University quality, interregional brain drain and spatial inequality. The case of Italy.

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UNIVERSITY QUALITY, INTERREGIONAL BRAIN DRAIN AND SPATIAL INEQUALITY.

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Abstract:

Universities are increasingly recognized as key driver of economic development through their role in knowledge production and human capital accumulation, and as attraction poles for talents. That is why this paper analyses the sequential migration behaviour of Italian students-graduates before their enrolment at university, and after graduation, and the role that university quality has in these choices. From a regional development perspective, a better understanding of the causes of Italian interregional brain drain may help to guide policy intervention aimed at reversing or partially compensating for its negative effects on the source regions. The results confirm 'university quality' as a «supply» tool for policy makers to counterbalance the negative effects of the brain drain on human capital accumulation.

JEL classification: R23; R58; J 24; J 61

Keywords: Brain-drain, labour mobility, university quality, regional economic disparities.

INTRODUCTION

Universities have come under increasing pressure to become key drivers of economic

development in the age of the knowledge economy (European Commission, 2010). Recent

research on their regional impacts pointed to three kinds of contributions made by these

institutions to their host regions: a direct economic impact, an indirect service provision, and

the quality upgrading of local economies and political systems (Benneworth *et al.*, 2010).

From a demand point of view, their economic impact is mainly due to student spending power

which supports the local economy (Armstrong, 1993; Harris, 1997). From a supply side point

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of view, since knowledge ultimately rests within individuals (Boschma *et al.*, 2009) the outcome of their decision about where to study and work contributes to the process of regional human capital accumulation (Becker, 1964; Mixon and Hsing, 1994a) and knowledge creation (and its externalities), which are fundamental for regional growth and competitiveness (Lucas, 1988). Beside this knowledge transfer/creation argument (Faggian and McCann, 2009), graduates' mobility (and more in general labour mobility) also enables regional structural change that is crucial for long-term growth (Boschma *et al.*, 2009). Therefore, better higher education facilities and institutions might enhance - *ceteris paribus* - regional attractiveness and play a role in the decision of students and graduates to migrate (Niedomysl, 2006; Baryla and Dotterweich, 2001). This argument may hold especially for countries, such as Italy, characterized by persistent and significant regional per capita income and labour market divergences (Ciriaci and Palma, 2008; Saraceno, 1983; Graziani, 1978), and by low inter-generational mobility both in terms of educational level and employment opportunities (Checchi, Ichino Rustichino, 1999), and where migration towards wealthier regions makes the possibility of improving the standard of living more realistic. This in turn might stimulate the accumulation of human capital not only in wealthier regions - which attract new human capital -, but also in less industrialized regions as the possibility of migration might foster local universities enrolments (Mountford, 1997).

So far, however, Italian empirical evidence suggested something different. Instead of acting as an equilibrating mechanism, Italian interregional migration flows appear to enhance existent cumulative economic processes (Fratesi and Percoco, 2009; Marinelli, 2010; Ciriaci, 2005; Ciriaci, 2001) as it is increasingly directed from the less industrialized Italian Southern

provinces to richer Central Northern ones[2]. Furthermore, over the last decade both return migration and university enrolments in Southern regions have decreased (SVIMEZ, 2009; Ciriaci, 2005), rather than increased. Therefore, Italian human capital tends to accumulate in wealthier Centre-North regions, which offer better employment opportunities than their Southern counterparts.

Though the debate on the economic consequences of these flows is still an open one, the literature shares the idea that the greater is the net inflow of newly-acquired human capital, the greater are the specifically local regional returns to national higher educational policies (Faggian and McCann, 2008; Bennet *et al.*, 1995). Generally speaking, however, it is not guaranteed that all types of knowledge inflows (or outflows) have necessarily a positive (negative) effect on regional economic development (Boschma and Iammarino, 2009). Following Boschma *et al.* (2009)[3] and Boschma and Iammarino (2009), it can be argued that the process of skilled mobility cannot be easily separated into a simple dichotomy of *gain* and *drain*[4] as labour mobility crossing regional boundaries is not necessarily good or bad for

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[2] In this paper Central-Northern provinces include those of Lazio, Tuscany, Umbria, Marche, Emilia-Romagna, Liguria, Valle d'Aosta, Piedmont, Lombardy, Trentino A.A., Friuli Venezia-Giulia, Veneto and Southern (or Mezzogiorno) provinces include those of Campania, Abruzzi, Molise, Puglia, Basilicata, Calabria, Sicily and Sardinia.

