STUDENT FLOWS TOWARDS UAIC –A CASE STUDY ON THE FACULTY OF GEOGRAPHY AND GEOLOGY IN 2011

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Abstract. Using a sample of more than 500 candidates to the Faculty of Geography and Geology, we have elaborated three models of spatial interaction that statistically explain how functions the polarization area of this faculty in 2011. Taking into account the fact that the admission competiton is based on the candidates' results at the baccalaureate exam and their assiduity, mapping these results, in an aggregated form, helps understanding the qualitative dimension of the selction process. From a spatial point of view, we don't assist to a relevant correlation between these two components, making it hard to decide if some regional cities are more advanced in the local educational performance than others. One major concern derives from the shape of the polarization area of this faculty, reduced to its regional network of cities, almost completely ignoring the rural spaces and submitted to a high concurrence by other academic poles. In this context, the actual discussions concerning the role and the hierarchy of the universities should also pass by the analysis of the spatial interactions between some privileged cities, like Iasi, and their recruitement areas.

***Keywords**: spatial interaction, local educational performance, territorial auto-correlation*

1. Introduction

The flows represent maybe the most interesting dimension of the spatial interactions between places. Theoretically, these spatial interactions are driven by factors such as the local attractiveness for specific services, by distance or by interposed opportunities which shape the orientation and the volume of persons' flows. During the nomotehetic paradigm in the evolution of geography as a science, different models and formalizations were proposed, especially in a specific quantitative approach of the subject. Three major directions of analysis were developed: the gravity model, the multiple regression estimations and the entropy based models. Empirical observations and the common sense suggest that the flows are directly dependent on the demographic masses of places (cities, regions, countries) and suffer a *distance decay* reduction when we take into account their territorial distribution. Related to the transportation costs, to the accessibility and to the connectivity of the geographical objects, the distance decay parameters synthesize the way in which the society manages the space at different scales. A low friction of space is specific to territories endowed with performing transportation networks, with a genuine culture of mobility

and with a solid governance of the system of flows, taking profit from these facilities under the form of strong increasing returns. A high degree of spatial friction is rather visible in regions with reduced capacity to manage the transportation system and the benefits that might occur from the proper connectivity of cities and places.

The nature of flows is also an important point of discussion. The commercial relations need a special analytical approach (delimitation of the "iceberg cost of transportation", estimation of the barrier effects, multi-modal shifting etc.), while the commuters will be analyzed using the number of daily connections in the network, the time limits of commuters mobility or the public implication in the transportation sector). Our subject of study – the mobility of potential students towards a regional based university, involves a combination of different methodologies in order to better seize the geographical processes in action. The data used in this paper was collected using the candidates' application forms registered in July 2011 at the Faculty of Geography and Geology and only the relevant information was maintained (high-school of origin and scholar results), respecting thus the ethical policy during the analysis of individual data collection. The data and the results are highly questionable if one would take into account the special context in which the admission session took place in 2011 – a prolonged economic crisis and the bachelor reform, the last inflicting severe losses of candidates to universities. More, the internal competition between faculties and departments also has a role in the declination of candidate flows, especially in the field of social sciences. The inter-posed occasions induced by this competition reflect the general situation in the undergraduate system of education, with its incomplete specializations during the high school period.

2. Data collection and the explanation of candidates' flows

During the admission period of July 2011, more that 500 application-forms were submitted for the Faculty of Geography and Geology[1]. All this applications were organized in a geographical table that includes several variables and indicators: the city of origin for the candidate's high school, the results at the baccalaureate exam, the average results during the years of high school study and the results of the admission competition. Sub-totalizing this information was the second step in the data treatment. Consequently, we obtained information for 56 cities and communes. As we work with geographical objects, rather than individuals, we were interested in weighting these results by the total number of candidates. We used a simple method for this transformation - the sum of notes for each exam was divided by the maximum number of points obtainable in a spatial unit. For example, a city that sent 10 candidates to the Faculty of Geography can obtain 10*10 hypothetical points, at the baccalaureate exam. In reality, the sum of the candidates result at this exam was 80. Eventually, a simple division will provide us the local performance score for the baccalaureate exam – 0,8. The same method was applied for the other two indicators – the competition's results and the average results during the high school. Curiously, the degree of correlation between the indicators is rather reduced. There is almost no

[1] Only candidates for the Department of Geography were retained in this study.

statistical significant relation between the results obtained during high school and the results at the baccalaureate exam, when we take into account the scores of the local performance (Pearson's coefficient of correlation = 0.294). However, at individual level the coefficient seems to be relevant (0.53), indicating a possible relation between the two variables.

