Visualization of data relating to the spatial dimension of access to higher education in Greece for the year 2015

Abstract

In this paper, we aim to present the spatial dimension of access to Higher Education in Greece for the year 2015. In particular, we reflect the flows of students from their area of residence to higher education institutions located in the Attica region. The data concerning the introduction of secondary school graduates in higher education is from the Directorate of Examinations and Certifications of the Ministry of Education and Religious Affairs and are the results of Pan-Hellenic examinations for the year 2015. The research study area concerns the whole country at a regional level. The existence of the phenomenon of internal student migration in Greece shows the necessity of the study of the phenomenon. In addition to simple forms of data visualization (such as the histogram), maps are tools for presenting both the distribution of data and the analysis of a demographic phenomenon with spatial variations such as student mobility. Also, the use of maps is a convenient way of detecting spatial patterns. 

Key words: student migration, flow map, spatial autocorrelation

Introduction

Over the last decades, the demand for higher education increased in Europe. The contribution of higher education to both individual wellbeing and aggregate economic growth has long been discussed from different positions (Faggian, McCann, & Sheppard, 2007); (Canton & Blom, 2004). Several factors have been pointed out to explain this growing necessity, such as demographic or socioeconomic determinants. The growing importance of knowledge in the production process, emphasizes the role of higher education as an engine for economic growth. Furthermore, the decision process of potential students has an obvious spatial dimension. 

The flow of people is a complex and dynamic phenomenon, especially when is related to young people like students. The analysis and mapping of geographic mobility data is of great importance to advance our understanding of student mobility. Student mobility analysis refers to movement of students from their home location to the university’s one and is a joint function of the characteristics of both the place of origin and potential destination places and
the distance between them. These characteristics are often called push-and-pull factors, or drivers of and barriers to mobility (Wei, 2013).

Social, and economic conditions are frequently cited as factors pushing students to leave their home (González, Mesanza, & Mariel, 2011) as well as higher education characteristics (Barrioluengo & Flisi, 2017) in determining students’ mobility. Economic factors are related to region attractiveness (Barrioluengo & Flisi, 2017), while the quality of a university in relation to teaching and research, forms university attractiveness based on the quality of an institution (Dotzel, 2016). The gravity model of student migration, allows us to consider distance and as one of the factors that influence students’ decision (Alm & Winters, 2009).

Another challenging research problem to visualize these mobility data and understand its embedded patterns. Flow map is widely used to visualize spatial interaction data and display the movements of humans from one source to destinations.

In this paper is examined some of the theoretical and empirical issues surrounding geographical mobility amongst higher education (HE) students. This research focused on migration flows that imply a movement from all counties of Greece to the universities. The study has considered a range of important factors relating to the socioeconomic background of students as well as the role that university quality holds in the migration choice of high school graduates. The impact of distance has also been considered.

**Higher Education in Greece**

Higher education in Greece forms the last level of education system and consists of the following types of institutions:

**University sector**
- Research Universities
- Technical Universities
- School of Fine Arts
- Open University

**Technological Sector**
- Technological Education Institutions (TEI)
- School of Pedagogical and Technological Education (ASPETE)

Only students who have attended lyceums (i.e. those who have received 12 years of formal education) are allowed to continue their studies in tertiary education after successful participation in the general nationwide examinations- Panhellenic exams (Greek Parliament 1983, 1985). This is considered to be a hard, highly competitive but also fair exam process that students go through in order to ensure education at a higher level.

Candidates should select one of the major fields of study (Humanities, Science, Technology), each of which has a specified set of higher education institutions. A student’s preference for the institutions of the selected field of study is declared on the higher education application form. The selection and acceptance of students to higher education is determined by combining the candidate’s score in the entrance exam with the higher education institutions’ preferences and number of places available in each institution. The candidate’s score is the greatest consideration, and places available, the least. Under such a system, it is difficult for any candidate not to meet the entrance requirement.
Data

In this case study we analyze and map the internal student mobility data set covering the year 2015. In this research, we focus on the mobility within the 51 counties and 261 faculties of the universities and about 8,000 origin-destination flows. To apply our approach, each county area is converted to point (the area centroid), which retains all the attributes of the county such as population. Indicators such as income level, employment rate and higher education rate could provide additional knowledge to explain the student migration from a region to the university’s region.

Our study area is all the regional units and the faculties of every university in Greece.

Our unit of analysis is a combination (i,j) consisting of a administrative region (i) and the faculty of a university (j).

