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Local labour markets and the interregional mobility of Italian university students*

Nicola Francesco Dotti[1], Ugo Fratesi[2], Camilla Lenzi[3] and Marco Percoco[4]

Abstract

This paper looks at a little-explored role that universities can play: that of representing a channel for brain gain, enabling regions to attract bright students who may decide to stay after they have graduated. In this way, universities can be a source of selective migration processes and possibly of diverging development paths, by augmenting the capability of economically dynamic regions to attract bright people from the lagging regions. In this paper, we argue that student mobility behaviour is a function not only of the quality of universities, but also of local labour market conditions in the destination locations. The paper relies on a gravity model, and shows that graduate migrations respond to several determinants, among which graduate job vacancies (that is, the dynamism of the local labour market) appear to be essential.

JEL Codes: R11, R23, O15, I2.
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(1) DABC, Politecnico di Milano, Piazza Leonardo da Vinci, 32, 20133 Milano - Italy. E-mail: nfdotti@gmail.com.
(2) DABC, Politecnico di Milano, Piazza Leonardo da Vinci, 32, 20133 Milano - Italy. E-mail: ugo.fratesi@polimi.it.
(3) DABC, Politecnico di Milano, Piazza Leonardo da Vinci, 32, 20133 Milano - Italy. E-mail: camilla.lenzi@polimi.it.
(4) DAIMAP and CERTeT, Università Bocconi, Via Roentgen 1, 20136 Milano - Italy. E-mail: marco.percoco@unibocconi.it.

1. Introduction

Inter-regional migration flows are conceived in the neoclassical framework as a mechanism for balancing regional disparities in per capita GDP. From this perspective, more developed regions attract a labour force from less-developed regions by means of higher expected wages, and migration flows will persist for as long as the gap in expected earnings between these groups of regions exists. If there is perfect mobility of labour, and if markets are perfectly competitive, migration flows will automatically promote convergence in wages and per capita GDP; however, this view is likely to hold only if there are no sunk costs associated with labour mobility[1] and there is no heterogeneity in the workforce that is migrating from one region to another.

The growing literature on selective migration has built on the literature on brain drains, and it has pointed up the divergent effect of migration when it takes the form of attracting human capital from less-developed areas (Kanbur and Rapoport, 2005; Fratesi and Riggi, 2007). For example, Berry and Glaeser (2005) have found evidence of a conflicting pattern in human capital accumulation over the past few decades in U.S. cities.

The Italian case is particularly interesting in this respect, because the country experienced extensive migration flows from the 'Mezzogiorno' (the Southern regions of Italy) to the North during the 1950s and 1960s. Despite a period of relative decline in inter-regional mobility, South-North migration flows have exhibited a wide-scale upsurge in recent years. This new wave seems to be significantly different from previous cases, however, as 25% of migrants from the South now hold a bachelor degree, compared with only 7% of its total working population (Banca d'Italia, 2005; Viesti, 2005). According to Ciriaci (2005), only 27,170 out of 43,459 1998 graduates in the South had a job in 2001, and 31.1% of these jobs were located outside the Mezzogiorno. Push factors to migrate are even stronger for graduates in the scientific fields: for them, the likelihood of obtaining a job outside their region of origin is higher than it is for graduates in the humanities (Ciriaci, 2005;

[1] Sunk costs for migration can be conceived in the form of high home ownership rates or matching frictions in the labour markets. Recently, cultural traits have also gained ground in the explanation of migration (Falck et al., 2009).

Coniglio and Prota, 2008). Significantly, the drain of human capital to northern regions may eventually result in a concentration of the stock of human capital, and hence affect the economic potential of the Mezzogiorno. This has been documented by Fratesi and Percoco (2011), who have found that selective migrations in Italian regions have divergence impacts on regional growth.

In this paper, we move forward from these results, and take a first step towards gaining an understanding of the determinants of a specific type of selective migration: that of university students, with specific reference to the Italian case. It has been shown that the likelihood that southern students who graduate from northern universities will return to the Mezzogiorno to work is relatively small (Svimez, 2009). If this is true, then one important channel for human capital gain in the North takes the form of an early drain through the university enrolment process. Universities may therefore play an important role not only as enhancers of human capital through education, but also as a channel that facilitates the attraction of potentially highly-skilled people. In short, South-North selective migrations can be closely linked to university student migration flows.

In this paper, we look at student migration across Italian provinces (that is, NUTS3 level regions) and study it within a gravity model framework. As standard in the literature, we find that one of the key drivers of migration by university students is the presence of a good university in a given province. In addition, and less conventionally, we find that student migration flows are also driven by local labour market conditions. We reach this conclusion by assembling an original dataset in which for the first time variables measuring job vacancies (which are also disaggregated by subject area of university degrees) are included; they contextualise our results in a simple theoretical framework in which students' expectations regarding employment are taken into account.

The rest of the paper is organized as follows. Section 2 presents the context for the paper, including a short review of the many roles played by universities in regional development and an overview of the Italian case, with especial attention being paid to its dualistic structure in terms of both the attractiveness of universities and the local labour markets. Section 3 presents the methodological

framework and discusses the results of the empirical analysis of the determinants of graduate migrations. Section 4 concludes the paper and outlines a number of further research directions.

2. The mobility of university students and local labour markets

2.1 Universities and regional development

The relevance of universities to local development is widely accepted in the literature (see, among others, Pyke et al., 2006; Varga, 2009). Their importance is due to three main factors.

First, the oldest function of universities is the provision of educational services to the city and the area in which they are located. This role remains of great importance, since graduate workers are likely to show higher productivity than workers with a lower educational profile. The importance of this function is currently being amplified by the shift towards the new paradigm of the knowledge-based economy, within which human capital is becoming increasingly relevant. This is further linked to a rising demand for high-skilled workers in the labour market, and it has received increasing attention in the political debate in recent times (Council of the European Union, 2000; EC, 2010).

Second, universities may be thought of as a public investment which has a direct and indirect effect on their surroundings, because they attract workers and students and thereby generate income from them, in terms of both an increase in population and demand for certain kinds of specific consumer goods, including creative and recreational services. It is generally believed that universities have a positive effect on both local consumption and the reputation of a neighbourhood, which may be important for attracting other investors. Perry and Wiewel (2005) even introduced the notion of the 'university as urban developer', conceiving universities both as promoters of new settlement and as tools for urban regeneration.

Third, it has been acknowledged more recently that universities can play a direct role in the knowledge economy, in that they are capable of generating significant positive knowledge externalities which benefit other local actors (Jaffe, 1989). Firms located in close proximity to

universities are more likely to establish contacts and collaborations with them and to be exposed to their knowledge. In recent years, universities have also experienced an expansion of their functions in the area of technology transfer activities and the incubation of new firms (Etzkowitz & Leydesdorff, 2000), and in so doing have become key promoters of entrepreneurship, which is one of the key drivers of economic growth and spatial development. This has been largely inspired by the success of Silicon Valley, where the University of Stanford has incubated many highly innovative firms (Saxenian, 1994). In turn, this has led to a radical change in the role of universities towards the so-called 'entrepreneurial university' model (Etzkowitz, 2003).[2]

In this paper, we propose a fourth view of the role of academic institutions. In particular, universities represent poles for attracting talented students, and if this attraction is combined with local labour markets ready to absorb students once they have graduated, then universities will also promote local economies by draining potential human capital from other regions.

2.2. The mobility of university students

A large body of literature has addressed the determinants and patterns of students' migrations; two main streams of research can be identified. The first group of studies considers individual motivation and family background as key determinants of a decision to move from one place to another in order to enrol at a given university. For example, Sà et al. (2006) study the decisions of Dutch students to register at a certain university, and find that talent and geographical variation in higher education (including in terms of proximity to the universities) play a very important role in explaining these choices. Similarly, Frenette (2006) finds that longer distances between home and the nearest college dramatically reduce the likelihood that Canadian high school students will enrol at a university.

[2] However, Faggian and McCann (2009) have questioned the view that local universities promote regional innovation, and have found that in general, only a few play a significant role in their local economies.

The second group of studies considers local and university-specific characteristics as determinants of student attraction. Most of these studies find a positive effect of university quality and financial aid for students (Baryla and Dotterweich, 2001; Dotterweich and Baryla, 2005; Mixon and Hsing, 1994; Agasisti and Dal Bianco, 2007b). Similarly, Sà et al. (2004) find that distance and the cost of renting accommodation are among the most important factors.

