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ORIGINAL PAPER

Local labour market conditions and the spatial mobility of science and technology university students: evidence from Italy

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Abstract In the knowledge era, the importance of highly-qualified human capital has been widely recognized as a key factor for local economic development, especially for those areas specialized in science and technology (S&T). Assuming a regional perspective, the capacity to attract this kind of people is both a sign of territorial competitiveness and a way to further reinforce this by boosting the quality of the local labour market in a self-reinforcing process. In line with this perspective, universities play a fundamental role because they can attract students from elsewhere, and then provide local firms with qualified workers. On the other hand, this process is particularly detrimental for territories suffering 'brain drain'. This paper aims to show this process of selective migration in the case of Italian S&T university students. Specifically, we use a spatial gravity model to show that university students move from Southern towards Northern regions to study in S&T

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universities, and this mechanism is driven by the dynamism of local labour markets, and not just by the quality of universities. In our view, these results are supportive of the hypothesis that skill-biased migration occurs also very early in the lives of migrants, i.e., at the time they choose university.

Keywords Selective migration · University attractiveness · S&T jobs · Regional growth

JEL Codes R11 · R23 · O15 · I2

1 Introduction

Human capital and technological change are widely considered as the main (interconnected) drivers of modern regional development. In this respect, universities play a major role through three channels: (a) higher education is fundamental to training highly qualified workers; (b) through interactions with existing local firms and institutions, universities can enhance the innovative capability and hence the competitiveness of territories (Leydesdorff and Etkowitz 1998); (c) there is a cumulative nature in human capital attraction, further enriching the local labour market (Boschma and Iammarino 2007; Fratesi and Percoco 2014).

The role of universities and their students for regional development has been questioned on several dimensions, and in this paper we focus on the third channel mentioned above. If from a simplistic perspective, universities are important for regional development in terms of aggregate demand (i.e., in terms of consumption of their employees and students), from a more developed and important perspective, universities can be considered 'producers' of human capital (as well as potential partners for R&D activities, spinoffs etc). This element, however, holds true only in cases where graduates do not migrate further after completing their studies, i.e., only if the local labour market demands enough of the skilled labour of the local graduates.

This paper hence investigates a specific type of human capital migration, namely, that of university students.

It is a relatively common phenomenon for graduates to find a job in a different place from the one in which they graduate, which gives rise to graduate migration (see, for example, Faggian and McCann 2004, 2009). It is, however, also a common, although less studied, fact that young people often enrol in a university far from home and then stay in that place to find a job rather than returning to their regions of origin. Especially in the case of people from lagging regions, in fact, going back home after graduation is a difficult task unless they are willing to give up a higher salary in a job in which they can exploit their competences.

In this case, the university itself can act as a facilitator of brain drain, since for young people born in lagging regions it might be easier to relocate to richer regions when enrolling as university students rather than relocating after having graduated from a local university. In the latter case, in fact, they would miss the networks which are normally built in the university years, which are helpful for starting a successful career.

Certainly, this brain drain effect of universities is not their only or predominant one, but has to be considered when analysing the migration of qualified workers in general and when analysing the determinants of student mobility.

To test the empirical meaningfulness of this intuition, the paper presents an analysis of the Italian case, which has two advantages. First, there exist two datasets for this country which enable us to link job openings and student migration at the same time with an interesting breakdown at the level of the field of study. However, the most important reason why the Italian case is considered in this paper is that it is a case in which internal migration flows are particularly skill biased.

It is well known that the country experienced large flows of unskilled migrants from the South to the North during the post war "Italian Miracle" years (the 1950s and 1960s). However, starting from the early 1990s, migration flows restarted and became especially selective since a large proportion of Southern migrants now hold a bachelor's degree, with respect to only 7 % of the total Southern working population (Banca d'Italia 2005; Viesti 2005).

Svimez (2013) estimates that as many as 64 % of Southern Italian citizens who left their region to relocate to the North had a medium-high qualification (ISCED 4, 5, 6), and 25 % of these migrants were actually graduates. Due to the fact that young Italian people do not move their official place of residence before finding a job, it is not possible to know how many of these relocations are actually Southerners who already studied in the North, but the statistics show us that in the academic year 2007–08 as many as 20 % of Southerners were enrolled in centre-north universities, while only 1.4 % of students were resident in the centre-north and enrolled in southern universities.

In this paper we study the mobility behaviour of a specific group of students, namely, those enrolling in Science and Technology (S&T) courses. This class of students are in fact of particular interest since, once graduated, their work is strictly related to the innovation capacity of local systems and, hence, inter-regional mobility of S&T students can promote technological development if the local labour market absorbs a substantial proportion of graduates. Furthermore, if students chose the university by also looking at the local labour market conditions, then this mechanism can be seen as evidence of the relevance of universities for selective migration, and hence as a source of diverging trends in regional development. Ciriaci (2005) also documents that push factors are particularly strong for graduates in scientific fields, for whom the probability of obtaining a job outside of their region of origin is higher than for graduates in humanities.

By assembling a novel dataset on the inter-regional mobility of students in Italian NUTS3 regions and on job vacancies, we have found that students flows react to general market conditions, which is the expected income, as well to field-specific labour demand. In our view, this is evidence for selective migration flows since they chose the university also on the basis of the characteristics of the labour market of the province in which the university is located. This, in its turn, further reinforces the argument of the diverging effect of selective migration.

The rest of the paper is organized as follows: the next section will present the related theoretical and empirical literature. Sect. 3 will introduce the empirical analy-

sis, its methodology and its findings. Sect. 4 will conclude with the policy issues and recommendations arising from the results.