\( i(x_i, y_i) \quad \rightarrow \quad j(x_j, y_j) \)

The main dependent variable is the annual number of students of secondary education in Greece enrolled in higher education institutions–universities coming from a specific Greek administrative region over the year 2015 (our year of interest).

The data were provided to us by the Ministry of Education and Religious Affairs. The number of students that took part in the exams was about 105,000.

The explanatory variables that are used in our study are grouped in origin variables and destinations ones.
Origin variables:
  a. The population dataset held by the Hellenic Statistical Authority (EL.STAT.) of Greece. We calculated the population density for all the regional unities.
  b. The income variable refers to the Per capita gross domestic product.
  c. The rate of Higher Education in every unit of our analysis.
  d. The rate of unemployment
  e. The rate of holders of a house.

Destination variables:
  a. The total number of the university students’
  b. a measure of the university quality as reflected in the World University Rankings (WUR) (QS 2015)
  c. the number of academics coming from the universities.
  d. The percentage of the base regarding to the average base

The distance is the key variable. It is calculated between the centroids of the regional unit and the position of the department of the university, using Geographic Information Systems (GIS) via ArcMap, and is measured in kilometers.

**Methodology**

People, commodities and information constantly move in the geographic space and create location-to-location networks (graphs) that are often referred to as spatial interactions. Spatial interaction models describe and predict spatial flows of people, capital and information. There are many models concerning the determinants of migration such as standard gravity models that based on Newton’s gravity law. There have been many attempts to visualize spatial interactions (flows) for various purposes (Wood, Dykes, & Slingsby, 2010). Spatial interaction data is often characterized by having many variables. Each migration flow at the county level contains the origin county, destination point, the number of students, and other flow variables such as income levels, population, unemployment rate, etc.

Flow maps are commonly used to facilitate the understanding of flow patterns and the spatial context in a spatial interaction network (Koylu, 2014). Flow maps visualize movement and not only demonstrate which places have been affected by movement but also the type, direction, and volume of movement (Guo & Zhu, 2014). Flow map reading is a challenging task as it involves visual judgment of node (location or area), link (flow) and network characteristics (Ware, 2012). Visual exploration of spatial-temporal data has been the subject of many research papers and provides several motivating approaches to this area (Andrienko et al., 2010). The spatial context of flow map is important for the exploration of patterns of student mobility.

**Results**

The ultimate aim of this analysis is to gain a better understanding of student migration and figure 2 shows the observed flows. It is observed that the density of flows is too intensive in figure(a) and is becoming less heavy to figure(d). It could be explained by the fact that a large number of flows relates to a small number of students that move from counties to universities.
In contrast, the large number of students (>23) that go about from their home to their faculty is encountered in a small number of counties and is mostly referred to the three Universities that are located in Athens, Thessaloniki and Patra.

As it is expected, by focusing to figure 3, the counties that sustain the largest number of their students are the ones where the biggest universities are located (University of Athens-UOA, Aristotle University of Thessaloniki-AUTH, University of Patras).
Spatial autocorrelation

Global Moran’s I has become a popular method to measure spatial autocorrelation, which is a form of spatial dependence. In this paper, this method is employed to explore the existence of spatial auto-correlation. Considering the unique spatial autocorrelation in flow data, spatial weight is defined by using contiguity at origin sites.

Figure 3. Map of locality of students in their home county

Figure 4. LISA Cluster map of flows to UOA(A), AUTH(B) and UOP(C)
It is concluded, that there is positive spatial autocorrelation of flows to UOA (figure 4(A)). Moran’s I is 0.642 where is significant indicated that counties in Peloponnese have similar high flows to UOA. In the same map, is obviously inferred that counties in Macedonia have similar low flows to UOA. In figure 4(B) the phenomenon is reversed. Moran’s I is 0.650 and as it emerges there is also there is positive spatial autocorrelation of flows to AUTH. Counties in Peloponnese have similar low flows to AUTH, while counties in Macedonia have similar high flows there. Moran’s I is 0.372 for flows to UOP and is remarkably underlined that Peloponnese doesn’t consist local cluster pattern (except from county of Lakonia). Finally, Macedonia has similar low flows to UOP.

Discussion

Higher education systems typically reflect student preferences. The interpretation of student migration is central to design efficient policies aimed at allocating student flows. The main findings of this study are the following ones. The factors that play significant role in students’ flow are those who are related with the university (destination) and distance. It is important to note that factors should be implemented in order to calibrate the appropriate model. Finally, we hope that our findings will provide a useful starting point for further research into the internal migration patterns of students who migrate from home to university.
REFERENCES