Most of this second strand of literature uses production-constrained gravity models (Fotheringham and O'Kelly, 1989), whereas in this paper we opt for an unconstrained model, and more importantly, we introduce variables relating to the local labour market, such as the number of job vacancies (which are also disaggregated by field of study). As argued by Ciriaci and Muscio (2011), in fact, graduate employability is a function of the quality of the university that they have attended. Although this may not be surprising, it provides a powerful motivation for student decision-making processes to take the labour market into consideration as well. In particular, we study students' enrolment decisions by assuming that they also observe (and have expectations regarding) the outcomes of the local labour market to increase the probability of finding, *ceteris paribus*, a job that matches the subject they have studied. Universities are therefore considered as catalysts for talent that will mainly be employed at a local level, hence leading to a significant gain in human capital in the areas in which they are located. Specifically, we will study the mobility behaviour of graduates in Italy, where since the 1990s, South-North student migration has become a source of great concern because it is viewed as a mechanism for perpetuating the long-standing regional disparities and dualism between the North and the South (Gagliardi and Percoco, 2010; Fratesi and Percoco, 2010).

From the perspective of the place of origin, selective migrations can severely hamper the regional potential in several ways. First of all, students who move out of the family home have to be supported by their families or by grants from other institutions, and these costs represent a transfer of income in favour of the destination regions. Secondly, families will naturally pay for expensive studies in worthwhile cases, meaning that they will only pay for education in other regions for the

best students. Therefore, if a region loses young students, it is likely to lose 'good students', without any guarantee that it will have them back; in short, the regions of origin may support the educational costs of people who may be then employed in the destination regions. Accordingly, if out-migrating students do not return, the regions of origin are deprived of human capital, which may affect businesses and their ability to attract external investments.

2.3. The mobility of university students: the Italian case

The Italian North-South dualism is one of the most closely studied topics in the regional economic literature. Large disparities in terms of GDP per capita and labour market outcomes have persisted since the beginning of the twentieth century (Dunford, 2002; Gagliardi and Percoco, 2010).

Italy is also characterized by large flows of migration from the South to the North (Fratesi and Percoco, 2010) which are increasingly involving graduates. Furthermore, southern students who have studied at a northern university show very little inclination to return to the South, which suggests that the roots of these selective migration patterns can be found in students' inter-regional mobility. According to Svimez (2009), in fact, about 25% of southern students enrol at a university in the North or Centre of the country, and only one-third of them return to the southern regions after graduation, while the remaining two-thirds (about 11,000 in recent years, on average) remain in the North and Centre.

Table 1 reports the employment conditions of southern graduates according to their region of residence and study. Studying at a university in the North or Centre clearly provides an advantage in terms of labour market outcomes, whereas remaining in the South to study and work is a choice which has a lower expected value. As a consequence, the prospect of moving to the North and having a higher probability of finding a better job appears more attractive. Moving after graduation is also less common because of the lack of professional ties formed during the period of study, and because the more footloose individuals would have already moved (European Foundation for the Improvement of Living and Working Conditions 2006; Lenzi, 2008). This suggests that the most

common trajectory for ambitious young southerners with high potential is to move to the North to enrol at a university and then stay there to work, as evidenced in Figure 1, whereas moving after completing a degree is more complex, because of the lack of ties, and moving from the North to the South is fairly uncommon in a country characterized by strong dualism.

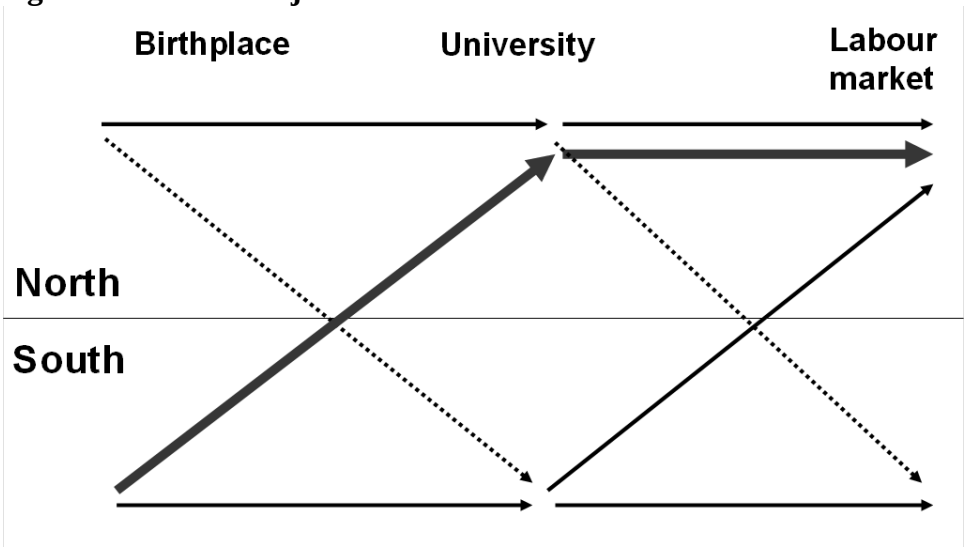
The characteristics of the Italian university system, presented in the next sub-section, are also extremely important for understanding migrations by high-skilled people.

Table 1: Working conditions of southern graduates (2007)

	Not employed	Employed
Current residence:	36.8	61.3
Centre-North	23.3	75.4
Place of study	35.1	63.5
Centre-North	21.9	76.0

Source: Svimez (2009). Note: The sum of each row is not 100 because of missing observations.

Figure 1: Possible trajectories for students born in the North or South



As mentioned in the previous sub-section, drawing students from other regions is beneficial to the attracting regions in several ways. In particular, bringing university students into a region also provides local firms with a workforce that will acquire knowledge in the area. Furthermore, the

possibility of internships in the later period of a university career or immediately after graduation can forge links between students, a university and local firms.

Attracting students is beneficial to the regional economy, and simpler than attracting qualified middle-aged professionals, because young people are more adaptable, and have a greater propensity to move. Conversely, it is more difficult to attract older workers, because this normally means that their families have to move as well. This seems to be even more relevant in the case of Italy, where the inter-regional mobility of workers is very limited, and family ties are closer than they are in other countries.

If local labour market conditions for student were to have an attraction effect on those who migrate, this could also lead to a self-reinforcing mechanism between economic dualism and the university system.

2.4 Regional labour markets, and attracting Italian university students

By drawing on data for all university enrolments by Italian students between 2003 and 2009 (source: MIUR, 2010) at a provincial level (NUTS3), we have been able to study the actual attractiveness of Italian universities and relate it to provincial labour markets.

We computed an attraction index for each Italian province on the basis of university enrolment flows, applying the literature on trade flows. Provincial attractiveness (PA) was calculated according to formula (1) below, where S_{in} is the number of students resident in other provinces who enrol in the focal province, and S_{out} is residents who enrol in other provinces[3]:

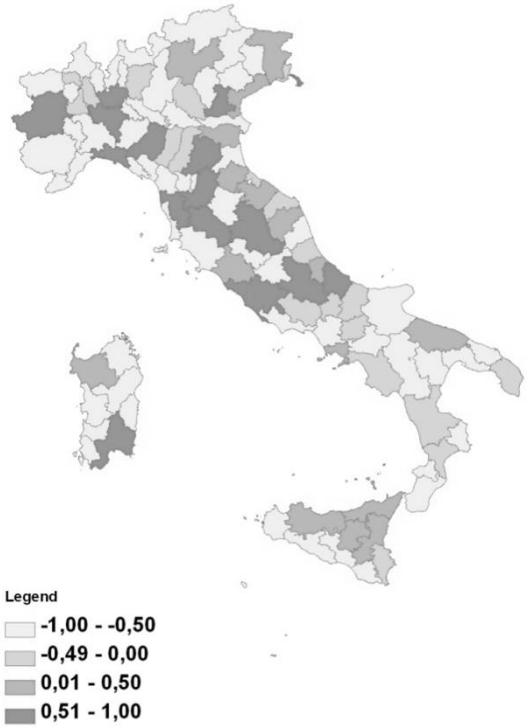
$$(1) \qquad PA = \frac{S_{in} - S_{out}}{S_{in} + S_{out}}$$

[3] It should be noted that calculation of this index is permitted by the fact that due to national habits, students will in most cases maintain their official residence at their parents' home throughout their university career.