2 The spatial mobility of skilled people and university students: theory and empirics in the Italian case

The rise of the importance of knowledge is associated with an increased emphasis on human capital and, specifically, on qualified and highly skilled workers, and their mobility. In line with this perspective, the policy and scientific debate has started discussing the effects of "brain drain" (Vidal 1998). While the attraction of human capital is clearly a positive indicator, the debate has focused on the effects for territories that are losing their human capital since this might undermine their possibility for knowledge-driven economic development.

The origins and relevance of selective migration for regional development has been the subject of an extensive theoretical literature (Kanbur and Rapoport 2005; Fratesi and Riggi 2007). Recently, Fratesi and Percoco (2014) have provided evidence of the driving forces and of the economic impact of this phenomenon. They have found that the migration of human capital increases the growth rate of destination regions and decreases the development potential of origin ones. In a life cycle perspective of selective migration, understanding the spatial mobility of university students may be very important, especially if graduates remain in the region of their university because they enrich the local labour market, while, poorer regions lose their would-be highly-skilled workers. In line with this perspective, the analysis of university students' mobility is a specific case, since it is mainly university-driven and at the same time relevant as an indicator for the general migration of human capital.

In the literature on university students' mobility, Sá et al. (2004) highlight the relevance of geography and family backgrounds in Dutch students' choice to enrol in a university. They find that individual characteristics and spatial proximity to university colleges play a very important role in explaining such a choice. In this perspective, housing rent becomes a fundamental variable for university students' migration. Furthermore, a lot of studies in the literature have found university quality and financial aid for students to have a positive effect (Baryla and Dotterweich 2001; Dotterweich and Baryla 2005; Hsing and Mixon 1996).

In this paper we focus on S&T students. These are defined as those students whose specializations are in science (physics, mathematics, etc.) or engineering and related fields. This definition comes from Istat (Italian national statistical office) which aggregates the data on the area of graduate study into four macro-fields (Science & Technology, Medicine and Healthcare, Social Sciences and Humanities).

By selecting S&T university students, we aim to fill a gap in the literature, as previous analyses of student migration have normally not distinguished between the fields of study.

Moreover, since universities are clearly linked to the innovative capability of regions, by choosing S&T students, we also aim to highlight the feature of human capital, which is expected to be more directly related to technological innovation.

The case of Italy has always attracted significant attention from scholars due to the persistence of inter-regional economic disparities between the South and the Centre-North and also, more recently, due to the relevance of intra-national university students' mobility. (Dunford 2002; Avveduto 2012; Ciriaci and Muscio 2010, 2011; Dotti et al. 2013; Dotti 2007; Iammarino and Marinelli 2012). The Italian case is one clear example of the challenges of brain drain to regional development and, specifically, the role that universities can play (Gagliardi and Percoco 2011; Svimez 2009).

The Italian case also holds some relevant characteristics for the empirical test of our research hypothesis.[1] First, Italy has been long characterized by a strong dualism in terms of labour market opportunities between the richer North and the poorer South (the 'Mezzogiorno'). Second, Italy is a multipolar system with multiple territories hosting both competitive labour markets and attractive universities, different from other cases such as the UK where London plays a major role (Faggian and McCann 2009) or the Netherlands where regional disparities are very limited (Sá et al. 2006). Third, the attractiveness of local labour markets is strongly differentiated across Italian regions and provinces depending on the local industrial structure. As an example, S&T graduates are more interested in areas where high-tech industries are localized (e.g., Milano and Torino), while, political science students are more interested in locating to where policymakers are (e.g., Roma). Figure 1 shows the spatial distribution of S&T students' inflows across provinces, which is interestingly correlated with the distribution of patents as shown in Fig. 2, although they do not perfectly overlap.

In the case of Italy, high-tech firms are mostly concentrated in the North and in the Centre, suggesting that their industrial specialization advantage can undermine the possibilities of the 'Mezzogiorno' catching up once this process of S&T students migrating has started. On the other hand, the simple establishment of new universities in the South would not be enough to stop this process of brain drain. In fact, spill over and synergy effects between the university and the business realms have been consistently detected in the literature since the seminal paper by Jaffe (1989). A well-developed business environment (and consequently a vibrant job market) is much needed especially in the S&T sector in order to develop and carry on joint research projects with academic staff. This cumulative dynamic can help explain the persistence of Italian inter-regional disparities, at least regarding the human capital divide.

3 Empirical analysis

In order to test the research hypothesis of the paper, this section aims to verify that the local labour market for S&T skilled people acts as a draw for prospective university students in S&T, i.e., prospective scientists and engineers prefer to move to and study directly in those universities that are located in areas with stronger labour markets for their future qualifications.

[1] As already mentioned in the introduction, there is also the practical advantage of the presence of specific datasets which allow the hypotheses to be tested.

