

Geography and the Built Environment

Spatial Trends in Urban Growth Induced by a Core-Periphery Model

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Introduction

Natural advantages determine in a first instance where agglomerations emerge. These first order advantages create the conditions for long-term growth in particular locations. The emergence of new agglomerations/markets/cities is then a function of growth (in terms of economic activity or simply resident population) and of the initial hierarchies which emerged in initial development rounds.

Urban growth, although deeply related with population dynamics, depends on other variables such as land-use typologies and urban functions. Also, in a country characterized by a polarization of activity in a small group of cities, long-term growth in other locations, which constitute lower order urban nodes, is always dependent on distance in relation to the nearest higher order node.

This article intends to use a traditional core-periphery scenario to model urban growth as a function of peripherality. This latter variable is itself a function of time-distances and resident population. Hence, it may be decomposed in order to better understand observed patterns. The ultimate goal of this research is to understand general urban growth patterns in Continental Portugal, a territory characterized by strong polarization of activity towards two urban nodes, Lisbon and Oporto. It is also intended to understand differences between population growth and urban sprawl as this may help understanding different planning policies which were adopted in the country.

Agglomerations, Development and Urban Growth

Within an existing urban hierarchy, made up of urban nodes of different sizes and functions, centripetal and centrifugal forces determine how, why and how fast a city develops or declines. In this sense, development is associated normally with growth. In the case of Portugal, since the revenue of municipalities is normally associated with urban growth in terms of population and new construction, there is a long-term trend to incentive the expansion of new built-up areas. This paradigm results in the

fact that dynamics in what is considered urban areas do not necessarily follow population dynamics.

In the field of Regional Science, centripetal forces which encourage regional development, also referred as agglomeration economies, are understood as positive externalities which attract new rounds of investment into a region. This implies some sort of functional autonomy from higher-order urban nodes (ex. It excludes purely dormitory cities). These agglomeration economies may be divided in three groups: (i) internal returns to scale, (ii) Marshallian agglomeration economies and (iii) urbanization economies (McCann 2001).

The first type refers to mechanisms internal to a specific firm which result in the spatial concentration of certain stages of production (from R&D to retailing). Marshallian agglomeration economies in turn may be divided into three types: (iia.) specialized pool of labour, (iib.) dedicated service sector and (iic.) information spillovers. Urbanization economies refer to local characteristics in the built environment which are positive pooling factors related to the size of a given urban node.

Positive externalities may be understood as those factors which, other than urban planning policies, determine the evolution of a given urban hierarchy. Hence, it is reasonable to say that existing patterns in the spatial distribution of human activity are determined by planning policies, local economic conditions, exogenous conditions (ie. Macroeconomic factors) and complexity related variables which explain dynamics of any living entity (and a city or a group of cities may be understood as such).

The development of urban nodes of distinct sizes implies the existence of core-periphery relations. This has long been explained by central-place theories which, according to distinct functions, predict the existence of different layers whose density is defined simply by efficiency principles.

Peripherality is not necessarily related to Geography. The term peripherality is related to marginality, in the sense that an agent is marginal or peripheral if it is located away from the centre or simply if it is not related in some sense to a particular interest group. Even when one considers spatial peripherality, there are authors who defend that location should be ignored in the explanation of development levels (see for example Copus 2001).

It is defended in this article the idea that, even if geographical location is not the only variable which determines urban growth, it is central to the whole process of reorganization of urban hierarchies.

Methodology

In order to partially explain urban growth as a function of geographical location in relation to the main urban nodes, it is important to clearly define how distance is measured and how it is synthesized within a unique index which takes into account existing agglomerations/cities. The peripherality index to be used results from the computation of time-distances from any location of the study area (Continental Portugal) to either one of the two main cities (Lisbon and Oporto) or to the coast.

In Continental Portugal, the Atlantic coast served as a first order advantage which conditioned further rounds of investment. Hence, it is relevant to access the importance of the coast vis-a-vis proximity to Lisbon and Oporto.

Other than Geography, the existing spatial distribution of resident population is taken into account in building the peripherality index. This is done in order to identify lower order cities whose development depend on the growth rate of the whole system (measured for example the long-run population growth for Continental Portugal).

Following the methodology used in Rodrigues (2010), distance was calculated using raster methodologies within a Geographical Information System (GIS). Raster models are used, taking into account road-network typologies and the first order hydrographic network. This latter is used as additional barriers to simulate the effect of terrain differences from north to south.

Land-use dynamics will be analyzed through the use of CORINE land-cover information. Given the resolution of the information available, the analysis is based on data aggregated for each of the 28 NUTS3 regions of Continental Portugal.

Other idiosyncrasies which form the set of externalities which influence the shape of the urban hierarchy are treated as exogenous to the model. In a later stage, externalities are quantified (in particular Marshallian economies of scale and urbanization economies) in order to test their influence on urban growth in particular regions.

The model and preliminary results

In order to test the relation between time-distances to Lisbon or Oporto and to the coastline, empirical density functions are first computed and quantiles for the standardized distributions compared. Exploratory Spatial Data Analysis (ESDA) is used in order to identify significant spatial patterns within and between variables.

Accessibility maps allowed the computation of time-distances to the selected targets. Figure 1 shows one of the maps computed, and represents, with a 50 meter resolution, distances from every urban census tract to the nearest dominant urban node.

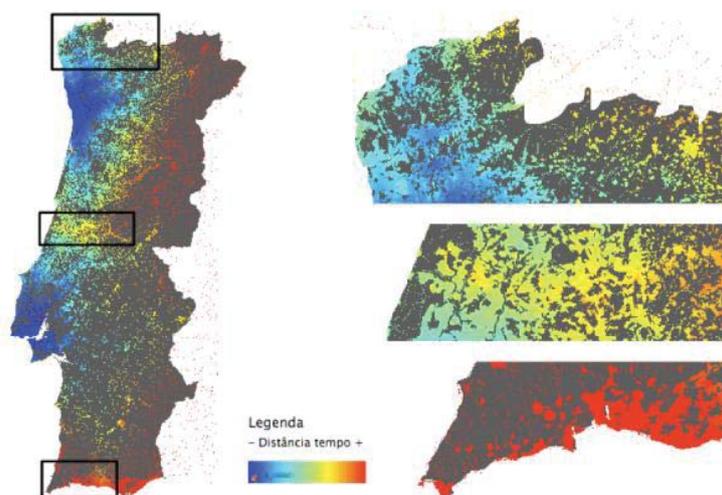


Figure 1: Accessibility map (time-distances to Lisbon or Oporto)

Following an analysis of the distribution of resident population, it is concluded that distances to Lisbon and Oporto are more relevant in explaining urban and population growth patterns than distances to the coastline. This results confirms those obtained in Freire et. al. (2009) and clearly show how first-order advantages conditioned initial concentrations to be located near the Atlantic Ocean. Scale economies then determined the growth only two large urban nodes. Later, further growth occurred as a function of distance to Lisbon and Oporto, originating the densely populated corridor between the two nodes.

After this analysis, urban growth patterns are used in order to access differences between population and land-use dynamics.