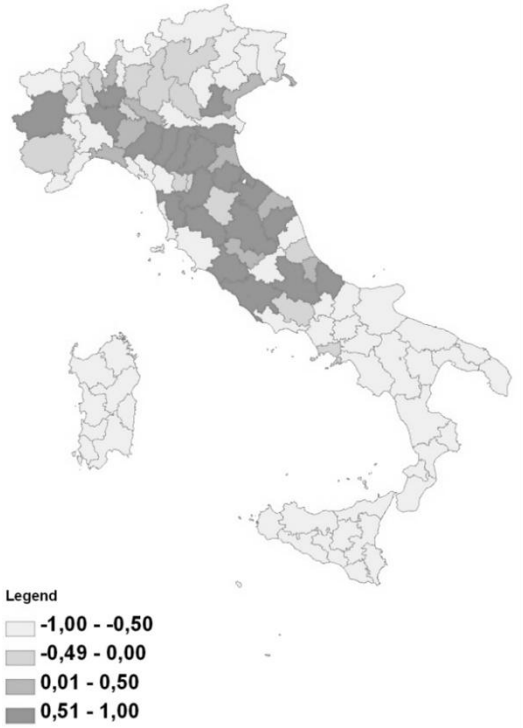
This provincial attractiveness index is positive for attractive provinces and negative for draining ones. Inspection of Figure 2a shows that attractive provinces NUTS3 exist in almost all Italian regions (NUTS2 level); these tend to be those with the largest cities (Bari, Bologna, Florence, Milan, Naples, Rome, and Turin), with the addition of provinces hosting some smaller traditional university towns (Macerata, Modena, Pesaro and Urbino, Perugia, Siena, Trento, and Venice).

At first glance, university student flows seem to be distinct from economic dualism, since many attractive provinces may also be found in Southern Italy. However, the results in Figure 2a may be biased by commuting flows rather than actual relocations, as commuter students are a relatively common phenomenon in Italy owing to the scant availability of halls of residence (Biggeri and Catalano, 2006).

Figure 2: The attractiveness of Italian provinces to university students



2a Attractiveness to all students



2b Attractiveness to students resident more than 200 km away

To detect actual relocations, we map the same provincial attractiveness index in Figure 2b, this time computed for only those students for whom the distance between the province of residence and that where they study is greater than 200 km. These students are expected actually to relocate in order to

study. The picture is very different from the previous one: many attractive provinces in the North or Centre also remain attractive where longer distances are involved, but no southern province remains attractive, including Naples, which has a long university tradition, and which is mainly attractive to students from other southern provinces. Interestingly, some northern provinces which are not commuter attractors, such as in Emilia-Romagna, prove to be long-distance attractors.

In this paper, we advance the hypothesis that this pattern, which may seem unexpected at first sight, is associated not only with the quality of the university system, but also with the dualism of the labour market, so that the long-distance attractiveness of northern cities is (also) explained by their dynamism in terms of labour market.

In fact, the Italian university system has to deal with significant government regulations which make it more homogeneous with respect to other countries of comparable size and economies. Firstly, degrees in Italy have a "legal value", so that (i) different universities have to comply with the same well-defined degree programmes in order to award a specific degree, (ii) the same degree is equally legally valid for all public administrations in the country, regardless of the university which has awarded it. Moreover, public universities - which make up the great majority - cannot charge students higher fees without incurring sanctions, which means that they cannot choose a high-fee, high-quality model. Finally, the Italian university system is not only little differentiated but also very fragmented, with universities and their 'ancillary campuses' in other towns competing for students on a door-to-door basis, with the result that universities are present in all but two of the 107 Italian provinces.

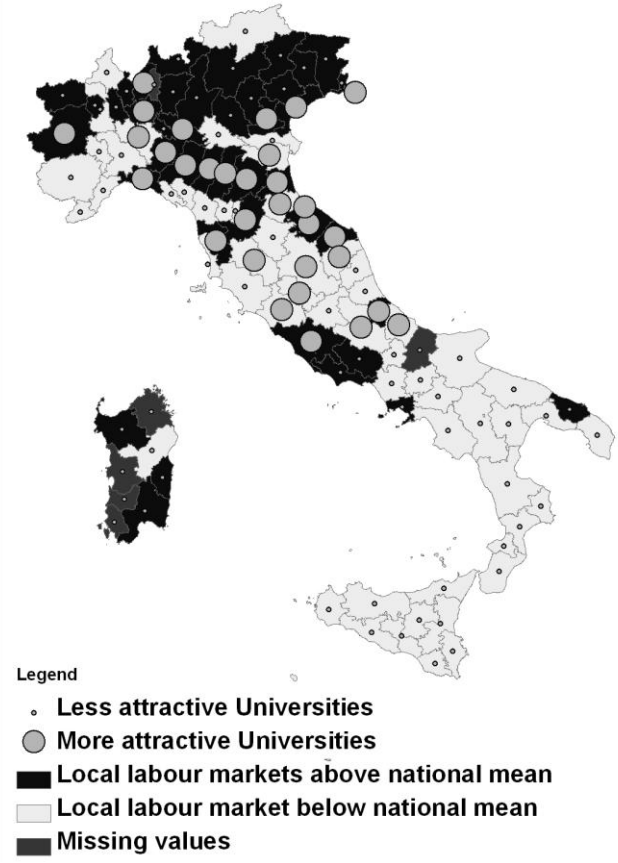
Our hypothesis, which will be tested in the next section, is that students move to study in different regions not only to attend a higher-quality university, but also to enrol at universities located in provinces and cities where they expect to find better job opportunities once they have graduated.

To explore this intuition descriptively, we rely on the Excelsior database, which collects data drawn from an official annual survey carried out in Italy on job vacancies at a provincial level, where firms are asked whether they plan to hire in the next year, and if so how many people, for what kind of

job, with what level of education, and in what field of study (for details on the database, see table A1 in the Annex).

In particular, we compute the ratio between the number of expected job vacancies and the provincial jobs as a proxy of attractiveness of the province for graduate job-seekers. In Figure 3, this measure is compared to the attractiveness for non-commuting university students (the one described in Figure 2b).

Figure 3: Provincial attractiveness for graduate job-seekers and attractiveness for non-commuting university students (from more than 200 km away). (Provincial attractiveness for job-seekers calculated as the ratio between the number of expected job vacancies and provincial jobs; university attractiveness calculated as in equation (1))



One notes immediately that the most attractive northern universities are generally located in provinces with a labour market which looks attractive for graduates (Figure 3). Conversely, no southern provinces are attractive for long-distance university students or graduate job-seekers, except in the cases of Naples, Sassari and Cagliari, where the labour market looks relatively more

dynamic. A smaller number of provinces in Central Italy are attractive to students without having strong labour markets for graduates: this mainly applies to sub-campuses of traditional universities in medium-size cities such as Siena and Perugia, which rely partly on nearby labour markets such as Rome and Florence, and partly on the university's reputation, since these are towns with a strong historical university tradition, where students can go to study and then return home after graduation. Finally, there is a non-negligible number of northern provinces with attractive labour markets but without a significant university population. These are provinces whose residents tend to commute to the main universities nearby (especially those in Milan, Venice and Padua) and return home to work after graduation.

This being the case, it therefore seems plausible that the university system also helps the economy of northern provinces by attracting intelligent young people from the lagging South of Italy. In the next section of the paper, we will test this hypothesis; in particular, we will investigate whether the dynamism of the local labour market is a further attraction factor for university students, besides the quality of the local universities.

3. The determinants of student migration

3.1 Methodology

The aim of this section of the paper is to explain aggregated migration flows of students across Italian provinces. In order to ground the empirical model, let us first consider a very simple, stylized theoretical model in which an individual *i* maximizes his/her utility across space and will move from place x to y to study if:

$$(2) \qquad u_i^x\left(z_i, \omega^x, \sum_t \frac{E[R_t^x]}{(1+r)^t}\right) < u_i^y\left(z_i, \omega^y, \sum_t \frac{E[R_t^y]}{(1+r)^t}, \text{distance}\right)$$

where u^x denotes utility at location x (or y), z_i is a vector of individual characteristics, ω^x is a vector of the socio-economic characteristics of location x (or y), while $\sum_t \frac{E[R_t^x]}{(1+r)^t}$ denotes the net expected value of future incomes (R) in location x (or y) discounted at the discount rate r. Variable *distance* is the distance between x and y.

If expectations are adaptive and are formed by observing current wage, i.e. $E[R_t^x] = f_t(R_0^x)$ and $E[R_t^y] = f_t(R_0^y)$, then equation (2) becomes:

$$(3) \qquad u_i^x\left(z_i, \omega^x, \sum_t \frac{f_t(R_0^x)}{(1+r)^t}\right) < u_i^y\left(z_i, \omega^y, \sum_t \frac{f_t(R_0^y)}{(1+r)^t}, \text{distance}\right)$$

If f is linear and constant across time, and if r is equal across locations, then the probability of moving from location x to location y can be expressed as:

$$(4) \qquad \Pr(move)_i = f(z_i, \varpi^x, \varpi^y, \text{distance}, R_0^x, R_0^y)$$

Hence, if the hypothesis of adaptive expectations is correct, then a decision to move will be made upon observation of current expected wages and more generally, by observing current labour market conditions.