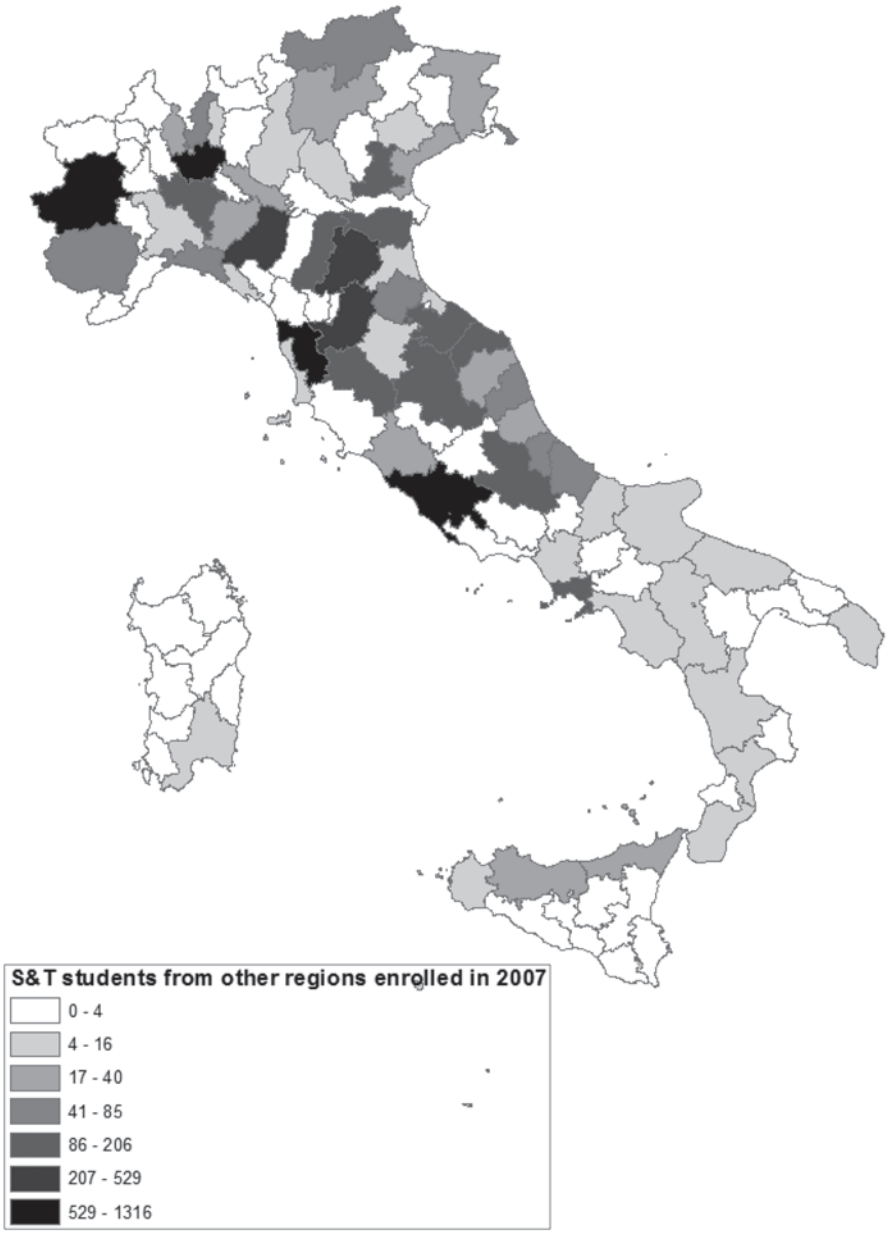

Fig. 1 Inflows of S&T students (2007)

The traditional factors that attract university students continue to hold true in our framework as well, but we do expect that, besides the quality of the university or the quality of life, prospective students move evaluating their possibility of finding a job consistent with their studies, and hence they tend to prefer universities located in

