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Contributions to assessing the relative dimension of agglomeration theories

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Abstract. *The aim of this paper is to structure, from a historical and spatial point of view, the existing specialists' concerns in developing theories about agglomeration. The complete and complex evaluation of agglomeration economies allows us to make important contributions to assessing the relative dimension of agglomeration theories, placing them within the research area of spatial economy and identifying them with the science of location and currently with the new economic geography (NEG).*

Keywords: agglomeration; spatial economics; location theories; regional science; new economic geography.

JEL Codes: B29, N 01, R10.
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1. Introduction

The scientific literature on agglomeration economies is based on the early studies in the field of spatial economy. A possible starting point for this field of study can be found in the papers which deal with differences in local productivity, D. Ricardo (1821) being a pioneer of this approach by developing a theory regarding the use of lands based on their relative fertility. His theory was later generalised to also refer to the exogenous technological differences for all types of goods. The second branch of the trade theory is founded on the differences regarding factorial endowments of trading regions, approach which is also known as the Hecksher-Ohlin theory of international trade. These two authors' contributions led to the development of theories on location and commerce, based on the existence of exogenous comparative advantages between several locations. Although these approaches were essential for its sister-discipline – international trade –, they played a less important role in the development of the spatial economics.

Nevertheless, spatial economics has dealt with the existence of non-convexities regarding transportation costs, while stating that, although comparative advantages are an attractive explanation for the understanding of international trade fluxes, they provide, at best, a partial explanation for the industrial location models within countries, and they cannot explain the driving force behind the concentration of people in metropolitan areas (Duranton, 2008). On the other hand, the non-convexities in production or consume seem to provide more convincing answers for the fundamental issues of spatial economy. The simplest way of modelling these non-convexities is to assume some indivisibilities in a spatial equilibrium framework (Duranton, 2008).

2. Contact points and areas of interference between theories on location and agglomeration

This type of model was pioneered by J.H. von Thünen (1826), who, in the paper *The Isolated State*, aimed at finding an optimal localisation for agricultural lands according to the distance between production sites and commercial markets.

Within his model, the author hypothesized the existence of a competitive farmland with complete physical homogeneity, whose production needs to be sold in the central city market. Having high transportation costs, the farmers are willing to bid for the lands up until the rent for a land situated at a given distance from the central city market is equal to the gross profit of production minus the cost of unused land minus transportation costs. On a competitive

market, the farmland is sold to the bidder who places the highest bid and, thus, this balance develops a pattern of concentric rings around the central city market.

Although there are critics who refer to its lack of realism and to its failure to also take into consideration the importance of industrial location apart from the one concentrated in the central city, von Thünen's model has generated a new perspective in the analysis of space and its influence on literature.

The term *agglomeration* was introduced through A. Weber's location theory, in 1909, in the study entitled *Theory of the Location of Industries*. Weber dealt with the issues regarding the optimal location of an indivisible and competitive manufacturing plant, taking into consideration transportation costs, with the purpose of directing the input of suppliers and the generated output towards markets. With the help of linear programming techniques, the optimal location can be obtained, by minimising the total cost of transportation. Just like Alonso's mono-centric model, Weber's theory was further expanded by taking into consideration, among others, several flexible production functions and the optimal location of public facilities.

Although Weber is mainly known for his industrial location theory, his main concern was explaining the formation process of industrial clusters. Weber's paper is a turning point in location theory, because it tries to optimise, through mathematical modelling, the location of enterprises regardless of their economic profile, passing from a microeconomic framework limited to a sole enterprise towards a mesoeconomic framework which offered clues regarding some specific areas of activity (branches of economics).

H. Hotelling (1929) also studied the location problems encountered by producers, but from a different perspective. His fundamental idea is that, because of indivisibilities, there will not be an infinite number of producers for every economic location, meaning that Weber's theory is no longer sustainable. With a small number of producers, the decision to locate somewhere implies more than just the reduction of transportation costs, since location affects competition as well. Therefore, starting from a fault of Weber's model, Hotelling deals with the issue of spatial competition.