[3] Boschma *et al.* (2009) analyzing the impact of skills portfolio and labour mobility on plant performance for the Swedish economy, found that labour mobility across regions has a positive impact on plants' productivity growth only when this concerns new employees with related competences (but non similar to the existing knowledge base of the plant). They argue that the inflow of new skills in the region might contribute to avoid a lock-in problem, which "with labour inflow of skills that are already present in the plant, will only get worse when the new employees are recruited from the same region" (Boschma *et al.*, 2009, p. 171). Similarly, investigating the effects of different types of trade linkages on regional growth in Italy, Boschma and Iammarino (2009) found out that when extra-region knowledge originated from sectors a region was already specialized in, it did not positively impact on regional growth as it did not add anything new to the existing base of the region.

[4] This implies that to the extent that these complementarities exist, the ability of a region to maintain its competitiveness would mainly rely on its capability to retain its "complementary" university graduates than everyone (whether or not resident in that region before their enrolment) and to attract "complementary"

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regional competitiveness (Boschma *et al.*, 2009; Boschma and Iammarino, 2009). The positive or negative "competitiveness outcome" will depend on the extent to which these inflows (outflow) of skills are complementary (or not) to existing competences in the region of destination. Anyway, in the context of innovation studies there is evidence supporting the potential knowledge transfer of human capital mobility (Faggian and McCann, 2009; Power and Lundmark, 2004; Breschi and Lissoni, 2003)[5], although there is no obvious dominant causality between skilled labour migration and regional innovation (Faggian and McCann, 2009). There is also a body of empirical evidence showing that scientific excellence has positive effects on local economic development processes, technology transfer, and firms' innovation activity (Geuna and Muscio, 2009). Sterlacchini (2008) has shown that the recent economic growth of the EU regions has been positively and significantly affected by their knowledge base captured by the intensity of R&D expenditures and the share of adults with tertiary education, although this effect was lower in the case of European southern regions. As far as Italy is concerned, Fratesi and Percoco (2009) found out that over the period 1980-2001, the loss of human capital due to skilled migration outflows has been detrimental for growth in the regions of origins.

With these considerations in mind, the purpose of this paper is to analyze the sequential migration behaviour of Italian students-graduates before their enrolment at university, and after graduation, and the role that university quality has in these choices. In both migration cases, the analysis is carried out for graduates as a whole, namely it includes both migrants and not migrants. Their migration choices may be influenced by university quality in two

graduates from other regions (Faggian and McCann, 2008). I am grateful to an anonymous referee for such a comment.

[5] Faggian and McCann (2008) found evidence of an endogenous and cumulative process of British graduates migrating to employment in British innovative regions, whose innovation performance was also positively related to such human capital inflows.

different ways: it may act as a "pull" factor when a student decides where to study - a student may decide to migrate to study to look for a better university - and as a "signal" to firms when the former student decides where to live after graduation. In the Italian case, for instance, previous findings (Ciriaci and Muscio, 2010; Zinovyeva and Sylos Labini, 2008) suggests that graduating from a better university significantly increases the probability to find a job in the same region of the university. Therefore, the probability that after graduation the individual will face the necessity to migrate to find a job will be lower. Furthermore, Di Pietro and Cutillo (2006) found out that Italian graduates who graduated from research-oriented universities are likely to achieve better labour-market outcomes than their peers who graduated from a less research-active institution.