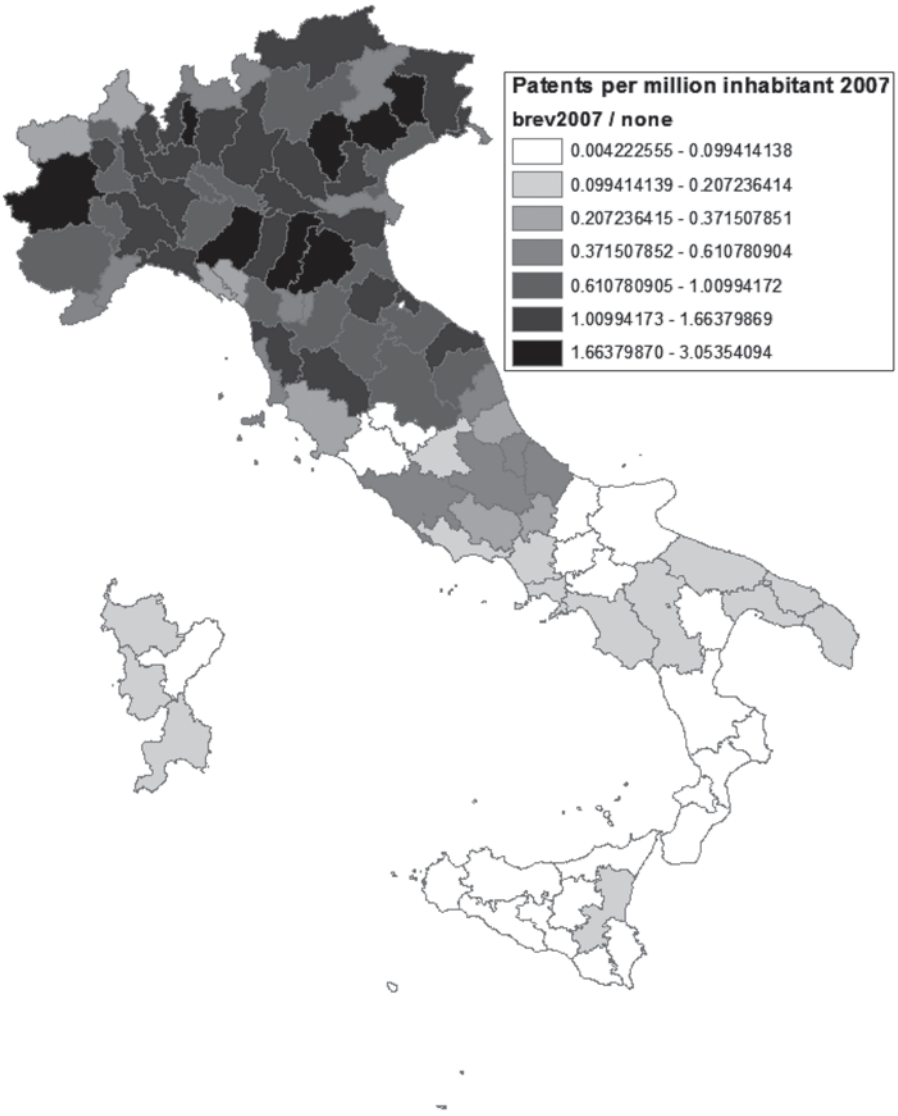

Fig. 2 Patents in Italian provinces (2007)

areas in which the labour market is stronger for graduates in the field in which they plan to enrol.

This reasoning underlines two assumptions, which are not empirically testable but quite plausible given the aggregate outcome of individual choices. First, prospective students make decisions on the basis of adaptive expectations, i.e., they expect features of the local labour markets in the S&T field to be the same in the future, or at least highly similar, to the current situation, which is the one they observe. This is indeed a rational assumption considering that territorial specialization and competitiveness evolve very slowly over time. For this reason, in our empirical analysis, uni-

versity students' decision to move from a province to another one is based on the local labour market in the same year as those of university enrolment. Second, graduates from local universities have easier access to the local labour market with respect to those who graduated elsewhere. This is also a plausible assumption, given the fact that the job-placement university offices hold stronger contacts with local firms compared with firms in different provinces, while students tend to start building their relational capital during their university years (e.g., bonds with colleagues or bonds with firms through internships), and these relations are helpful in finding jobs or at least hearing about job openings. Finally, firms might be more willing to hire young people who graduated from local universities compared to people who graduated elsewhere, and this is because they can more easily monitor the quality of the local university, as well as because those graduates are more likely to be already locally embedded. This stability is fundamental to establishing medium-term relationships, which are necessary to build knowledge, develop R&D projects and then drive innovation (Ciriaci 2005).

The empirical analysis uses a gravity model in which the dependent variable is the number of university students moving from one province to another when enrolling in S&T university courses. Empirically, these data are available at a rather fine provincial level. Italy is in fact divided into 110 administrative provinces, which also act as statistical units and correspond to the European NUTS3 regions. It is possible to know, for each of them, how many students enrol to study at local universities, and the province in which they are officially resident. Since, for institutional and opportunity reasons, university students do not change their official place of residence during the period in which they study, it is possible to know how many of them come from a different province. These data are available from the statistical office of the Italian University Ministry (MIUR). Data are also available for four different groups of fields (namely, Science & Technology, Medicine and Healthcare, Social Sciences, Humanities). Therefore, it is possible here to restrict the analysis to S&T students, who are the most relevant in the knowledge economy.[2]

Since provinces are geographically quite small (NUTS3, according to Eurostat's definitions), the empirical analysis presented here focuses on those students who move to provinces more than 200 km away from their province of origin.[3] In fact, due to the very limited availability of university student houses and the very limited number of scholarships, students of adjacent or nearby provinces prefer to commute to their university rather than to really relocate.

The most important independent variable for the purpose of this paper is the labour market attractiveness for S&T graduates. This variable is measured using an original database called 'Excelsior', owned by the Italian Chambers of Commerce. In the Excelsior database, a representative sample of firms in each province are asked at the beginning of the year what workers, if any, they plan to hire during the incoming year.

Being a survey conceived for policy purposes, it provides data on the number of workers that firms plan to hire at the beginning of the year as well as for which type of job, specifically if they are looking for a graduate or not. The aggregation of job

[2] For a comparative analysis across groups, see Dotti et al. (2013).

[3] The distance, in this case, is measured as the arc distance between the centroids of the provinces.

openings for S&T graduates at the provincial level is a very precise indicator of job opportunities in each Italian province for a given year.[4]

Moving from one province to another to enrol in a university is not just a matter of job opportunities. Two other important groups of factors are in fact identified and examined in the literature: the socio-economic characteristics of the origin and destination provinces, and the quality of universities.

The socio-economic characteristics of provinces are relevant in enrolling students' choices, since the costs and benefits of moving depend on the differences between the province of origin and the destination with respect to a number of characteristics. The per capita income and the employment rates in the two areas provide a proxy of the probable income of the student once he/she has entered the labour market. On the contrary, the differences in living costs between the two will determine whether the relocation brings additional costs or not. Obviously, the distance between the origin and the destination province is also a factor which adds to relocation costs, even if this is not so much due to pure transport costs but more to the opportunity costs of moving to a different context in which the additional distance makes it harder to rely on the safety net of family and social ties.

The quality of universities is also a very relevant variable in the explanation of students' choices, because students will prefer universities which provide 'better' education and more opportunities to find a job after graduation. An important feature of the Italian university system is the 'legal value' of degrees. This means that all universities awarding a certain degree have to comply with quite strict rules on the amount and type of courses that have to be taught. At the end, the same degree obtained in two different universities is equally valid from a legal point of view. This is still relevant for graduates entering public administration, while, the liberalization of the labour market has progressively overcome this, reducing the importance of the legal value of degrees, mainly for private positions. Accordingly, S&T students are for a large part bound to enter the private sector, rather than the public, with the exception of teachers and public researchers, which means that university quality is probably more relevant to these students compared to other qualifications for which the public sector is the main employer.