A. Marshall, in his paper *Principles of Economics*, published in 1890, identifies three sources of profit for localised industries: labour market, producer services location and knowledge spillovers, also known in literature as the *Marshall's trinity* regarding the sources of agglomeration economies. Actually, the proximity between suppliers and clients leads to savings in transaction costs, facilitating input-output connections. A bigger market labour may allow a better division of labour and stimulates workers to invest in their skills. The diffusion of knowledge and human capital appears thanks to the

possibility of spatially-concentrated firms and workers to learn more easily from each other than they would by being dispersed in space (Marshall, [1890], 1920).

W. Christaller (1933), another important theoretician, tried to determine the size, number and distribution pattern of cities in a certain area, based on a series of elementary assumptions about consumer behaviour. He developed a structure based on marginal returns and urban agglomeration, refining a concept taken from Launhardt – the concept of hexagonal shape, which is the optimal boundary shape for complementary markets. His theory changed the way cities were viewed and analysed, from simple hierarchies or individual entities, as they were considered until then, to systems of cities.

A. Lösch (1940) is a researcher who generated a true school of thought around his theory, through his contributions to this field of study, but also through his great ideas which were later pursued and developed by other theoreticians. Lösch demonstrates that the existence of a large number of producers in a certain market area decreases total transportation costs and normalises their profits. The conclusion of this analysis is that the optimal market area, where transportation costs are minimised, has a hexagonal shape, thus ensuring an even use of a given domain. The overlapping of several hexagonal regions which have a common economic centre and a maximum number of intersections with other production centres, with the purpose of minimising total transportation costs, results in a certain hierarchy of industrial zones, which leads to the formation of *central places*, as Lösch names them.

Another pioneer of spatial economics, who introduced the agglomeration theory, was W. Alonso (1964). In his model, presented in the paper *Location and Land Use,* he hypothesizes, just like von Thünen, the existence of a physically homogeneous land, but replaces the market with a business centre where residents have to commute in order to find a workplace.

In developing his theory, also known as the *spatial equilibrium theory*, Alonso started from the idea that, in addition to its residential function, the city is home to many industrial, commercial and administrative activities. The equation expected to determine the spatial equilibrium is:

$y = Pz \times Z + Pt \times q + Kt$

where:

Pz – price of goods and services per unit;

Z – quantity of goods and services;

Pt – price of a land unit depending on the t distance from the city centre;

q – quantity of land;

Kt – transportation costs depending on the t distance from the city centre.

Alonso's theory ignores some elements belonging to both the city and suburbs, and its application to some real cases gave no results. This microeconomic model succeeded in replicating reality in what concerns land use and land costs in urban areas, generating a vast literature which continued developing this initial model towards the theory of multi-centric cities (Fujita, 1989).

A valuable contribution to the panoply of location theories was brought by the prominent scientist of Romanian origin, N. Georgescu-Roegen. He addresses the village and its optimal size in a socio-economic manner, also taking into account some historical insights. Thus, the village houses are arranged compactly in a place that is the centre of the village and is based on a primitive instinct, which has to do with the individuality and cohesion of the rural community.

Resorting to physical and biological approaches on this coagulation, Georgescu-Roegen seeks to establish the factors that have enabled rural communities to not exceed those dimensions that would jeopardize their cohesion. As for location, it must meet certain restrictive conditions, also taking into account the role of transportation in this decision: "Whereas by the end of the last century transportation was not a very easy job, various resources were being placed conveniently around the site which was suitable for becoming the heart of the village" (Georgescu-Roegen, 1997).

The Romanian scientist who demonstrated many different approaches accepts that the first inhabitants who grouped in a certain place were determined by their gregarious instinct, and that the optimal size of a village cannot exceed certain limits. N. Georgescu-Roegen summarizes that what matters to any rural community is its optimal size, because the village territory is seen as a material basis, and that the cause of human concentration in a single socio-economic entity is the determined, invariable structure of this material basis, which must be able to meet the vital needs of its residents.