To analyze students' ante and post lauream migration choices, I use data from the last survey by the Italian National Statistics Institute (ISTAT) of labour market entry conditions three years after graduation (2007) for Italians who finished their degrees in 2004. This database has been matched using the university attended by the individual as merging variable with the results of the national evaluation of Italian universities' quality carried out by the CIVR (Committee for Evaluation of Research, Italian Ministry of University and Research, 2007) in 2005. This evaluation covered the research activities conducted in the 2001-03, therefore when the students/graduates interviewed by ISTAT were attending university. To my knowledge, this is the first work which use this source - which at the moment is the only official ministerial source of evaluation of academic institutions and are used by the Italian government to assign financial resources to universities - to elaborate two indexes, one to proxy research quality, and the other to proxy teaching quality, and using them to analyze Italian students/graduates migration choices. If empirical evidence were to support the hypothesis that university quality enhances regional attractiveness (favouring the inflow of

students, and reducing their outflow), university quality would emerge as an additional policy instrument to be used to enhance regional capabilities in attracting skilled and "learned" people (Persons, 2004) and acting as nodes within a national system of student-graduate mobility (Faggian and McCann, 2009).

Following the literature on migration modelling (Faggian and McCann, 2009; Hansen and Niedomysl, 2009; Faggian *et al.*, 2007; DaVanzo, 1976, 1983; Greenwood, 1972; Tuckman, 1970; Sjaastad, 1962) the individual migration choice is modelled controlling for individual characteristics, field of study, wage differentials (Kwok and Leland, 1982), and of a number of 'push and pull' socio-economic factors accounting for the relative attractiveness of the potential destination in comparison to the origin location (Mixon and Hisng, 1994b). As there is a large body of research that suggest that these two migration waves are partly interdependent, namely the decision about whether to move to study or not influences subsequent migration behaviour (Bacci *et al.*, 2008; Faggian *et al.*, 2007a; DaVanzo, 1976 and 1983), a system of two structural structural equations has been estimated in which the first equation models the decision to move to study and is used to obtain the linear prediction of the probability to move to study which enters the second equation - which explains the decision to move after graduation - as latent variable.

The paper is organized as follows. Section 2 describes the datasets used, the empirical framework, and the methodology. Section 3 discusses the results and their the empirical relevance, while section 4 concludes and discusses the policy implications of the analysis.

2. EMPIRICAL ANALYSIS

2.1. Description of the dataset

The overarching aim of this article is to study the migration choices of Italian students/graduates, focusing on if (and how) university quality affects them. The student information used comes from the last survey administered by the Italian National Institute of Statistics (ISTAT) on Italian graduate labour market entry conditions. This survey was conducted in 2007 on a cohort of students who graduated in 2004 and comprised a total of about 47,340 degree holders, interviewed by Computer-Assisted-Telephone-Interview (CATI), with a response rate of 69.5%. The sample is stratified and derived by dividing the population by sex, attended university and field of study (see ISTAT, 2009) and represents 17.3% of the cohort of 2004 Italian graduates (260,070 individuals). The respondents attended university courses in 16 different scientific disciplines in 67 private and public universities. ISTAT attributed to each individual in the sample a weight - the carry-over coefficient -, namely the number of units of the population of the original universe represented by individual i himself/herself. The ISTAT survey collects information on previous educational attainment, degree results, employment status, and parents' socio-economic status, as well as a range of personal characteristics. Furthermore, the Italian National Institute of Statistics provided me with the province of residence before the enrolment at the university, the province of the university attended, and the province of residence three years after graduation (in 2007). This information is then used to determine whether the individual has or has not moved away to study or to look for a job, and to classify the sequential migration choices (*see* next section).