Another relevant characteristic of the Italian university system is the predominance of public universities, which have very strict restrictions on the fees they can charge to students. This means that it is impossible for most universities to choose a 'high-fee high-quality' model. If universities want to improve the quality of their education they have to rely on different sources.

With all the difficulties associated with the availability and quality of data on university quality in Italy, we made an effort to include variables measuring university quality in the empirical model.

In particular, we make use of the average fees paid by students, the share of students with high grades from high school and a dummy for the presence of a "Rectorate". This variable, indicating the main campus since several universities have more campuses,

[4] Firms are asked which kind of graduate they plan to hire by distinguishing between 22 categories, which are, however, (originally in the survey) aggregated to the four categories corresponding to those of graduates: S&T, Social Sciences, Humanities, Medicine.

might appear to be a mere measure of the centrality of the cities where the universities are located, but this is not the case in the Italian system. Peripheral campuses in Italy are actually different from those with a "Rectorate", as in the central campuses senior professors teach and do research, while in the secondary campuses it is not so rare that the professors commute to teach and go back as soon as the lecture is over. Many other variables (both related to the quality of the research and to the accessibility to students facility) have been tested in the analysis but never found to be significant, also because of the peculiar situation of the Italian university system which makes it difficult for the best universities to distinguish themselves from the average ones. Hence, in the paper we decided to rely only on the three aforementioned variables.

Data availability limits the possibility of building a panel, since data on job openings are only available for a few recent years. Even if it is only possible to estimate a cross section, this cross section is luckily available for enrolments in 2007, i.e., before the economic crisis that could have affected any ordinary enrolment decisions by students and their families.

Summing up, the empirical model is, as already mentioned, the following gravity model:

$$enrolments_{2008}^{S\&T} = f\left(mass_O,\ mass_D,\ distance,\ char_O,\ char_D,\ jobs_O,\ jobs_D,\ qual_O,\ qual_D\right)$$

Where *O* and *D* stand for origin and destination, the masses are needed for the gravity equation and are measured by the total number of students, the *distance* is a metric distance, *char* are the socio-economic characteristics, *jobs* are the job openings for graduates in S&T fields, *qual* is the quality level of universities. The empirical results of the multivariate analysis are presented in Table 1.

The first estimation presented uses a standard negative binomial estimator (model 1 in the Table), but the Vuong test has a z-statistics of 7.82 ($Pr>z=0.0000$), which means that there is an excess of zeroes in the model and hence a zero inflated negative binomial model shall be preferred.

The fact that there is an excess of zeroes is not due to the fact that there are provinces without universities (only two out of the 110 do not have a campus and are excluded from the analysis). On the contrary, the excess of zeroes is due to the fact that students deciding to migrate out of their province of origin are unlikely to take into account more than 100 alternative destinations, but will probably evaluate and confront only a reduced number of more known destinations, which makes it highly unlikely, more than would be ordinary due to their size, that we will observe migrations to small or peripheral provinces.

Table 1 Number of resident students and enrolled students by macro-area Centre-North and South, academic year 2007–08. (Source of data: Istat)

Place of residence	Place of study				
	North (number)	South (number)	Total	North (%)	South (%)
North	944,873	13,299	958,172	98.6	1.4
South	159,306	637,914	797,220	20.0	80.0
Total	1,104,179	651,213	1,755,392	62.9	37.1

The econometric model of reference is therefore the second one presented in Table 1 and is a zero-inflated negative binomial model, which also allows us to account for the presence of over-dispersion. This model, as with all those in the Poisson family, is inherently heteroschedastic and requires a robust estimator. For coherence, the same factors are present in the count equation (investigating why some flows are stronger than the others) and in the inflate equation (which explains the excess of zeroes).

Although the differences between the negative binomial estimation (model 1) and the zero-inflated negative binomial estimation (model 2) are very small, the second is to be preferred due to the Vuong test, and is hence commented upon here. First of all, as expected, the masses, measured in total number of students, are positive and significant, since larger flows are expected to take place between larger provinces. As expected, distance also acts as a deterrent to student migration, as the flows between provinces farer away are significantly smaller.

The innovative variable of the paper, namely, the job openings in S&T of the total S&T jobs in the province, i.e., the dynamism of the S&T labour market, is insignificant for the origin, but positive and highly significant in the destination. This confirms the hypothesis that, *ceteris paribus*, students are likely to move to enrol in universities located in places where the labour market for S&T occupations is more developed.

The other variables act mainly as controls in this paper, but produce the expected signs and confirm the expectations. First of all, the local characteristics are significant. The coefficient for the income in the province of destination is positive and significant. The employment rate is significant both as an attractor (positive coefficient for the destination level) and as a repulsor (negative coefficient for the origin level). The cost of life, measured through house prices, has the expected sign and is negative and significant in the destination province.

University quality indicators are also significant, with all the limits due to data availability.

One first proxy is the presence in the province of a 'Rectorate' (i.e., the office of the Rector), meaning there is the main campus of a university which has many campuses in the province.[5] This variable is positive and significant in the destination, i.e., it acts as an attractor, as expected. The quality of the destination universities as measured by the talent, i.e., the percentage of high grade students they are able to enrol, is also positive and significant. As expected, on the contrary, the level of fees is not a significant variable, since they cannot really change from one university to the other.

