STUDENT MOBILITY IN HIGHER EDUCATION: A DESTINATION-SPECIFIC LOCAL ANALYSIS

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ABSTRACT: Student mobility flows are usually analyzed through gravity models. However, researchers devote less attention to the potential spatial heterogeneity in the estimated parameters: indeed local analysis is a crucial task within the Italian territory, where, as a consequence of the decentralization process, there are universities with national or local vocation. Then, in the empirical analysis of our work, we estimate the parameters for each university to identify their catchment area: the results show different interaction behaviors among Italian universities.

KEYWORDS: gravity models, student mobility, higher education, Poisson regression.

1 Introduction

Mobility of students across a country in higher education has gained increasing attention in the last years, due to the socio-economic impact of such a migration. Flows between an origin and a destination are usually analyzed through gravity models, which rely on Newton's law of universal gravitation: the interactions among two areas are proportional to the product of their "masses" (attraction effect) and inversely proportional to their distance (deterrence effect). Generally, the employed gravity models in literature, in order to explain the flows between the area of origin and the university of destination, assume the same relationship for each origin and each destination (see e,g., Sa *et al.*, 2004, for the Dutch universities, and Bacci & Bertaccini, 2021, for the Italian ones), then they do not consider possibly different interaction dynamics.

In the present contribution, we consider a destination-specific gravity model to obtain disaggregated information for each university (Haynes & Fotheringham, 1984): allowing model parameters to vary across the space is a crucial task in heterogeneous countries like the Italian one, where many students coming from the South decide to study in the universities located in the North. Furthermore, we allow the distance parameter, reflecting the deterrence effect, to vary among three thresholds: less than 250 kilometers, between 250 and

500 kilometers, and more than 500 kilometers. The idea is that if we have an increasing value of the parameter as we move from the lowest classes to the highest ones, the university has a national vocation rather than local. Furthermore, identifying the catchment area is of interest for university administrators for their marketing strategies. More in detail, in this work we focus on students enrolled in Science & Technologies (S&T) courses: they are of particular interest for the policy makers, because they are directly related to the technological development of the area where the university is located (Dotti *et al.*, 2014).

The data employed for this work comes from the Italian National Student Registry (in Italian, Anagrafe Nazionale Studenti - ANS), the Italian administrative database that records the students, by their province of residence, enrolled in any degree program in a certain university located in Italy.

The work is structured as follows: Section 2 describes the model we employ for the empirical analysis, Section 3 analyzes the data and comments the estimation results, and Section 4 offers some concluding remarks.

2 Theoretical Model

In order to analyze student mobility in higher education we rely on gravity models, a useful tool to describe people flows over a geographic area. By assuming the flow T_{ij}, denoting the number of students moving from the province of residence i ($i = 1,\ldots,I$) to the university of destination j ($j = 1,\ldots,J$), as an outcome of a Poisson process, its conditional mean λ_{ij} can be expressed as follows (see, e.g., Flowerdew & Aitkin, 1982):

$$\lambda_{ij} = exp\left(k + \sum_{p=1}^{P} \alpha_p \log x_{ip} + \sum_{q=1}^{Q} \beta_q \log z_{jq} + \gamma \log d_{ij}\right) \quad (1)$$

where x_{ip} and z_{jq} are the explanatory variables measuring origin propulsiveness and destination attractiveness, respectively, d_{ij} is the road distance, expressed in kilometers, between each origin and destination (that we expect has a negative influence on the student flows), k is a constant of proportionality, while α_p, β_q and γ are the other parameters to be estimated. In the model specified above, we assume the same relationship for each origin and each destination. Then, we can obtain disaggregated information if we estimate the model for each university (see Haynes & Fotheringham, 1984), thus obtaining destination-specific parameters.

As opposed to log-normal models, the Poisson regression allows us to deal with the problem of zero-valued flows, while this is not the case when we have to use the log-transformation of the dependent variable. Then, we estimate the parameters through the Poisson-Quasi-Maximum-Likelihood estimation (QMLE) technique, in order to obtain consistent estimates of the parameters even if the assumed distribution is no more valid, except the correct specification of the conditional mean, as it could be the case when dealing with a large amount of zero-valued flows.

3 Empirical Analysis

The data of this work come from the ANS, the Italian administrative database that records students' enrollment in Italian universities, by their province of residence. The analysis focuses on students enrolled in a bachelor or five-years degree program for the academic year 2011-2012. More specifically, we consider a subset of students, those attending S&T courses (ISCED 5, 6 and 7) due to their relevance for local technological development. As proxy for the origin propulsiveness, we use the total number of students resident in province i (O Mass), while for the distance, we allow its parameter to vary according to its belonging to one of the categories defined by the following thresholds: less than 250 kilometers, between 250 and 500 kilometers, and more than 500 kilometers. Table 1 reports the summary results of the estimated destination-specific gravity model: as we can see, there is a lot of variation in the value of the coefficients among the universities, thus supporting the hypothesis of spatial heterogeneity. For lake of space, we do not report the estimates for each destination, but we find that the universities offering very specialized degree programs (e.g., Polytechnic universities of Milan and Turin) show an increasing value of the deterrence effect (national vocation) as opposed to universities with a decreasing level (local vocation), this is the case for most of the universities of the South (Bacci & Bertaccini, 2021).

4 Conclusion

This work analyzes S&T student mobility flows in Italian higher education through a Poisson gravity model. More specifically, we allow the parameters to vary across institutions to detect some heterogeneity in the interaction behaviors. Empirical analysis supports our hypothesis thus allowing us to discriminate among universities with national vocation as opposed to universities with local vocation: this is of relevant interest for university administrators in implementing their orientation strategies aimed at high school students. As

Table 1. *Summary results of the estimated Poisson destination-specific gravity models for student mobility in higher education.*

	Coefficients					
	Min	Mean	Max	1Q	2Q	3Q
Constant	-6.604	3.476	12.591	0.831	3.395	5.749
d < 250	-2.156	-0.688	-0.261	-0.788	-0.656	-0.536
250<d<500	-4.479	-1.394	-0.568	-1.293	-1.123	-0.961
d>500	-3.954	-1.395	-0.417	-1.402	-1.04	-0.789
O Mass	-0.863	0.347	1.833	0.071	0.324	0.635
Pseudo-R^2	0.843	0.505	0.981	0.795	0.864	0.933

future research, it could be interesting to obtain deeper information by allowing the parameters to vary according to the origin through the Geographically Weighting Regression (GWR) technique (Fotheringham *et al.*, 1998).

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