The ISTAT database on the labour market entry conditions for 2004 Italian graduates was matched with university-level data on Italian university quality using the university attended as the merging variable. The information on the quality of the higher education sector in Italy were obtained elaborating the final results of the first - and only - national evaluation of

research activity (VTR), which has been conducted in 2005 by the Committee for Evaluation of Research (CIVR) on the behalf Italian Government. This evaluation covered all the research activities conducted in the period 2001-03 (MIUR, 2007) and was carried out at the centralised level of the academic institution. To join it, each institution had to declare the annual average number of full time equivalent (FTE) researchers over the period 2001-03. Based on this FTE researcher number, each institution declared the number of products which had to be evaluated by the CIVR. The VTR rates and ranks university research performance, assessing a certain number of research outputs (journal articles, books, book chapters, patents, art craft etc.) defined on the basis of university size (small universities: up to 10,000 students; medium universities: 10,000 to 15,000 students; large universities: 15,000 to 40,000 students; mega universities: over 40,000 students).[6] Each research output is rated on the basis of a peer review evaluation (excellent=1.0, good=0.8, acceptable=0.6, poor=0.2, not classifiable=0). The weighted sum of the ratings divided by the number of products submitted to the evaluation provides a score – a rating - for each academic institution reviewed. As evaluation of research performance is conducted by scientific area, I calculated an average 'university ranking index' for each university. Furthermore, the available data, allowed me to proxy the university quality of teaching with the number of professors per student[7].

In terms of local socio-economic characteristics, since the models are estimated with individual students as the unit of observation, the more disaggregated resolution available – (for which all data are consistent) was used. Therefore, the database on Italian students-graduates was matched with NUTS-3 regional level data on quality of life (QoL) and standard

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[6] In the sample 36.3% of graduates attended a mega university, 48.0% attended a large university, 7.7% attended a medium university and 8.0% were enrolled at a small university. Enrolment of over 50% of the students interviewed by ISTAT was split across 15 university institutions.

[7] It is worth to stress than in Italian universities the role of fee and student selection procedures is modest and does not significantly vary over the territory, especially if per capita income differences are taken into account.

of living (SoL) carried out each year by the Italian financial newspaper *Il Sole 24ore* to account for "push and pull" regional factors[8] (Niedomysl, 2006). In fact, several scholars (*see for instance* Florida, 2002) have pointed out that young high skilled are attracted not only by economically buoyant areas, but by the availability of cultural amenities too (Di Pietro, 2005). The composite indicator of quality of life (QoL) is an arithmetic mean of 36 individual indicators split into six groups: life standards (bank deposits, average monthly pension, inflation index, gross domestic product, house price, average consumption per inhabitant), job & business (defaulting firms, new economy firms on 100 inhabitants, new/dead enterprises, per inhabitant protests, persons in search of a job on labour force, % employed aged 25-34), environment & health (infrastructure index, road accidents, climate, school dispersion index, quality of environment index, civil action speed), public order (car thefts on 100,000 inhabitants, thefts at home on 100,000 inhabitants, denounced minors on 1000 inhabitants, robberies on 100,000 inhabitants, pocket robberies on 100,000 inhabitants, murder trend), population (population density, percentage of foreign citizens, percentage of graduates on 1,000 inhabitants aged 25-30, births on 1000 inhabitants, registrations/cancellations, ratio of population aged 15-29 to population aged 65 and over), and free time (book reading index, bar and restaurants on 100,000 inhabitants, concerts on 100,000 inhabitants, sporting index, associations of voluntary service on 1,000 inhabitants, cinemas on 100,000 inhabitants.

The index of standard of living is part of the QoL composite index, however, while in the case of QoL the higher the value of the index, the higher the quality of life (the index is expressed in levels), in the case of standard of living, the index gives the position of a province with respect to others and goes from the best province (ranked 1) to the worst (ranked 103), hence the higher the number, the lower the standard of living.

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[8] See the appendix for a description.

As already stressed, there are two students-graduates' migration waves: before the enrolment at the university, and after graduation. Clearly, the choices of migrating to study and to live/work after graduation can hardly be considered as independent from each other. As stressed by DaVanzo (1983), the post-degree choice will be influenced by the mobility choice made by the student when he/she decided where to study: if the student has chosen to migrate, the probability of moving residence again will likely be higher than if he/she did not. The empirical evidence in this study is in line with what suggested by DaVanzo (1983): the percentage of the Italian graduates who move after graduation is largely higher among those students who already moved to study: 53.2% of those 2004 graduates who moved to study, moved also after graduation *versus* 6.5% of those who did not move to study. These findings are also supported by those of Bacci *et al.* (2008) who, analysing the mobility of Italian graduates who completed their studies over the period 2000-02, found a strong association between mobility flows for study and occupational reasons. This tendency towards mobility for occupational reasons tends to decrease with the passing of time, given the tendency, by some graduates, to go back eventually to their region of origin (Bacci *et al.*, 2008).

