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Gravity vs radiation model: two approaches on commuting in Greece

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Abstract

Commuting –defined as the daily travelling for employment purposes– has gradually intensified in the last decades. At the heart of today's working life, the multivariate commuting is of great importance for every sustainable policy. Thus, the objective of this paper is to examine, using the latest available census data, commuting flows in Greece at relatively fine unit scales (Local Administrative Unit - LAU1). For this purpose, the gravity model is used, as is the radiation model, which recently was introduced in the approach of transportation fluxes. Both the methodology and the results are compared. Consequently, this paper aims not only to approach the commuting patterns in Greece, but also to conclude whether the radiation model is a good alternative to the use of gravity models in spatial interaction analysis.

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1. Introduction

Human mobility is quite the center of attention in recent years. Commuting constitutes a basic part of it. Commuting is defined as the daily travelling for work. However, it is researched only the part of commuting beyond the territorial unit of residence, mainly because of the data availability (Drobne et al., 2012; Polyzos, 2015; Stefanouli & Polyzos, 2015a; Stefanouli & Polyzos, 2015b; Tsiotas & Polyzos, 2013; Van der Laan & Schalke, 2001).

Commuting constitutes a multidimensional phenomenon, whose characteristics vary depending on time and region. Since many factors, such as economy, technology, culture etc., influence essentially the nature of work, commuting evolves continuously. The last decades, the number of commuters, as well as the average commuting distance travelled have been increased in most countries, and also in Greece (Gargiulo et al., 2012; Polyzos, 2015; Polyzos et al., 2014; Stefanouli & Polyzos, 2015b).

The commuting flows between municipalities depend greatly on the relative competitiveness and complementarity of them and on the regional concentration of an asset as well. Besides this, commuting flows usually presuppose spatial interactions and also differences between the municipalities, either a different total level of development or significant different macroeconomic indicators, such as unemployment, wages, etc. The deconstruction of commuting flows remains an ongoing challenge, because of the general complex nature of human mobility. The aforementioned challenge is even bigger in Greece, due to the recent lack of data.

As far as commuting is concerned, a variety of models has been developed with the aim of modelling and analyzing commuting flows. Throughout the commuting research, the class of gravity models has always been one of the most popular classes of models. In these models the "gravitational force" (the flow of commuters) between two units depends on the distance between them, as well as on the "mass" (population) of the units (Drobne et al., 2012; Horak et al., 2014; McArthur et al., 2011; Ren et al., 2014).

On the other hand, recently more and more new models are being detected in commuting research, many of which are proposed as an improvement of the gravity models. One of them is the radiation model, which conceptually could derive from the gravity model, but it uses probabilistic arguments. It came up aiming to overcome the problems and inadequacies of the gravity model. The application of both models in Greece and their comparison constitute the subject of the present paper.

The next section presents some basic information regarding commuting behavior in Greece. Section 3 describes the methodological framework used in the analysis, highlighting the differences between the two models, as well as the available data. In Section 4 the empirical analyses are conducted and the results are illustrated. Section 5 summarizes the analysis and provides suggestions for further research.

2. A Greece-wide view of commuting

The last years in Greece the population growth in cities and the construction of new, long highways, combined with the lack of urban policy analysis and management resulted in the expansion of cities and usually following the transport networks, altering by this way the spatial interactions and relations. Thus, also in Greece the traditional up to now dipoles city center – city region have been altered due to urban sprawl and daily journeys. On that ground, the modern approach subdivides a country according to regional functions, constructing the Functional Urban Areas, despite the fact that in Greece there is not a formal definition of such areas yet (Polyzos, 2015; Stefanouli & Polyzos, 2015a).

Undoubtedly two of the main land uses of a region are the commercial/office use and the residential use. These result in daily commuting. In parallel with the above, in Greece, especially the last years, people usually do not work in the municipality where they live, but they travel every day long distance to reach their work. This has affected essentially the spatial interactions among the municipalities and the playing role of each one of the municipalities in its region. In many cases the old dipoles (city center – city region) do not exist anymore or have been expanded significantly.

The following maps in Figure 1 show clearly the differentiation of commuting intensity among the Greek municipalities and different functions of space can be revealed as well. Regarding out-commuting intensity, it is low in most of the islands and in the municipalities of Tripoli, Mani, Grevena, Komotini and others. It is interesting to note that in Grevena and in Komotini the primary sector of the economy is highly developed. Areas such as these with low commuting intensity in general are considered to be quite autonomous, since most jobs are held by their residents. On the other hand, as expected, high out-commuting intensity is observed in municipalities close to urban centers. This intensity can be connected to the lack of working "hubs" able to attract workers more strongly than the urban centers. The urban centers seem to behave in this case as nodal regions (Kraft & Blazek, 2012). Therefore, the inequality of commuting intensity among the municipalities is obvious, as well as the polarization of employment in the main urban centers. Hence, the issue of jobs available in small and medium sized towns becomes increasingly important.

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