Therefore, the main hypothesis of this paper is that local labour market conditions are an important determinant of the choice of whether and where to move for undergraduate studies.[4] Since we will use data aggregated at a provincial level (the smallest scale for the job-opening data) in this paper, this hypothesis is suitable for testing by estimating a gravity equation where local labour market

[4] In the regressions, the employment rate rather than the unemployment rate is used consistently with the descriptive model, in which the individual makes a decision on where to migrate on the basis of expected income, i.e. $e_i W_i$, where e_i is the employment rate and W_i is the wage/income in province i. By taking logs of this expression, one arrives at the conclusion that the employment rate is one of the regressors in the migration equation.

characteristics are considered as independent variables that influence the process of producing interregional student migration flows.

As per equation (4), student migration across provinces can be conceived as a form of spatial interaction, and thus be studied within the framework of gravity models. In analogy with Newton's law of gravity, student flows (that is, interaction intensity) can be predicted according to the following formula:

(5) $$I_{xy} = K \frac{M_x^{\beta_1} M_y^{\beta_2}}{d_{xy}^{\beta_3}}$$

Where I_{xy} is the interaction intensity or the number of students resident in province *x* enrolling for graduate courses in province *y*, K is a proportionality constant, M_x is the mass of the province of origin (in this case the row sum of the student origin-destination flow matrix), M_y is the mass of the province of destination (in this case the column sum of the students origin-destination flows matrix), d_{xy} is the physical distance between the two provinces, β_1 is the potential to generate flows, β_2 is the potential to attract flows, and β_3 is an impedance factor reflecting distance decay (Burger et al., 2009). This model can also accommodate the inclusion of additional variables (Feenstra, 2004).

The decision to estimate a gravity model is not new in the literature on migration, and Sà et al. (2004) also use this approach to estimate Dutch student migration determinants. In this case, however, the authors focused on certain universities, so that their origin-destination flow matrix was rectangular. In our case, we focus on all provinces, because our aim is to highlight the capacity of a province to attract potentially highly-skilled workers.

Traditionally, the usual estimation strategy of gravity models was to use ordinary least square methods (OLS). However, a series of papers have questioned this estimation strategy, pointing out

the limitations, inconsistencies and biases that it yields (Burger et al. 2009; Flowerdew and Aitken, 1982; Peri, 2005; Santos Silva and Tenreyro, 2006)).

Among the possible alternatives, the use of Poisson and modified Poisson models in particular has progressively gained attention (see e.g. Peri, 2005 on patent data; Santos Silva and Tenreyro, 2006, and Burger et al., 2009 on trade data; and Flowerdew and Aitken, 1982 on migration data). In fact, this family of models can easily accommodate applications to non-negative integer variables such as student flows across provinces.

In this paper, after statistical testing for the correct specification, we will make use of zero-inflated models (Long and Freese, 2006), which are a specific, modified family of Poisson models that make it possible to take into account the highly skewed distribution of the dependent variable and the large number of zeros it shows (i.e. about 60% of observations).

More precisely, our model of reference is the zero-inflated negative binomial model which also allows one to account for the presence of over-dispersion (that is, the variance is different from the mean). Other studies have adopted a zero-inflated negative binomial model to study migration flows (Flowerder and Aitken, 1982; Bohara and Kreig, 1996); in this paper the choice of the estimation model is statistically supported by the results of the Vuong test (reported in Table A3 in Annex).[5] Finally, as with all models in the Poisson family, it is inherently heteroschedastic, and requires the use of a robust estimator.

3.2 Empirical results

In section 3.1, we proposed a simple theoretical model in which individuals (students) maximize utility across locations and form expectations regarding their future earnings under the assumption of adaptive expectations. Given equation (4), we estimate an econometric model with the following form:

[5] Please note that the results obtained using more traditional estimation techniques, performed as robustness checks, are qualitatively similar.

(6) $I_{xy} = f(\text{origin characteristics, destination characteristics, distance, controls})$

where I_{xy} is the interaction intensity, or the number of students resident in province *x* enrolling for graduate courses in province *y*. It is worth remarking that provinces without university campuses are excluded from the estimations *ex-ante*, because by definition they do not attract flows.[6] The 'masses' of province *x* and *y* are measured as row and column sums of the students origin-destination flow matrix respectively. This variable is also highly correlated with the human capital stock of a given province. It should be noted that our model is fully symmetric, with the sole exception of the dummies indicating the size and attractiveness of the university and those for the location of the province of origin. Furthermore, we do not impose the condition of equal coefficient for origin and destination.

The data are very detailed in their spatial and educational characteristics, but somewhat short as a time series, because collection of them began only recently. For this reason, the model must be estimated as a cross-section, with the independent variables lagged in order to mitigate the risks of endogeneity. The lagged explanatory variables are those which students should have already observed before taking a decision on enrolment. We use student flows in year 2007 as the dependent variable and year 2006 for independent variables; more recent data (year 2008) are also available, but they may have been distorted by the effects of the economic crisis.

In particular, as explanatory variables in equation (6), we use origin and destination masses (as defined above), the Euclidean distance, labour market variables and a set of province- and university-specific variables. As to labour market variables, we use the ratio between job vacancies for graduates and the total number of jobs in the province, while controlling for the province's employment rate. With regard to province-specific variables, we include province income, house prices to measure the cost of living as well as geographic destination dummies for central and

[6] The Italian university system is very fragmented, with almost 400 universities and "sub-campuses" competing for students on a door-to-door basis, with the result that there are universities in all but two Italian provinces [già detto].

Southern regions, which are meant to control for the traditional north-south migration flows that characterize the Italian case, as discussed in Sections 1 and 3.

As to university-specific characteristics, we control for a series of variables intended to measure the quality of the university and hence its attractiveness. In particular, we control for the presence of a "*Rettorato*" in both the origin and destination provinces - that is, whether the province is the location for the offices of the Rector (this variable is very important for universities with multiple locations), for the average university fees in the province, and for the average research quality in the province, as measured by the share of the faculty who receive national funds for research. We also control for the average share (in the province) of students who graduated from high school with honours (defined as "talents" in the tables). All these data are taken from the database published annually by the leading Italian economic newspaper, *Il Sole 24 Ore*, which re-elaborates the data from official government sources which are the foundation of all analyses of the Italian university system (Agasisti and Dal Bianco, 2007a).

In addition to these control variables, we have created a destination dummy variable "national university attraction pole" for the provinces of Bari, Bologna, Florence, Milan, Naples, Rome, and Turin (that is, the provinces with the largest student populations in Italy), and another dummy variable "small traditional university" for the provinces of Macerata, Modena, Pesaro and Urbino, Perugia, Siena, Trento, and Venice, where the ratio between student in-flows and the resident population is two standard deviations above the national average. These provinces tend to coincide with those with long-established universities. Table A1 of the Annex reports details on the data and their sources.

As stated above, the dataset is characterized by a large proportion of zeroes; the Vuong test strongly supports the implementation of the zero-inflated negative binomial model ($z=10.29$; $p<0.001$).

For ease of interpretation and in order to assess the magnitude of impact, Table 3 reports only the marginal effects for the econometric estimates of the count equation in the baseline regression. The two sets of estimates, one for the count regression and one for the ancillary inflation regression

(which is mainly intended to control for biases in the estimation of zero flows in the count equation) are reported in the Annex (Table A2)[7]; our estimates are based on robust standard errors clustered on the provinces of origin.

In particular, consistently with the prediction of the gravity model, the greater the masses, the greater the number of students moving from region *x* to region *y*; also, the effect of geographical distance is negative and statistically significant.

Contrary to our expectations, per capita income in both the destination and origin provinces has no significant effect, and does not support the idea that more developed provinces are able to attract more students, perhaps because per capita income is not a direct indicator of opportunities for young people and is normally positively correlated to the general cost of living (excluding housing, that is).

On the other hand, as expected, housing prices in the destination province negatively and significantly affect migration flows. Housing prices in the origin province also have a negative coefficient, although it should be noted that this has a high probability of being zero, as it is not significant at 5%.

Also as expected, employment rates in origin and destination provinces significantly affect the number of students moving from province x to province y;[8] while the employment rate in the province of origin has a negative effect, the employment rate in the province of destination has a positive effect, since the effect of the former is greater than that of the latter. Therefore, student migration can be seen as a reaction to a low employment rate in the province of origin, and is primarily directed towards provinces with better employment opportunities. This might also explain why we do not find any significant effect for per capita income in both the origin and destination provinces. It may be, in fact, that employment rate captures the effect of the actual conditions in the local labour market and in the local economy in general.

[7] Accordingly, the text comments only on the count equation estimates.

[8] It should be noted that we make use of the employment rate as a proxy of the probability of finding a job, and hence as an important ingredient in the choice on where to migrate, according to equation (2).