Before explaining the methodology used to tackle with this issue, there is another fundamental aspect that needs to be underlined. In Italy there are persistent disparities in terms of per capita income and labour market outcomes between Sothern and Central-Northern provinces (Ciriaci and Palma, 2008; Saraceno, 1983; Graziani, 1978). As clearly shown by the data, three years after graduation, 65 out of 100 graduates in the southern region are employed, while in the Central-Northern region the rate of employment is 11 points higher - 76 out of 100. Furthermore, the empirical evidence also confirms that studying in a central-northern university brings high returns in terms of employability: the rate of

unemployment among southern graduates who studied in a central-northern university is 28.9%, significantly lower than the 35.1% who attended a southern university (SVIMEZ, 2009). Therefore, following previous empirical literature (Ciriaci, 2006 and 2005; Jahnke, 2001), only students-graduates who moved from one province of macro area i to a province in macro area j (i= 1, 2) are considered 'migrants'.[9] That is to say, I divided Italy in two macro-regions (Centre-North and South), and I focus on interregional (or "between" macro area) migration flows, not intraregional ones (van Ommeren *et al*., 1999). This choice is not only motivated by the structural differences between the two macro regions, but also by the fact that focusing on the South – Centre-North flow of human capital limits specification problems due to commuting. In fact, commuting occurs mainly among the Northern provinces in the form of a brain exchange and follows different patterns (SVIMEZ, 2009; Ciriaci 2006 and 2005) with respect to the between macro areas migration.

2.3. THE ECONOMETRIC APPROACH: THE MODEL

The modelling approach chosen is constituted by two stages. Firstly, I modelled the student's choice of whether to study in his province of origin or to migrate to a province belonging to the other macro area using a standard migration probability model (AL equation in the system of equations; Faggian *et al*., 2007a). Secondly, I modelled the graduate's choice of whether to remain in the province of location of the university where he/she graduated from or to migrate to a province belonging to the other macro region (PL equation in the system of equations) inserting the predicted value obtained at the first stage (AL*) as explanatory variable, endogenizing the post-lauream choice with respect to the choice of migration to study.

Therefore the reduced form equations are as follows:

[9] Individuals going abroad to study or work are not included in the sample.

$$AL = \begin{cases} AL^* & \text{if} & AL^* = \beta_{AL} z_{AL} + \varepsilon_{AL} \geq 0 \\ 0 & \text{if} & AL^* = \beta_{AL} z_{AL} + \varepsilon_{AL} < 0 \end{cases}$$

$$PL = \begin{cases} PL^* & \text{if} & PL^* = \beta_{PL} AL^* + \beta_{PL} z_{PL} + \varepsilon_{PL} \geq 0 \\ 0 & \text{if} & PL^* = \beta_{PL} AL^* + \beta_{PL} z_{PL} + \varepsilon_{PL} < 0 \end{cases}$$

Where ε_{AL}, and ε_{PL} are normally distributed error terms with zero mean and respectively, σ_{AL}, σ_{PL} standard deviations, and z_{AL} and z_{PL} are vectors of exogenous variables. Therefore, the first equation describes the choice about whether or not to migrate in order to study: AL_{ijur} takes the value 1 if the student originally resident in province $r=1....R$ decides to enrol at the university $u=1....U$ located in a province in another macro area with respect to the macro area of origin, and 0 if he/she does not migrate.[10] Namely, it is the likelihood of studying 'abroad', where 'abroad' is the other macro area. In the case of *post-lauream* migration, the dependent variable is the likelihood of leaving after graduation the province of origin and study $r=1....R$ (belonging to macro area i) and migrating to a province belonging to the macro-area j. In this case the dependent variable is the probability of leaving the region of origin after graduation to move. In both migration cases, the analysis is carried out for graduates as a whole (i.e. including both movers and *stayers*).