The spatial distribution of the candidates presents no surprise (excepting the situation of Suceava); it is dictated by the demographic mass and by the distance to Iasi. It is also influenced by the attractiveness of other cities that present academic and research functions – Bucharest, Cluj-Napoca and Brasov. If we compare the results at different exams that count in the admission competition, we will observe that few cities provide the Faculty of Geography and Geology with very performing students, situation also confirmed by the baccalaureate local score. The "exotic" candidates (far away from the regular area of polarization of the faculty) have very good results in the competition process but they are in a reduce number to count in our statistical model – Galati, Braila, Bihor, Salaj or Covasna. At the opposite pole, small cities or rural boroughs such as Podu Turcului, Podu Iloaiei, Dolhasca and others send candidates with modest or low results in both components of the competition (baccalaureate and high school assiduity). Obviously, this description is valid only for this session of the competition and only in the context of our candidates' sample.

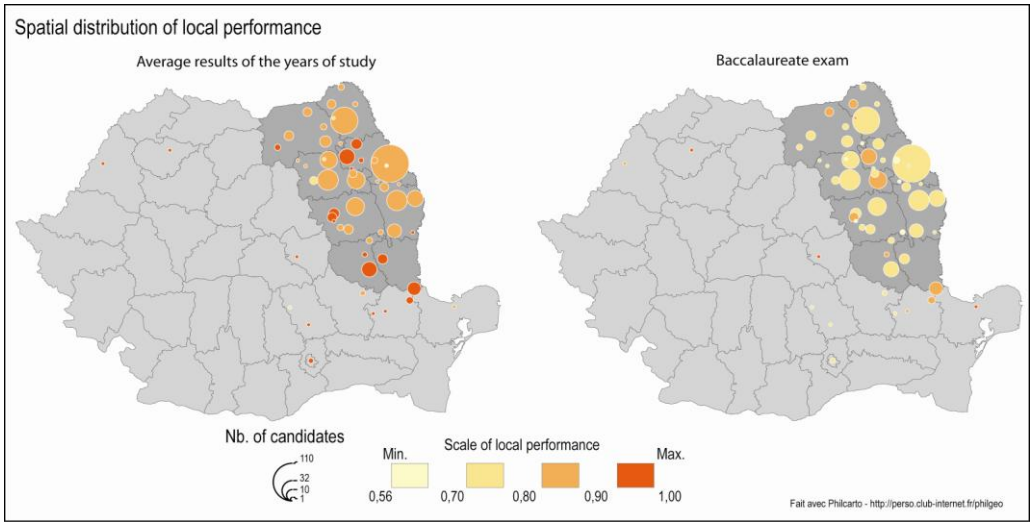

Figure 1. The spatial distribution of the local educational performance

How can we explain this distribution of candidates and scholar results? Is the spatial frame responsible for the mediocrity of the local performance and for the declination of the students' flows? The low number of spatial objects in our geographical table (only 56 cities and communes that present relevant data) forbids us to apply for sophisticated models that need severe validation. In this situation, we will organize our explanation using simple models of spatial interaction, based on demographic mass and distance. In the same time, the explanation of the results will

test two hypotheses: the local performance is spatially and territorially auto-correlated. The distance variable was deduced using the X,Y coordinates of the local administrative units, in the absence of a geo-reference system.

The first method that we propose puts into relation the number of candidates, the number of employees of the origin's spatial units and the distance between Iasi and these spatial units. We prefer the number of employees instead of the total population for a simple reason: the future students need a financial assistance during their cycle of study. Consequently, it would be logical to think that this financial grant is assured by the active employed population in the city of origin.

Table 1. List of indicators and variables describing the candidates' spatial behavior

List of indicators	**Description**
Nb.	Number of candidates by origin. Collected using the candidates' application form.
Sal2006	Number of employees in 2006. The data was collected from the BorgDesign firms' database.
IntSal2006	The flows intensity. It represents the result of the division between the number of candidates and the number of employees. ***IntSal2006 = Nb./Sal2006***
DistIasi	Euclidean distance between Iasi and the city/commune of origin (high school).
rapANI	The local performance of the years of study.
rapBAC	The local performance of the baccalaureate exam.
rapCONC	The local performance of the admission competition at the Faculty of Geography and Geology.

Building a variable called the *flows intensity* allows us to put into relation the candidates' mobility with the distance to Iasi, using a regression model. The results of the equation synthetically explain the role of the distance in the organization of flows. After preliminary tests, we have excluded from the analysis three spatial units: Iasi, Bucharest and Miroslava. The distortions that these three spatial units introduce have a strong influence on the prediction of the theoretical flows and on the determination coefficient.