Confirming the intuitions of Sections 2 and 3.1, the existence of a vibrant local labour market for graduates in the destination province acts as an attractor of student migration, because its coefficient is highly significant with the expected sign. Student migration responds to labour market incentives: that is, university student flows are directed towards areas where students can expect to have better employment possibilities. This result seems to confirm our hypothesis that students also make their migration choices on the basis of adaptive expectations. First, students make the choice to migrate on the basis of local labour market outcomes (i.e. employment rate), and second, they form their expectations by observing current outcomes in terms of job opportunities, as measured by job vacancies.

Interestingly, while the effect of the number of graduate job vacancies in the destination province is significant, that in the origin province is insignificant, and almost nil. This might be due to the fact that what really matters is attraction by the dynamic job-market, while the push from less dynamic job-markets is less able to differentiate the flows.

As to variables related to the quality of university, as expected, the presence of a "*Rettorato*" in the destination province plays a significant role in explaining student movement; equally expectedly, "small traditional" and "national" universities attract more students than the others.

Interestingly , university quality measured by "talents" is found to be significant and with the expected sign (student enrolments are higher in provinces with universities able to attract the best students). Despite their limited variance, university fees are negatively correlated with the quantity of students enrolled, as expected.

To be noted is the negative and significant coefficient associated with research quality, which measures the share of faculty who have received grants of national funds. However, we think that this widely-used variable is a poor approximation for the true quality of research (as expressed, for example, by the number and quality of publications or citations per academic), as the funds are allocated not as a function of scientific productivity, but on a quasi-redistributive basis. Data on

research output are not currently available, although they will probably be released in the near future, because research assessment exercises have been recently introduced.

Table 3. Marginal effects on the baseline model

Dependent variable: Enrolments 2007 > 200 km	Marginal effect
Mass (1000s of students) - destination	0.176***
	(0.000)
Mass (1000s of students) - origin	0.139**
	(0.004)
Metric distance (100s of km)	-0.221***
	(0.000)
Per capita income (log) - destination	0.321
	(0.540)
Per capita income (log) - origin	-0.344
	(0.818)
House prices (log) - destination	-1.495***
	(0.000)
House prices (log) - origin	-0.665
	(0.091)
Employment rate - destination	18.650***
	(0.000)
Employment rate - origin	-14.593**
	(0.007)
Graduate job openings on jobs (log) - destination	1.890***
	(0.000)
Graduate job openings on jobs (log) - origin	0.046
	(0.896)
Rettorato (dummy) - destination	0.350**
	(0.022)
Rettorato (dummy) - origin	0.008
	(0.968)
National university attraction pole (dummy) – destination (1)	0.785***
	(0.000)
Small university (dummy) – destination (1)	2.890***
	(0.000)
University fees – destination	-0.410**
	(0.006)
Talents – destination	0.080***
	(0.000)
Research quality - destination	-0.040***
	(0.000)
Centre (dummy) – destination (1)	-0.819***
	(0.000)
South (dummy) – destination (1)	0.440
	(0.494)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. P-values in parentheses. Standard errors are clustered on the origin province.
(1) dy/dx is for discrete change of dummy variable from 0 to 1

As to the control variables 'Centre' and 'South' as destinations for migrants, students are significantly less likely to move to central Italian provinces than to northern Italian provinces, whereas (somewhat unexpectedly) students move to southern Italian provinces as much as they do to northern Italian provinces.

To sum up, the attractiveness of the destination province in terms of labour opportunities and employment rate, besides the presence of high-reputation universities within a national market area, largely explains student flows from one province to another.

3.3 Robustness checks

The results in the previous section generally seem to confirm our hypothesis that student migration behaviour reacts to local labour market conditions. In this section, we discuss the series of robustness checks we conducted, the results of which are reported in the Annex.

The inclusion of interactions between university variables and geographic distance allows us to test whether our results are robust to possible different distance-decay effects on the attractiveness of national/international high-quality universities and the rest, this is done in Table A2, where the first column reports the same baseline regression of sub-section 3.2. As shown by Table A2 in the Annex (column 2), the interaction term between distance and national university attraction pole is not significant, and wipes out the significant effect of the latter variable (possibly because of multi-collinearity problems); conversely, there is a moderate distance decay effect for small, traditional universities, which seem to be more sensitive to distance (Table A2, column 3). Lastly, no distance decay effect is detected when the variable *Rettorato* is used (Table A2, column 4), even if the coefficients of some destination variables, notably house prices and employment rates, decrease. Importantly, the job openings variables which are the focus of the paper are unaffected in terms of magnitude and significance.[9]

[9] We introduced the three interaction terms in turn to preserve the interpretability of the simple effect of the distance variable. In fact, once interacted, the coefficient of this variable must be interpreted, not as the main but as a simple

Our methodology also proves to be robust to considering other estimation procedures. Table A3 reports the results of a series of tests on the goodness of fit (in our baseline specification) when using Poisson, negative binomial, and zero-inflated Poisson models, as well as - for comparison - our zero-inflated negative binomial model; on this basis, the methodological choice of using a zero-inflated model seems the most appropriate, although the results are equally qualitative with all estimation techniques.

Finally, our data allowed us to split the number of students enrolling for graduate courses in a province other that of residence into four groups, according to their field of study (models 1 to 4 in Table A4 in the Appendix). The results (from the count equation) on the job-openings effect in the destination province confirm the indications in Table 3, although to a reduced degree, with the exception of Medicine and Healthcare, in which job vacancies in related fields are unexpectedly found to be significant but negative. Our interpretation of this result is that the main type of employment for graduates in this field is in the public sector (for example, public healthcare) and subject to public competitions; in this case, there is little point in migrating to attend better universities or enter more dynamic labour markets when what matters more is the final score in university examinations.[10]

As to the university-related variables, the sign and significance of the estimated coefficients (in the count equation) are confirmed overall, despite the fact that they become somewhat more instable (for example, *Rettorato* loses significance in two cases, national university attraction pole in one, and small university in two). Similarly, university quality variable coefficients become somewhat more unstable.

Finally, we also tested model 1 of Table A2 by removing the (destination) observations of Rome and Milan, the two largest and most dynamic metropolitan areas in the country, which may be

effect: that is, the effect of distance when the other variable takes value 0. Therefore, the interpretation of the simple effect of the distance variable becomes problematic when three interactions are introduced jointly.

[10] It is worth mentioning that the magnitude of the coefficient of the variable job-openings in the destination province underwent a rather significant decrease when we re-ran our regressions by field of study, maybe in part because it is not just the discipline-specific vacancies that affect student flows in any one discipline.

outliers in a number of socio-economic aspects. The impact (from the count equation) on our main variables of interest (i.e. labour market variables) is qualitatively unchanged, although with a lower coefficient.

4. Conclusions

In this paper, we have analysed the role of universities in regional development as potential catalysts for brain gain processes, enabling regions to attract bright students who may decide to stay on after graduation. In this way, universities can augment the capacity of regions with vibrant economies and dynamic labour markets to attract intelligent people from lagging regions.

The paper has detected and tested this mechanism for the Italian case, which is of interest because of its dual labour market structure and its university system. The descriptive analysis in Section 2 has shown that no province in the lagging South is a net attractor of university students from more than 200 km away.

Econometric evidence has highlighted that the attractiveness of provinces for university enrolment is linked to the prospects of job vacancies for graduates, meaning that although university quality and characteristics do play an important role, the characteristics of the labour market of the destination province should not be overlooked. The results on our chief variables capturing labour market conditions have the expected sign, and these results are robust to several controls, confirming the hypothesis that students make their migration choices according to the tightness and dynamism of local labour markets.

The results point up the fact that there may be a reinforcing mechanism between university attractiveness and economic development, since universities benefit from the dynamism of the local labour market in terms of superior student attractiveness, and, in turn, richer provinces benefit from the presence of attractive universities in order to gain bright students from lagging areas of the country.

This suggests that using university policy as a stand-alone development measure may be ineffective. In fact, on the one hand, university knowledge spillovers need a receptive local firm system; on the other hand, good local universities may find it hard to attract and keep the best students when these can find better opportunities if they study at universities embedded in more dynamic labour markets.

Our empirical results are quite robust. However, a caveat should be expressed in regard to some possible limitations. Firstly, we acknowledge that the university quality measures we have adopted could be refined. However, more accurate measures are either not available or available for a smaller sample of universities (e.g. mostly public), and aggregating university level data at the provincial level is far from straightforward. Also, our estimates might be affected by a certain degree of endogeneity, although the use of lagged dependent variables is intended to mitigate a bias of this kind, and some of the data used are brand new, and hence available on a short-term series.

Further research could therefore be directed towards identifying a more causal link between migration flows and labour market outcomes, as our results are based on a pure cross-section due to the data available. In addition, a richer analysis of the role of spatial spillovers, especially in terms of local labour market interactions, could prove beneficial for overall understanding of the phenomenon.

