factor of urbanization of agglomeration economies.

The paper concludes that the spatial parameters of agglomeration economies within the urban structure of the city should be analyzed as a region, because the administrative boundary of the city splits the agglomeration economies.

According to the urban economic concept, the urban spatial structure of Wrocław can be considered as a polycentric city structure which results from arising local structures. These local structures, either inside or outside the administrative boundary of Wrocław, can emerge as poles generating agglomeration patterns; the concentration of populations, concentration of employment (labor market) and appropriate locations for establishments and firms. From this perspective, there are several questions that emerge; are population, employment, location of firms and land values correlated strongly with the spatial parameters of agglomeration economies? Is it possible to apply the methodology of this research to determine the central district of Wrocław's metropolitan area? The answers to these questions will be the topic of forthcoming research.

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PARAMETRY PRZESTRZENNE EKONOMII AGLOMERACJI W RAMACH STRUKTURY MIEJSKIEJ WROCŁAWIA

Streszczenie

Zadaniem niniejszego artykułu jest zgłębienie efektów parametrów przestrzennych, które odgrywają kluczową rolę w badaniu aglomeracji działań gospodarczych w ramach struktury przestrzeni miejskiej oraz udzielenie odpowiedzi na pytanie jak mierzyć parametry przestrzenne w ramach konfiguracji struktury miejskiej. Te parametry przestrzenne uważa się za wzorce struktury

miejskiej, łączące przestrzenne formy aglomeracji działań gospodarczych oraz dostępność koncepcji modelu konfiguracji urbanistycznych. W artykule korzystam z teorii space syntax jako metodologii do analizy i badania koncepcji dostępności w ramach struktury przestrzeni miejskiej. W celu badania parametrów przestrzennych ekonomii aglomeracji wybrano Wrocław. Wnioski przedstawione w niniejszym artykule potwierdzają, że na parametry przestrzenne ekonomii aglomeracji w strukturze miejskiej Wrocławia ma wpływ uwzględnienie potrzeb społeczności lokalnych oraz globalna dostępność.