The first method can be mathematically written as **IntSal2006**=5.215***DistIasi**$^{-1.84}$ with an average coefficient of determination $\mathbf{R^2 = 0.44}$. The slope of the equation reflects the distance decay of the candidates' flows, its value being lower than the usual reference (-2) but still very strong. The second method introduces the logarithmic values for the intensity of flows. The new equation has the next form **Log(IntSal2006)**=-0.008***DistIasi**-1.963, with a higher coefficient of determination $\mathbf{R^2 = 0.521}$. This second method presents interest because we can deduce a different pattern in the organization of the residuals and in the distribution of the predicted flows. However, the distance decay parameter is harder to interpret, in this linear context.

for the number of candidates, the number of employees in 2006 and the distance to Iasi. The mathematical formalization of flows by the multiple regression method propose a higher $\mathbf{R^2}$ **(0.591),** suggesting that almost 60% of the flows could be

explained by Euclidean distance and the economic characteristics of the spatial units : **Log (Nb.) = 2.189 – 1.173*Log(DistIasi) + 0.480*Log(Sal2006).**

The three equations are useful if we need to estimate the theoretical flows towards Iasi and if we attempt to compare the predicted flows with the observed ones, in order to investigate what cities or rural communes send flows of candidates under their potential. Not depending on the method that was used to predict the flows, several cities regularly appear in the category of under-predicted: Suceava, Galati, Bacau, Braila, Roman and Targu Frumos. In the same time, cities like Botosani, Focsani, Targu Neamt, Tecuci or Husi send more candidates than normally predicted by the models. An interesting case we have in Vaslui. This time, depending on the method we used, Vaslui acts like a negative residual (lower flows than predicted) for the first model, like a *well-fitted* value for the second model or like a positive residual (more candidates than predicted), in the case of the multiple regression.

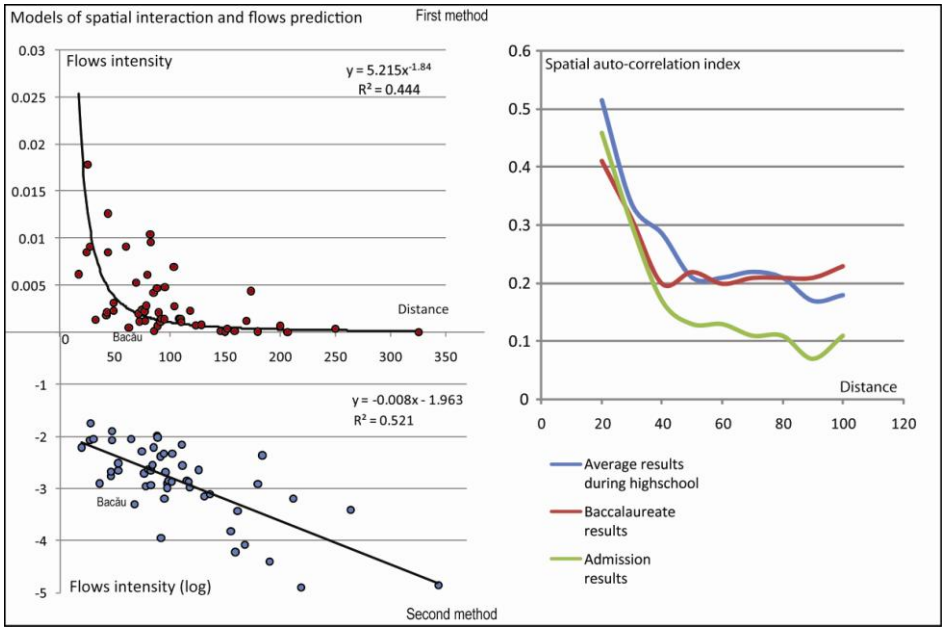

Figure 2. Graphic illustration of the spatial interaction models and the spatial auto-correlation of results

A third method was tested, based on a multiple regression with logarithmic values

It is obvious that every model we built emphasize one component of the explanation, either the distance, either the mass of employees. It would be an illusion to think that individual options could be perfectly deduced using quantitative models. Instead, we can predict aggregate behaviors, if statistical explanation and prediction are equivalent terms. In many cases, this aggregate or mass behavior can be describe as a stable state in the structure of flows, a form of equilibrium induced by basic spatial

actions (principle of less effort, principle of spatial competition and principle of hierarchy stability).