References

Agasisti, T. and Dal Bianco, A. (2007) Cost Structure of Italian Public Universities: An Empirical Analysis, *Higher Education in Europe*, Vol. 32, No. 2/3, July–October 2007

Agasisti, T. and Dal Bianco, A. (2007) Determinants of College Student Migration in Italy: Empirical Evidence from a Gravity Approach, mimeo retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1063481.

Banca d'Italia (2005), *Relazione Annuale*, Banca d'Italia, Roma.

Baryla, E.R., and Dotterweich, D. (2001). Student Migration: Do Significant Factors Vary by Region?. *Education Economics*, 9(3): 269-280

Berry, C., and Glaeser, E.L. (2005), The Divergence of Human Capital Levels across Cities, *Papers in Regional Science* 84(3): 407-444.

Biggeri, L. and Catalano, G. (Eds.). (2006). L'Efficacia delle Politiche di Sostegno agli Studenti Universitari. Bologna: Il Mulino.

Brizzi, G. P., Del Negro, P. and Romano, A. (Eds.). (2007). *Storia delle Università in Italia*. Messina: Sicania by GEM.

Bohara A.K. and Krieg, R.G. (1996) A Zero-inflated Poisson Model of Migration Frequency, *International Regional Science Review*, 19(3): 211-222

Burger, M., van Oort, F., Linders, G-J. (2009) On the Specification of the Gravity Model of Trade: Zeros, Excess Zeros and Zero-inflated Estimation, *Spatial Economic Analysis*, 4(2): 167–190.

Cameron, A.C. and Trivedi, P.K. (1998), *Regression Analysis of Count Data*. Cambridge: Cambridge University Press.

Cameron, A.C., Li, T., Trivedi, P.K. and Zimmer, D.M. (2004) Modelling the differences in counted outcomes using bivariate copula models with application to mismeasured counts, *Econometrics Journal*, 7(2): 566-584.

Cameron A.C. and Tirvedi P.K. (2010), *Microeconometrics: Methods and applications*, Cambridge University Press, Cambridge, UK.

Ciriaci, D. (2005), La fuga del capitale umano qualificato dal Mezzogiorno: un *catching up* sempre più difficile, *Rivista Economica del Mezzogiorno*, 19(2-3): 369-403.

Coniglio, N.D. and Prota, F. (2008), Human Capital Accumulation and Migration in a Peripheral EU Region: the Case of Basilicata, *Papers in Regional Science*, 87(1): 77-95.

Dotterweich, D., & Baryla, E. r. (2005). Non-resident Tuition and Enrollment in Higher Education: Implications for Tuition Pricing. *Education Economics*, 13(4): 375-385.

Dunford, M. (2002) Italian regional evolutions, *Environment and Planning A*, volume 34, pp. 657-694.

Etzkowitz, H. and Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and "mode 2" to a Triple Helix of university-industry-government relations. *Research Policy*, 29(2): 109-123.

European Foundation for the Improvement of Living and Working Conditions (2006), "Mobility in Europe. Analysis of the 2005 Eurobarometer survey on geographical and labour market mobility".

EC- Commission of the European Communities (2010), *Europe 2020. A strategy for Smart, Sustainable and Inclusive Growth*, COM(2010) 2020 final, Brussels, 3.3.2010

EU-Commission (2003). The role of the universities in the Europe of knowledge. Retrieved on 24-04-2010. from http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=COMfinal&an_doc=2003&nu_doc=58.

Faggian, A. and McCann, P. (2004). Human Capital Flows and Regional Knowledge Assets: A Simultaneous Equation Model: European Regional Association.

Faggian, A. and McCann, P. (2009) Human capital, graduate migration and innovation in British regions," *Cambridge Journal of Economics*, 33(2): 317-333.

Faggian, A. and McCann, P. (2009) Universities, Agglomerations And Graduate Human Capital Mobility," Tijdschrift voor Economische en Sociale Geografie, 100(2): 210-223.

Faggian, A., Sheppard, S. and McCann, P. (2006). An Analysis of Gender Differences in UK Graduate Migration Behaviour: ERSA - European Regional Science Association.

Flowerdew, R., and Aitken, M. (1982) `A Method of Fitting the Gravity Model Based on the Poisson Distribution,' *Journal of Regional Science*, 22(2): 191-202

Foray, D. (2004). Economics of knowledge. Cambridge, Mass.: MIT Press.

Fotheringham, A.S. and O'Kelly, M.E. (1989) *Spatial Interaction Models: Formulations and Applications*, London: Kluwer.

Fratesi, U. and Percoco, M. (2011), Selective migration and regional growth: evidence from Italy, Politecnico di Milano and Università Bocconi, mimeo.

Fratesi. U. and Riggi, M.R. (2007) Does Migration Reduce Regional Disparities? The Role of Skill-Selective Flows, *Review of Urban and Regional Development Studies*,19(1): 78-102.

Frenette, M. (2004). Access to College and University: Does Distance to School Matter? Canadian Public Policy / Analyse de Politiques, 30(4), 427-443.

Gagliardi, L. and Percoco, M. (2010), Regional Disparities in Italy Over the Long Run: The Role of Human Capital and Trade Policy, Università Bocconi, mimeo.

Gutierrez, R. and Fermin Villeneuve, R. (2001). Il Manifesto di Oviedo: Universitas et Civitas. Il ruolo delle università nei processi di sviluppo locale. *Sviluppo Locale*, 3(16), 120-129.

Jaffe, A. B. (1989). Real Effects of Academic Research. *American Economic Review*, 79(5), 957-970.

Hsing, Y., & Mixon, F. r. (1996). A Regional Study of Net Migration Rates of College Students. *Review of Regional Studies*, 26(2), 197-209.

Kanbur, R. and Rapoport, H. (2005) Migration Selectivity and the evolution of spatial inequality, *Journal of Economic Geography*, 5(1): 43-57.

Kim, E.H., Morse, A. and Zingales, L. (2009), Are elite universities losing their competitive edge?, *Journal of Financial Economics*, 93(3):353-381.

Lenzi C. (2008), "The mobility of researchers in the knowledge-based society: The case of the pharmaceutical sector in Italy", *Economia e Politica Industriale – Journal of Industrial and Business Economics*, 35(2): 155-172.

Long J.S. and Freese J. (2006), *Regression models for categorical dependent variables using STATA*", 2nd edition, College Station, Texas: Stata Press.

Lundvall, B. A. (2001). Innovation Policy in the Globalising Learning Economy. In D. Archibugi & B. A. Lundvall (Eds.), *The Globalising Learning Economy*. Oxford: Oxford University Press.

Muzzicato, S., Sabbatini R., and Zollino F. (2008), Prices of Residential Property in Italy: Constructing a New Indicator, Banca d'Italia, Questioni di Economia e Finanza No. 17.

Orsi, R. (2001). Gli studenti fuori sede dell'Università di Bologna: un'analisi quantitativa dell'impatto sull'economia locale. Unpublished Institutional report. Università degli Studi di Bologna "Alma Mater Studiorum".

Perry, D. C. and Wiewel, W. (2005). *The university as urban developer : case studies and analysis*. Armonk, N.Y.

Pike, A., Rodriguez-Pose, A. and Tomaney, J. (2006). *Local and regional development*. London: Routledge.

Sá, C., Florax, R. and Rietveld, P. (2004) Determinants of the Regional Demand for Higher Education in The Netherlands: A Gravity Model Approach, *Regional Studies*, 38(4): 375-392

Santos Silva, J. M. C. and Tenreyro, S. (2006) The Log of Gravity, *The Review of Economics and Statistics*,88(4): 641-658

Saxenian A. L. (1996) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* Harvard University Press.

Spiess, C. K. and Wrohlich, K. (2008). Does Distance Determine Who Attends a University in Germany (Discussion Paper). Bonn: IZA - Institute for the Study of Labour.

Svimez (2009), *Rapporto sull'economia del Mezzogiorno 2008*, Bologna: Il Mulino.

Tight, M. (2007). The (Re)Location of Higher Education in England (Revisited). Higher *Education Quarterly*, 61(3): 250-265.