Although very important in empirical developments, location theories failed to impose themselves in mainstream economics and were absorbed by the so-called "regional science" (Blaug, 1992). Now, a special attention is given to the study of economic behaviour in certain locations, which proved the tendency of industrial activities to group in clusters such as industrial parks, smaller or larger cities etc.

The establishment of regional science as a distinct field was based on the incorporation, from a spatial perspective, of some of the concepts and methods of economics, geography, econometrics, mathematics, sociology, political science, which gave it a strong, consciously assumed, interdisciplinary character. This qualitative leap was based on adopted rigorous and systematic methods and techniques, used in the analysis of phenomena and processes in which space, distance and location play an important role.

At the same time, there has been a continuous expansion of its area of investigation. Therein, a range of disciplines has appeared and developed, disciplines that shape, along with regional economics, the complex profile of this science: regional planning, regional forecasting, urban economics, urban planning, rural economics, land use planning, infrastructure economics, sustainable spatial development etc.

3. Agglomeration theories and the new economic geography

For the past two decades, there has been an increased interest on location in the economic literature. Developments made in modelling market structures and transportation costs, combined with the increasing processing power of computers, have led to the discovery of congestion-control mechanisms. The data source which provides basic understanding of the economy based on industrial clusters is the *new economic geography*. The development of this filed is due to P. Krugman's works which, since 1990, have been oriented towards economic geography and location problems. One of the tasks of economics, the author said, is to understand why economic activities emerge and develop in one place rather than another. He also shows that a region can become, as a result of a cumulative effect and with an almost arbitrary start, more competitive than another, due to increasing returns allowed by the spatial concentration of activities.

The new economic geography is based on a series of prior contributions, such as the Dixit-Stiglitz monopolistic competition model (1977), which opened new perspectives in economic research; Samuelson's "iceberg" model of transportation costs (1952); research on imperfect market structures and origins of international trade (Helpman, Krugman, 1985). These major theoretical contributions have enabled researchers to operate with a range of keywords: the general equilibrium model of a spatial economy, different from the approach derived from the traditional location theory and economic geography; increasing outputs or indivisibilities at the level of the individual producer; imperfect competition, as a result of increasing outputs; transportation costs, giving an increasing importance to location; change of location for production factors and consumer input, which is a prerequisite for agglomeration (Fujita, Krugman, 2004).

Paul Krugman's *core-periphery model* (1991), based on the dualism of work, operates with three fundamental parameters: the costs of industrial goods, the appreciation of variety in consumption and commercial or transportation costs between different regions. Conducting simulations with different commercial costs, he observed important alterations of the model in terms of equilibrium and system stability. His theory generated a mainstream in

economics of agglomeration, which has developed exponentially in the 1990s, culminating in the work of Fujita, Krugman and Venables, *The Spatial Economy: Cities, Regions and International Trade*, published in 1999.

Subsequently, the economic literature has been enriched by the contributions of Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003), Fujita and Thisse (2003), and also of other researchers who have tried to answer the pragmatic aspects of contemporary real economy such as: globalization, integration, reunification of Germany, agglomeration, trade policy making etc. The main conclusions on location drawn from the study of the new economic geography are: concentration of economic activities depends on the dispersion and concentration forces; when transaction costs are high, industries will see the need to develop locally; when transaction costs are very small, necessary inputs can be distributed in areas which record maximum production costs; industrial agglomerations strengthen the relative attraction force of regional economies.

4. Conclusions

The issues regarding the economies of agglomeration fall within the scope of investigation of spatial economy, which addresses a number of aspects found between micro and macroeconomics, while asking for an integrated view of the two approaches. It is about regional issues, including settlements, i.e. approaching the economy at a spatial scale.

Although very important in empirical developments, location theories failed to impose themselves in mainstream economics and were absorbed by the so-called "regional science". Now, a special attention is given to the study of economic behaviour in certain locations, which proved the tendency of industrial activities to group in clusters such as industrial parks, smaller or larger cities etc.

The data source which provides basic understanding of the economy based on industrial clusters is the *new economic geography*. The study of this borderline area, found between economics and geography, between micro and macroeconomics, allows us to answer the question of why business and individuals locate in a place rather than in another.

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