Two other variables are added to assess the peculiarities of the Italian university system. The first one is the presence of national poles of attraction in the most populous provinces (Bari, Bologna, Firenze, Milano, Napoli, Roma and Torino), which turn out to be a positive and significant attractor.

The second is the presence of universities established a very long time ago in relatively small towns which, because of their tradition, continue to attract a large num-

[5] Almost all provinces host one or more campuses; however, many of them only host secondary, ancillary, campuses in which teaching takes place but often the professors do not stay for research, instead preferring to do research in the main campus.

ber of students from the rest of the country and, in some cases, abroad, which makes them have a far larger than average number of university students for their population (variable "small university").[6] These provinces (Macerata, Modena, Pesaro and Urbino, Perugia, Siena, Trento, and Venezia) have a positive and significant attraction impact only when the estimator is not zero-inflated, otherwise the coefficient remains positive but is not significant.

Table 2 presents some robustness checks which help test whether there are some distance decay effects in some of the explanatory variables. This is done by interacting the relevant variable with the distance variable.

Model (1) tests whether there is a distance decay effect on the 'Rectorate' and it seems that, on the contrary, the relevance of having a 'Rectorate' in the destination works as an attractor, and this factor increases with distance: the further the origin of the students is, the more likely they are to head for the main university campuses.

Model (2) tests the distance decay effect for small traditional universities. There is a significant distance decay effect, and this implies that small traditional universities are more likely to attract students in nearby provinces rather than from very far away (maybe also because of their accessibility).

The distance decay effect of national poles of attraction is not present (model 3). On the contrary, it appears that these poles are more likely to attract students from long distances, as shown by the interaction coefficient which is positive and significant.

For this reason, the last model presented in Table 2 (model 4) is estimated with the exclusion of the largest provinces from the sample, namely, Milano and Roma. The coefficients are highly consistent, although some lose in significance and also the overall model is slightly less significant, as expected due to the fact that most long-distance student migrations take place towards the universities in the two largest and economically most important Italian cities.

In all the estimated models of Table 2 the coefficients of the various variables are stable and robust, especially the importance of the labour market (S&T job openings) in the destination province.

This confirms the hypothesis that, beyond traditional territorial characteristics and university quality, the level of enrolment of graduate students in science and technology appears to be sensitive to the strength of the S&T job market in the region.

4 Concluding remarks

Migration flows were often considered as a factor promoting regional convergence. However, this view holds true only if migration does not affect total factor productivity, i.e., only if migrants are homogeneous and unskilled. If migration flows are selective in the sense that emigrants are more educated than the average individual in the region of origin, then they may generate inter-regional divergences between origin and destination.

[6] These are empirically determined as those provinces for which the ratio between student in-flows and the resident population is two standard deviations above the national average.

This paper aimed to shed light on the factors behind the decision to migrate. In particular, we have studied the spatial mobility of students enrolling in universities in S&T fields. Our research is based on the hypothesis that students decide on where to enrol by looking at university quality as well as the conditions of the local labour market where the universities are located, and then inter-regional brain drain occurs (also) through the university students.

Our empirical analysis has considered the case of Italy and has shown that flows of prospective S&T students follow the labour market conditions of the destination provinces, after controlling for a large number of variables and across several robustness checks.

This result is important for two reasons. First, it shows that contemporary migration flows react to field-specific labour demand in addition to changes in the expected income (i.e., to changes in average income and the unemployment rate). In our view, this is clear evidence of the selection mechanism behind the composition of inter-regional migration flows in Italy, where migration from the relatively poorer Mezzogiorno to the relatively richer Centre-North is significantly skewed towards people with high qualifications and, at the same time, there is significant student mobility South-to-North and almost negligible North-to-South.

Second, although in our analysis we have not considered the consequences of students' migration, if regional innovation capacity is a function of human capital, and especially of S&T graduates, then the geography of university students' mobility flows can be considered as an important determinant of the concentration of patents, and more generally innovative activities, across Italy. This last point, however, calls for further research.

In terms of policy implications, our findings question the Italian strategy adopted during the 1990s and early 2000s to build several campuses all over the country, in a large number of cases in which there were few relationships with local labour markets, mainly but not only in southern regions. On the contrary, the development of new university campuses in provinces suffering from brain drain should be included in a comprehensive long-term local strategy considering dynamics between universities, local firms and their capacity to attract students. Where these synergies do not take place, there is the risk of having university campuses as a 'cathedral in the desert' unable to prevent brain drain.

A possible way out for this policy dilemma is the creation of research-oriented university campuses with relevant efforts to reinforce partnerships between universities and firms (and hence the right specialization), and, only once these systems are in place, an investment in education focusing on attracting students to enhance the already existing local labour market. Indeed, this requires both long-term strategies and capacities to integrate regional and university policies.

Finally, one future research direction would be the analysis of changes in the migration patterns of university students determined by the current crisis. While out-migration from poorer regions is growing due to increased needs for better labour perspectives, the crisis has both weakened the attractiveness of central and northern Italian local labour markets, and the possibility for southern students to afford the costs of studying in another region.