Varga, A. (2009) (Ed.) *Universities, Knowledge Transfer and Regional Development: Geography, Entrepreneurship and Policy*. Edward Elgar

Viesti, G. (2005), Nuove migrazioni. Il "trasferimento" di forza lavoro giovane e qualificata dal Sud al Nord, *Il Mulino*, 4: 678-688

Annex

Table A1: Data Sources

Variable	Description	Year used in estimations	Source
University student flows	Number of students enrolling from outside province	2008	ISTAT, "Indagine sulla mobilità degli studenti" and "Anagrafe Nazionale degli Studenti" (National Registry Office for Students) provided by the Ministry of Universities (MIUR)[11]
Housing prices	Price in Euros per square metre of a house in semi-periphery of the provincial capital.	2006	Annuario immobiliare, Il Sole 24 Ore Editore
Attractiveness of labour market	Number of job vacancies on total jobs in the province	2007	Excelsior database[12]; available at: http://excelsior.unioncamere.net/web/index.php
Population		2006	ISTAT (the Italian Institute of Statistics), *Conti territoriali*
Employment	Employment rate	2006	ISTAT, *Conti territoriali*
Per capita income	GVA per capita	2006	ISTAT, *Conti territoriali*
University fees	Average of fees paid by students	2006	ISTAT, "Indagine sulla mobilità degli studenti" and "Anagrafe Nazionale degli Studenti" (National Registry Office for Students) provided by the Ministry of Universities (MIUR)
Rettorato	Presence of university Rettorato	2006	Anagrafe Nazionale degli Studenti" (National Registry Office for Students) provided by the Ministry of Universities (MIUR)
Talents	Share of students with high grades in high school diploma	2006	Il Sole 24 ore
Research quality	Share of faculty scholars granted national funds	2006	Il Sole 24 ore
Metric distance	Distance in km between provincial centres	--	Calculated from GIS maps

[11] In this database, all bachelor and master students are included with their home province (NUTS3 level) and the municipality (NUTS5) where the university campus is located.

[12] As a proxy for the attractiveness of the labour market, we make use of a set of very new variables, which have never been used in other analyses. Our dataset is very detailed, so that we can divide job vacancies into the four categories into which students are classified: Science & Technology (S&T), the Humanities, Social Sciences and Medicine and Healthcare. This is of particular interest when we test our hypothesis for different types of bachelor degrees. The source of these data is micro-data from the Excelsior database, and they have elicited through an *ad hoc* survey every year since 2006. Firms are required to answer questions each year on how many people they are intending to hire over the next period, what functions they will perform, and what experience and qualifications they will have. See the website www.excelsior.unioncamere.net for further details.

Table A2: Estimation coefficients and robustness to distance-decay effects (university-distance interaction effects; zero-inflated negative binomial estimations).

Dependent variable: Enrolments 2007 > 200 km	(1)	(2)	(3)	(4)
Count equation				
Mass (1000s of students) - destination	0.091***	0.091***	0.093***	0.088***
	(0.000)	(0.000)	(0.000)	(0.000)
Mass (1000s of students) - origin	0.101**	0.101**	0.102**	0.101**
	(0.006)	(0.006)	(0.006)	(0.006)
Metric distance (100s of km)	-0.168***	-0.170***	-0.158***	-0.236***
	(0.000)	(0.000)	(0.000)	(0.000)
Per capita income (log) - destination	0.076	0.079	0.101	0.076
	(0.845)	(0.839)	(0.795)	(0.846)
Per capita income (log) - origin	-0.247	-0.249	-0.227	-0.261
	(0.826)	(0.825)	(0.840)	(0.815)
House prices (log) - destination	-1.157***	-1.151***	-1.174***	-1.081***
	(0.000)	(0.000)	(0.000)	(0.000)
House prices (log) - origin	-0.526	-0.525	-0.535	-0.519
	(0.072)	(0.072)	(0.068)	(0.073)
Employment rate - destination	14.280***	14.247***	14.207***	13.861***
	(0.000)	(0.000)	(0.000)	(0.000)
Employment rate - origin	-11.176**	-11.154**	-11.180**	-10.773**
	(0.005)	(0.005)	(0.005)	(0.007)
Graduate job openings on jobs (log) - destination	1.487***	1.487***	1.482***	1.480***
	(0.000)	(0.000)	(0.000)	(0.000)
Graduate job openings on jobs (log) - origin	0.041	0.039	0.029	0.028
	(0.876)	(0.881)	(0.913)	(0.918)
Rettorato (dummy) - destination	0.261*	0.262*	0.255*	-0.295
	(0.016)	(0.016)	(0.019)	(0.109)
Rettorato (dummy) - origin	0.007	0.006	0.006	-0.007
	(0.962)	(0.968)	(0.966)	(0.966)
National university attraction pole (dummy) - destination	0.438***	0.378	0.441***	0.451***
	(0.000)	(0.129)	(0.000)	(0.000)
Small university (dummy) - destination	1.200***	1.196***	1.689***	1.216***
	(0.000)	(0.000)	(0.000)	(0.000)
Centre (dummy) - destination	-0.744***	-0.744***	-0.737***	-0.735***
	(0.000)	(0.000)	(0.000)	(0.000)
South (dummy) - destination	0.283	0.281	0.315	0.248
	(0.518)	(0.520)	(0.476)	(0.567)
University fees (1000s of Euros) - destination	-0.307**	-0.308**	-0.326**	-0.265*
	(0.004)	(0.004)	(0.002)	(0.019)
Talents - destination	0.060***	0.060***	0.059***	0.059***
	(0.000)	(0.000)	(0.000)	(0.000)
Research quality - destination	-0.030***	-0.030***	-0.028***	-0.032***
	(0.000)	(0.000)	(0.000)	(0.000)
National university attraction pole (destination) * Metric distance		0.000		
		(0.716)		
Small university (destination) * Metric distance			-0.001***	
			(0.001)	
Rettorato (destination) * Metric distance				0.001***
				(0.000)
Inflation equation				
Mass (1000s of students) - destination	-1.492***	-1.492***	-1.494***	-1.508***
	(0.000)	(0.000)	(0.000)	(0.000)
Mass (1000s of students) - origin	-0.119**	-0.119**	-0.118**	-0.119**
	(0.007)	(0.007)	(0.008)	(0.009)
Metric distance (100s of km)	-0.101*	-0.103*	-0.095*	-0.129**
	(0.011)	(0.010)	(0.017)	(0.002)
Per capita income (log) - destination	-6.053***	-6.047***	-6.000***	-5.949***
	(0.000)	(0.000)	(0.000)	(0.000)
Per capita income (log) - origin	0.379	0.378	0.407	0.390
	(0.719)	(0.720)	(0.696)	(0.716)
House prices (log) - destination	-1.378***	-1.376***	-1.391***	-1.336***
	(0.000)	(0.000)	(0.000)	(0.000)
House prices (log) - origin	-1.016*	-1.018*	-1.023*	-1.042**
	(0.011)	(0.011)	(0.010)	(0.009)
Employment rate - destination	11.643*	11.619*	11.379*	10.334

	(0.027)	(0.027)	(0.031)	(0.054)
Employment rate - origin	-9.178	-9.164	-9.201	-8.754
	(0.107)	(0.108)	(0.104)	(0.140)
Job openings on jobs (log) - destination	2.650***	2.650***	2.639***	2.649***
	(0.000)	(0.000)	(0.000)	(0.000)
Job openings on jobs (log) - origin	0.250	0.250	0.231	0.256
	(0.329)	(0.329)	(0.363)	(0.327)
Rettorato (dummy) - destination	0.300	0.302	0.296	0.296
	(0.122)	(0.120)	(0.127)	(0.142)
Rettorato (dummy) - origin	0.046	0.044	0.050	0.031
	(0.822)	(0.827)	(0.802)	(0.882)
National university attraction pole (dummy) - destination	-5.489***	-5.515***	-5.475***	-5.429***
	(0.000)	(0.000)	(0.000)	(0.000)
Small university (dummy) - destination	-0.533	-0.534	-0.416	-0.529
	(0.310)	(0.307)	(0.397)	(0.305)
Centre (dummy) - destination	-0.160	-0.160	-0.160	-0.141
	(0.524)	(0.525)	(0.525)	(0.571)
South (dummy) - destination	-1.352*	-1.353*	-1.324*	-1.380*
	(0.020)	(0.019)	(0.021)	(0.018)
Constant	66.062	66.071	66.673	68.985
	(0.057)	(0.057)	(0.054)	(0.052)
Ln-alpha	0.377***	0.377***	0.370***	0.369***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	6448	6448	6448	6448
Zero observations	4081	4081	4081	4081
Chi2	5897.59	5989.75	5690.58	6216.03

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. P-values in parentheses. Standard errors are clustered on the origin province.

Table A3: Robustness checks (alternative estimation procedure and excluding province without campuses)

The counfit command implemented in STATA11 and discussed by Cameron and Trivedi (2010) allows a comparison of the goodness of fit of the estimates obtained from Poisson (PRM), negative binomial (NBRM), zero-inflated Poisson (ZIP) and zero-inflated negative binomial (ZINB) models. This command compares the four models using BIC, AIC and the Vuong test. Accordingly, it gives an indication of the model to be preferred and the strength of the evidence supporting the relevant choice (which in this case is very strong).
Below, we report a summary of the tests implemented that all support the use of the zero-inflated negative binomial model over the other models.