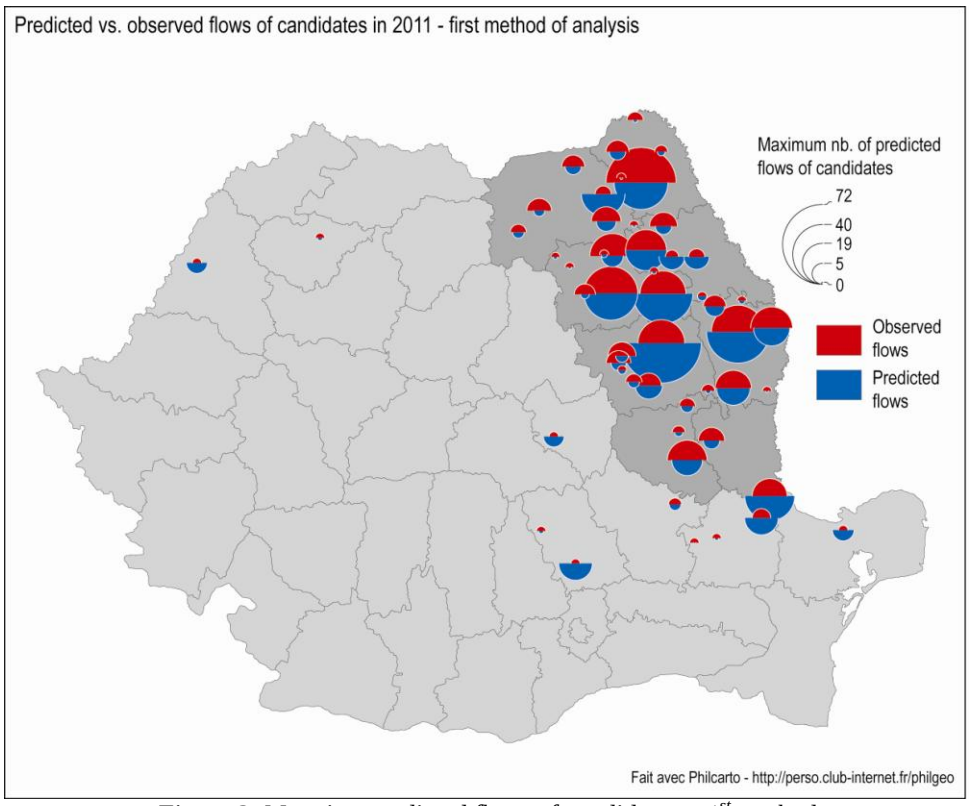

Figure 3. Mapping predicted flows of candidates – 1st method

If the aggregate behavior of the individuals statistically depends on the distance towards Iasi and on the number of employees, we can carefully extrapolate some of the conclusions of these models to other faculties in the UAIC. The distance decay parameter indicates how these flows of candidates are influenced by the spatial organization of the polarization area of the Faculty of Geography and Geology. Retroactively, we can also explain how flows behaved in time and how the distance parameters varied. Comparing the observed and the predicted flows might help decision makers to orientate their energy in order to better capitalize the image of one faculty or another, during the popularization campaigns. Taking into account that the data reflect the situation for 2011 (from many points of view, a special year for the education system), we can advance some new hypothesis related to this study. We can ask ourselves, for example, if the shape and the dimension of the polarization area aren't just accidentally or conjecturally sub-regional. Intuitively, we expected to observe on the map a better attraction of candidates from the South of Moldavia (Galati and Vrancea). Instead of that, what we observe is a massive concentration of sending potential in Botosani and Neamt. Is there a relation between the results in the

baccalaureate exam from 2011 and the distribution of flows? How universities and faculties should deal with these new realities? Where to find and recruit good future students?

3. Spatial contexts and local educational performance

There are many ways to deal with the spatial differences between regions or other geographical objects. Basically, the dissimilarities between a region i and a region j could be defined as the absolute difference of the statistical indicator that we investigate (revenue, nb. of employees, age ratio between young and old population etc.). In some cases, these results need to be weighted by a geographical context, such as the neighborhood relations, the territorial belonging to a hierarchical superior region or the position in a spatial top, in order to provide us some insights concerning the spatial development of a geographical processes (the spatial and territorial auto-correlation are specifically related to this kind of exercise).