Appendix

Table 2 Data sources

Variable	Description	Source	Year used in estimations
University student flows	Number of students enrolling from outside the province	"Anagrafe Nazionale degli Studenti" (National Registry Office for Students) provided by the Ministry of Universities (MIUR)	2008
Attractiveness of the labour market	Number of job vacancies per total jobs in the province	Excelsior database: http://excelsior.unioncamere.net/web/index.php	2007
Housing prices	Price in Euros per square metre of a house in semi-periphery of the provincial capital	Annuario immobiliare, Il Sole 24 Ore Editore	2006
Employment	Employment rate	ISTAT, *Conti territoriali*	2006
Per capita income	GVA per capita	ISTAT, *Conti territoriali*	2006
University fees	Average fees paid by students	ISTAT, "Indagine sulla mobilità degli studenti" and "Anagrafe Nazionale degli Studenti" (National Registry Office for Students) provided by the Ministry of Universities (MIUR)	2006
Rectorate	Presence of university Rectorate	"Anagrafe Nazionale degli Studenti" (National Registry Office for Students) provided by the Ministry of Universities (MIUR)	2006
Talent	Share of students with high grades in their high school diploma	Il Sole 24 ore	2006

Table 3 Coefficients estimates (p-value in parentheses)

Dependent variable: Enrolments in Science and Technology 2007 (>200 km)	(1)	(2)
Estimator	Neg. Bin.	ZINB
Count equation		
Mass (1000 students)—destination	0.098***	0.081***
	(0.000)	(0.000)
Mass (1000 students)—origin	0.122***	0.093**
	(0.002)	(0.031)
Metric distance (100 km)	−0.194***	−0.175***
	(0.000)	(0.000)
Job openings on jobs (log)—destination	0.357***	0.540***
	(0.002)	(0.000)
Job openings on jobs (log)—origin	−0.039	0.036
	(0.808)	(0.831)
Per capita income (log)—destination	2.178***	1.758***
	(0.000)	(0.003)
Per capita income (log)—origin	0.012	−0.069
	(0.992)	(0.960)
Employment rate—destination	6.269	8.482**
	(0.174)	(0.047)

Table 3 (Continued)

Dependent variable: Enrolments in Science and Technology 2007 (>200 km)	(1)	(2)
Estimator	Neg. Bin.	ZINB
Employment rate—origin	−10.167**	−10.327**
	(0.046)	(0.046)
House prices (log)—destination	−0.536*	−1.025***
	(0.059)	(0.005)
House prices (log)—origin	−0.562	−0.551
	(0.112)	(0.107)
Rectorate—destination	1.385***	0.745***
	(0.000)	(0.000)
Rectorate—origin	−0.002	0.017
	(0.989)	(0.913)
University fees (1000 €)	−0.342	−0.247
	(0.130)	(0.272)
Talents—destination	0.081***	0.098***
	(0.000)	(0.000)
National university attraction pole (dummy)—destination	0.457***	0.610***
	(0.001)	(0.000)
Small university (dummy)—destination	0.204*	0.072
	(0.078)	(0.593)
Centre—destination	−0.326	−0.288
	(0.144)	(0.214)
South—destination	1.020**	0.967*
	(0.036)	(0.070)
Ln-alpha	0.865***	0.442***
	(0.000)	(0.000)
Inflate regression		
Mass (1000 students)—destination		−1.333***
		(0.000)
Mass (1000 students)—origin		−0.100*
		(0.085)
Distance (100 km)		−0.030
		(0.558)
Job openings per jobs (log)—destination		1.813***
		(0.000)
Job openings per jobs (log)—origin		0.592***
		(0.002)
Per capita income (log)—destination		−2.950*
		(0.051)
Per capita income (log)—origin		−1.852
		(0.115)
Employment rate—destination		17.194*
		(0.079)
Employment rate—origin		−3.775
		(0.564)
House prices (log)—destination		−1.871***
		(0.003)

Table 3 (Continued)

Dependent variable: Enrolments in Science and Technology 2007 (>200 km)	(1)	(2)
Estimator	Neg. Bin.	ZINB
House prices (log)—origin		−0.429
		(0.383)
University fees (1000 €)		−1.345***
		(0.000)
Talent—destination		0.103**
		(0.011)
Rectorate—destination		−0.240
		(0.552)
Rectorate—origin		0.006
		(0.978)
National university attraction pole (dummy)—destination		−5.067***
		(0.005)
Small university (dummy)—destination		−1.000
		(0.149)
Centre—destination		−0.368
		(0.390)
South—destination		−1.104
		(0.132)
Constant		7.060
		(0.887)
Observations	6448	6448
Zero observations	5194	5194
Chi2	4032.18	2609.62
Log-likelihood	−4557.23	−4572.32
Vuong test	7.82***	–

*$p<0.10$; **$p<0.05$; ***$p<0.01$

Table 4 Robustness Checks (p-value in parentheses)

Dependent variable: Enrolments in Science and Technology 2007 (>200 km)	(1)	(2)	(3)	(4)
Estimator	ZINB	ZINB	ZINB	ZINB
Count equation				
Mass (1000 students)—destination	0.081***	0.079***	0.080***	0.141***
	(0.000)	(0.000)	(0.000)	(0.004)
Mass (1000 students)—origin	0.093**	0.093**	0.092**	0.105**
	(0.030)	(0.039)	(0.033)	(0.021)
Metric distance (100 km)	−0.168***	−0.303***	−0.194***	−0.184***
	(0.000)	(0.000)	(0.000)	(0.000)
Job openings per jobs (log)—destination	0.549***	0.511***	0.527***	0.435*
	(0.000)	(0.000)	(0.000)	(0.059)
Job openings per jobs (log)—origin	0.033	0.025	0.032	0.030
	(0.845)	(0.882)	(0.851)	(0.875)
Per capita income (log)—destination	1.780***	1.820***	1.789***	2.396***
	(0.002)	(0.002)	(0.002)	(0.001)

Table 4 (Continued)