Tests and Goodness of Fit Statistics

PRM			BIC=-11164.690				
			AIC= 7.019				
					Prefer	Over	Evidence
	vs	NBRM	BIC=-38134.518	dif = 26969.828	NBRM	PRM	Very strong
			AIC=2.835	dif=4.184		NBRM	PRM
			LRX2=26978.600	prob = 0	NBRM	PRM	p-value=0.000
	vs	ZIP	BIC=-17626.920	dif= 6462.23	ZIP	PRM	Very strong
			AIC=5.998	dif= 1.021	ZIP	PRM	
			Vuong=5.253	prob=0	ZIP	PRM	p-value=0.000
	vs	ZINB	BIC=-38762.432	dif=27597.743	ZINB	PRM	Very strong
			AIC=2.719	dif=4.3	ZINB	PRM	
NBRM			BIC=-38134.518				
			AIC=2.835				
					Prefer	Over	Evidence
	vs	ZIP	BIC=-17626.920	dif=-20507.598	NBRM	ZIP	Very strong
			AIC=5.998	dif=-3.163	NBRM	ZIP	
	vs	ZINB	BIC=-38762.432	dif=627.914	ZINB	NBRM	Very strong
			AIC=2.719	dif=0.116	ZINB	NBRM	
			Vuong=10.287	prob=0	ZINB	NBRM	p-value=0.000
ZIP			BIC=-17626.920		Prefer	Over	Evidence
			AIC=5.998				
	vs	ZINB	BIC=-38762.432	dif=21135.512	ZINB	ZIP	Very strong
			AIC=2.719	dif=3.279	ZINB	ZIP	
			LRX2=21144.284	prob=0	ZINB	ZIP	p-value=0.000

Table A4. Robustness checks: estimations by groups of disciplines of study

Enrolments 2007 > 200Km	(1) (Model 1) Science & Technology	(2) (Model 2) Medicine and Healthcare	(3) (Model 3) Social Sciences	(4) (Model 4) Humanities	(5) (Model 5) All fields except Rome and Milan
Count equation					
Mass (1000s of students) - destination	0.070***	0.096***	0.101***	0.034***	0.204***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mass (1000s of students) - origin	0.091*	0.059	0.123**	0.106***	0.115**
	(0.039)	(0.168)	(0.009)	(0.001)	(0.003)
Metric distance (100s of km)	-0.179***	-0.147***	-0.171***	-0.198***	-0.177***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Per capita income (log) - destination	1.910**	2.268**	0.083	3.218***	1.298**
	(0.001)	(0.008)	(0.876)	(0.000)	(0.006)
Per capita income (log) - origin	-0.037	-0.839	0.202	-0.015	-0.384
	(0.979)	(0.512)	(0.840)	(0.990)	(0.746)
House prices (log) - destination	-1.046**	-2.368***	-0.482	0.118	-1.395***
	(0.010)	(0.000)	(0.073)	(0.668)	(0.000)
House prices (log) - origin	-0.529	-0.551	-0.330	-0.382	-0.560
	(0.123)	(0.220)	(0.286)	(0.210)	(0.067)
Employment rate - destination	7.512	19.271**	13.181***	-2.142	11.864***
	(0.086)	(0.002)	(0.001)	(0.589)	(0.000)
Employment rate - origin	-9.541	-17.373**	-12.876**	-5.111	-10.706**
	(0.076)	(0.006)	(0.003)	(0.175)	(0.010)
Job openings on jobs (log) - destination	0.574***	-0.209**	0.534***	0.242***	1.283***
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Job openings on jobs (log) - origin	0.025	0.002	-0.061	-0.145	0.046
	(0.885)	(0.988)	(0.768)	(0.139)	(0.866)
Rettorato (dummy) - destination	0.751***	-0.223	-0.129	0.378**	0.114
	(0.000)	(0.252)	(0.448)	(0.004)	(0.366)
Rettorato (dummy) - origin	0.018	0.013	-0.095	0.070	-0.009
	(0.914)	(0.950)	(0.494)	(0.633)	(0.955)
National university attraction pole (dummy) - destination	0.674***	0.071	0.435**	0.850***	-0.163
	(0.000)	(0.699)	(0.010)	(0.000)	(0.248)
Small university (dummy) - destination	0.063	-0.029	1.381***	0.930***	1.248***
	(0.633)	(0.829)	(0.000)	(0.000)	(0.000)
Centre (dummy) - destination	-0.223	-1.124***	-0.698***	-0.502**	-0.854***
	(0.348)	(0.000)	(0.000)	(0.005)	(0.000)
South (dummy) - destination	1.111*	-0.256	0.597	0.942	0.220
	(0.035)	(0.663)	(0.160)	(0.076)	(0.635)
University fees (1000s of Euros) - destination	-0.111	-0.255	0.521***	-0.538**	-0.008
	(0.550)	(0.361)	(0.000)	(0.002)	(0.955)
Talents - destination	0.101***	0.062***	0.046***	0.018	0.035***
	(0.000)	(0.000)	(0.000)	(0.209)	(0.000)
Research quality - destination	-0.034*	-0.056**	0.005	0.043**	-0.021*
	(0.034)	(0.001)	(0.594)	(0.001)	(0.015)

Inflation equation					
Mass (1000s of students) - destination	-1.165***	-1.116***	-1.894***	-2.425***	-1.744***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mass (1000s of students) - origin	-0.103	-0.135***	0.015	0.012	-0.094
	(0.103)	(0.000)	(0.631)	(0.712)	(0.079)
Metric distance (100 km)	-0.038	-0.154*	-0.020	-0.048	-0.140**
	(0.487)	(0.014)	(0.644)	(0.493)	(0.003)
Per capita income (log) - destination	-2.891	0.704	-0.087	0.990	-4.194*
	(0.053)	(0.623)	(0.948)	(0.651)	(0.036)
Per capita income (log) - origin	-1.716	2.915*	0.633	-0.720	0.236
	(0.130)	(0.022)	(0.582)	(0.443)	(0.850)
House prices (log) - destination	-1.402*	-1.724***	-0.777	-0.203	-2.036***
	(0.031)	(0.001)	(0.163)	(0.777)	(0.000)
House prices (log) - origin	-0.358	-1.447**	-0.806	-0.615	-1.217**
	(0.493)	(0.002)	(0.121)	(0.214)	(0.010)
Employment rate - destination	3.829	-22.516	-6.116	-16.054	7.353
	(0.673)	(0.063)	(0.594)	(0.301)	(0.471)
Employment rate - origin	-0.921	-12.928*	-11.002	-6.404	-9.243
	(0.878)	(0.022)	(0.071)	(0.320)	(0.194)
Job openings on jobs (log) - destination	1.348**	-0.266**	0.661**	0.498*	2.719***
	(0.001)	(0.008)	(0.001)	(0.044)	(0.000)
Job openings on jobs (log) - origin	0.535**	0.342	-0.521*	-0.027	0.301
	(0.003)	(0.070)	(0.030)	(0.857)	(0.333)
Rettorato (dummy) – destination	-0.650	0.628*	0.288	3.252***	0.291
	(0.059)	(0.036)	(0.568)	(0.001)	(0.231)
Rettorato (dummy) – origin	0.011	0.894***	-0.029	0.001	0.038
	(0.958)	(0.000)	(0.894)	(0.995)	(0.882)
National university attraction pole (dummy) - destination	-7.059**	4.500***	-2.596	-0.944	-3.489
	(0.008)	(0.000)	(0.429)	(0.774)	(0.335)
Small university (dummy) - destination	-2.624	-1.337**	0.205	-0.120	0.140
	(0.745)	(0.005)	(0.831)	(0.803)	(0.892)
Centre (dummy) - destination	-0.110	0.543	-0.217	-0.529	-0.365
	(0.794)	(0.151)	(0.553)	(0.060)	(0.265)
South (dummy) - destination	-0.583	-0.774	-0.921	-1.294*	-1.467*
	(0.488)	(0.260)	(0.100)	(0.015)	(0.045)
Constant	50.206	153.964***	87.387	110.572*	75.185
	(0.314)	(0.000)	(0.120)	(0.048)	(0.060)
Ln-alpha	0.467***	0.896***	0.548***	0.138	0.474***
	(0.000)	(0.000)	(0.000)	(0.271)	(0.000)
Observations	6448	6448	6448	6448	6311
Zero observations	5194	5514	4983	5472	4081
Chi2	2080.19	566.62	3058.06	1440.18	2803.04

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. P-values in parentheses. Standard errors are clustered on the origin province.