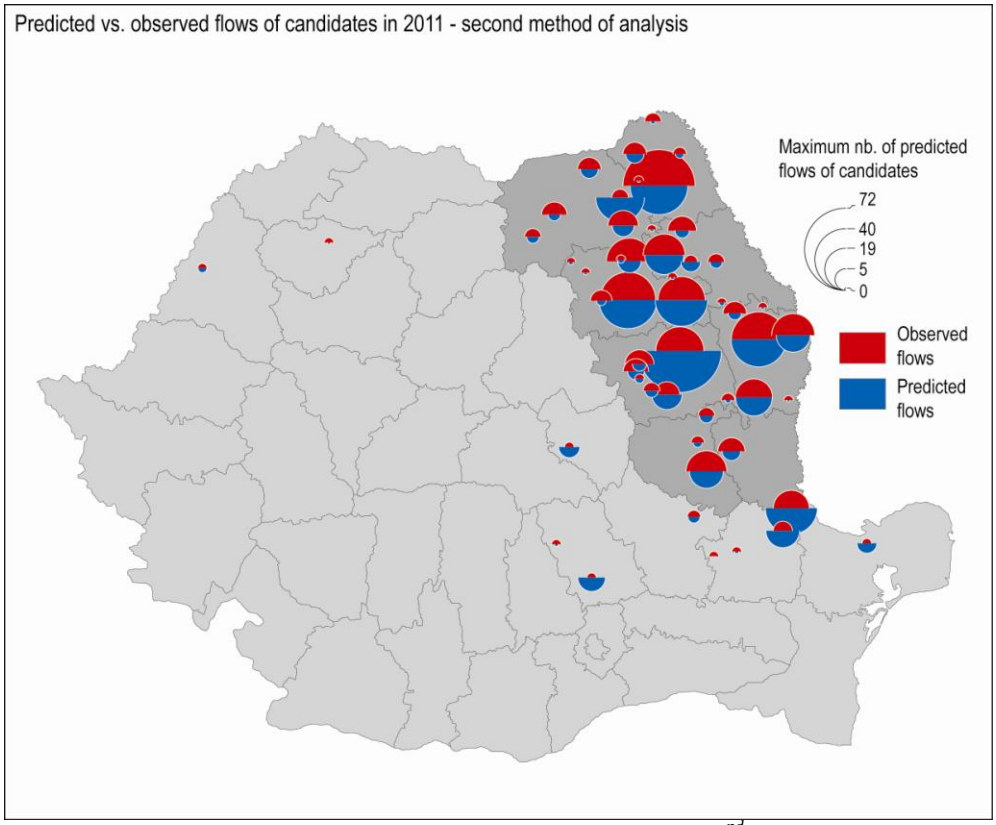

Figure 4. Mapping predicted flows of candidates - 2nd method

The first test that we propose is related to the territorial context. Is the administrative frame and the appurtenance to one county or another responsible for the distribution of

the educational local performance? In order to respond to this question, we weighted the dissimilarities concerning the baccalaureate results with a matrix of county belonging and we obtained the territorial auto-correlation coefficients. Theoretically, the values of the coefficient vary between -1 and 1. A value closed to 1 will suggest that the aggregated results highly depend on the administrative frame and that belonging to certain counties have an influence on these results. In our case study, we can say that 30 % of the dissimilarities between the spatial units for the baccalaureate performance could be explained by the county of origin. The assiduity of the candidates also depends on the administrative geometry, this time at a lower level (only 22% of the distribution being explained by this statistical mechanism). Consequently, the admission results are also influenced by the territorial belonging effect (21%).

Table 2. Territorial auto-correlation coefficients for educational local performance

	Baccalaureate exam	Assiduity (average results of the years of study)	Admission results
Territorial auto-correlation coefficient	0.3	0.22	0.21

The same method was applied in order to observe how the spatial neighborhood affects the distribution of the educational local performance. By spatial neighborhood we understand a spatial link defined by different contexts of distance. Thus, in a bandwidth of 27 km we observe the highest value of the spatial auto-correlation coefficient – 0.51, for the baccalaureate exam. This value suggests that neighbor cities or communes act similarly, compared to cities or rural poles situated at bigger distances. The proximity effect decreases with the contextualization of the neighborhood linkage, at 41 km of range being more reduced (0.33) and so on (Fig.2). The spatial – autocorrelation coefficient becomes almost a constant after a range of 70 km, so we can conclude that the size of the homogeneous regions, describing the local educational performance, is limited to approximately 70 km.

Conclusions

The major conclusions emerging from this analysis are related to the role of the regional urban systems of Moldova in the declination of flows. The maps show that the polarization area of the Faculty of Geography is not regional but relies on a network of cities, with concentrated flows and with a problematic absence of the rural spaces. In the same time, the quality of the education received during the high school period should be more scientifically questioned. The results of the territorial auto-correlation test, applied on 56 spatial units, indicate that the dissimilarities in the educational performance at local level consistently derive from the administrative county scale. If the assiduity results are related to administrative frame and political action, they can also be manipulated. This aspect is in opposition with the principles of all meritocratic system.

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