Dependent variable: Enrolments in Science and Technology 2007 (>200 km)	(1)	(2)	(3)	(4)
Estimator	ZINB	ZINB	ZINB	ZINB
Per capita income (log)—origin	−0.064	−0.041	−0.074	−0.111
	(0.963)	(0.976)	(0.957)	(0.941)
Employment rate—destination	8.400**	8.056*	8.220*	7.413*
	(0.049)	(0.067)	(0.056)	(0.088)
Employment rate—origin	−10.312**	−10.081*	−10.241**	−10.435*
	(0.047)	(0.053)	(0.047)	(0.089)
House prices (log)—destination	−1.021***	−0.970***	−0.941**	−1.011*
	(0.006)	(0.005)	(0.012)	(0.088)
House prices (log)—origin	−0.556	−0.555	−0.554	−0.627*
	(0.104)	(0.107)	(0.106)	(0.080)
Rectorate—destination	0.736***	0.003	0.751***	0.661*
	(0.000)	(0.994)	(0.000)	(0.077)
Rectorate—origin	0.014	0.014	0.011	0.002
	(0.928)	(0.929)	(0.945)	(0.990)
University fees (1000 euro)	−0.264	−0.143	−0.231	−0.036
	(0.240)	(0.503)	(0.293)	(0.885)
Talents—destination	0.099***	0.099***	0.098***	0.077**
	(0.000)	(0.000)	(0.000)	(0.025)
National university attraction pole (dummy)—destination	0.603***	0.597***	0.261	0.245
	(0.000)	(0.000)	(0.373)	(0.369)
Small university (dummy)—destination	0.392	0.070	0.043	0.061
	(0.141)	(0.593)	(0.757)	(0.650)
Centre—destination	−0.281	−0.277	−0.283	−0.365
	(0.226)	(0.229)	(0.219)	(0.151)
South—destination	0.985*	0.940*	0.970*	0.943
	(0.067)	(0.076)	(0.068)	(0.112)
Small university (dummy)—destination * Metric distance	−0.001*			
	(0.088)			
Rectorate—destination * Metric distance		0.002***		
		(0.000)		
National university attraction pole (dummy)—destination * Metric distance			0.001*	
			(0.081)	
Ln-alpha	0.439***	0.434***	0.440***	0.635***
	(0.000)	(0.000)	(0.000)	(0.002)
Inflate regression				
Mass (1000 students)—destination	−1.338***	−1.351***	−1.337***	−1.588*
	(0.000)	(0.000)	(0.000)	(0.088)
Mass (1000 students)—origin	−0.100*	−0.095	−0.101*	−0.107
	(0.087)	(0.130)	(0.096)	(0.354)
Distance (100 km)	−0.026	−0.094	−0.051	−0.062
	(0.612)	(0.133)	(0.355)	(0.444)
Job openings per jobs (log)—destination	1.817***	1.816***	1.814***	1.725*
	(0.000)	(0.000)	(0.000)	(0.090)
Job openings per jobs (log)—origin	0.586***	0.609***	0.590***	0.614*
	(0.002)	(0.003)	(0.002)	(0.081)

Table 4 (Continued)

Dependent variable: Enrolments in Science and Technology 2007 (>200 km)	(1)	(2)	(3)	(4)
Estimator	ZINB	ZINB	ZINB	ZINB
Per capita income (log)—destination	−2.915*	−2.676*	−2.904*	−1.814
	(0.055)	(0.087)	(0.055)	(0.336)
Per capita income (log)—origin	−1.836	−1.823	−1.877	−2.044
	(0.117)	(0.142)	(0.110)	(0.455)
Employment rate—destination	16.991*	15.201	16.885*	15.795
	(0.081)	(0.147)	(0.084)	(0.243)
Employment rate—origin	−3.759	−3.041	−3.691	−3.063
	(0.562)	(0.664)	(0.573)	(0.696)
House prices (log)—destination	−1.860***	−1.881***	−1.766***	−2.204*
	(0.004)	(0.003)	(0.006)	(0.085)
House prices (log)—origin	−0.428	−0.549	−0.456	−0.410
	(0.388)	(0.229)	(0.347)	(0.549)
University fees (1000 euro)	−1.365***	−1.164***	−1.312***	−1.142**
	(0.000)	(0.002)	(0.000)	(0.023)
Talents—destination	0.102**	0.109***	0.104***	0.077
	(0.012)	(0.004)	(0.009)	(0.515)
Rectorate—destination	−0.249	−0.136	−0.219	−0.385
	(0.540)	(0.725)	(0.581)	(0.804)
Rectorate—origin	0.005	0.010	−0.001	−0.018
	(0.980)	(0.964)	(0.997)	(0.957)
National university attraction pole (dummy)—destination	−5.375***	−5.192***	−6.504***	−4.014
	(0.003)	(0.003)	(0.000)	(0.649)
Small university (dummy)—destination	−1.009	−0.958	−1.055	−1.452
	(0.162)	(0.131)	(0.129)	(0.676)
Centre—destination	−0.361	−0.338	−0.364	−0.479
	(0.404)	(0.400)	(0.397)	(0.659)
South—destination	−1.071	−1.185*	−1.111	−0.828
	(0.145)	(0.094)	(0.124)	(0.768)
Constant	7.308	10.768	7.329	3.513
	(0.883)	(0.837)	(0.882)	(0.971)
Observations	6448	6448	6448	6311
Zero observations	5194	5194	5194	5194
Chi2	2662.99	2793.66	2727.81	1089.33
Log-likelihood	−4571.09	−4562.21	−4570.48	−4082.85
Vuong test	–	–	–	–

*$p<0.10$; **$p<0.05$; ***$p<0.01$

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