For the sake of simplicity in the following discussion I group the variable included in z_{AL} and z_{PL} in three groups: (i) individual characteristics and family background, (ii) regional characteristics and economic opportunities, and (iii) university quality variables. As within groups the variables included as explanatory ones might vary according to the individual's choices analyzed (AL or PL), in the following I discuss them in details (the name of the explanatory variables included is reported in brackets in italics).

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[10] This definition allows solving the problem of whether the respondent may decide to study in a different province belonging to the same macro area of origin because there is not a University in his/her original province.

The first group of variables (i) has been included to control for selection bias. As correctly stated by the literature on self-selection (e.g. Chiswick, 2000; Borjas, 1987; Kwok and Leland, 1982) certain characteristics/skills may make it more profitable for some individuals to move and, therefore, they will be self-selected. It follows that the migrant 'brains' may not be representative of a random sample of the source province population, but rather a sample systematically selected from the relevant distribution. Among these individual characteristics controls three are common to both equations: (1) student/graduate's sex (*sex*), (2) age (*age*), and (3) the level of education of the respondent's father (*father's education*). To this three common variables, in the case of migration after graduation (PL) I added (4) a dummy for pre-reform graduates (*4 year course*, see section 3.2); (5) a control for the level of degree obtained (*master level degree*), which helps identifying who after graduation moved to continue studying[11], and not to work; (6) graduate's university performance (*degree mark*); (4) a set of 14 degree course dummies accounting for differences in terms of occupational mobility dues to the field of study (Bacci *et al*., 2008).

Among the regional characteristics and economic opportunity controls (ii) in the AL equation there are (1) the average value of the index of quality of life in the destination province over the period 2001-04 (*QoLd*), (2) the average standard of living index in the province of origin (*SoLo*) over the same period, (3) a control for cross-boarder students' movements (*contig_is*), and (4) the ratio between value added in the destination province and Italian value added (*value added ratio*). The standard of living in the province of origin has been included for two reasons. First of all, it is a proxy accounting for student's family income (the survey does not provide it). The higher the family income, the higher the probability the student can afford

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[11] I did not directly control for the employment status of the graduates given the endogeneity issues which would have arise: it was not possible to precisely assess whether the individual's migration decision was made before or after an employment was found.

moving or staying in another macro area. Secondly, it also controls for the level and quality of information that a student may acquire before choosing where to study. In fact, information concerning alternative locations is costly and fundamental for migrant's decision to move, hence students with higher family incomes might be able to afford more (or better) information (Greenwood, 1972) giving rise to self selection issue. Furthermore, the probability to migrate could be systematically higher for those students living along the "boarders" between the two macro areas. Given the fact that the definition of migration used does not allow to insert a vector of distances between province of origin and destination – this vector is perfectly collinear with the dependent variables[12] - I controlled for cross-border movements inserting a dummy (*contig_is*) for those individuals who before the enrolment at the university where living in contiguous provinces located along the borders between the two macro areas (Latina, Frosinone, Isernia, Caserta, Aquila, Teramo). Finally, the ratio between value added in the destination province and Italian value added is inserted (*value added ratio)* as a proxy for the attractiveness or economic size (Glaeser, 2008) of a province with respect to the others.

In the case of migration after graduation (PL equation) among the regional and economic controls[13] there are (1) the average value of the index of quality of life in the destination province (where the graduate declares to live in 2007; *QoLd*) over the period 2001-04 (the migration choice is made from 2004 on), (2) the *wage differential* between the province of origin (where the individual was living before university enrolment) and that of destination (where the graduate declares to live in 2007).

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[12] To a positive distance between provinces belonging to the same macro area is always associated a zero value of the dependent variable, and to a distance different from zero, but related to provinces belonging to different macro areas is always associated a value of the dependent variable equals to "one".

[13] In the case of post lauream migration the dummy for contiguous provinces has turned out to be not statistically significant.

Since data on skilled labour wages at the geographic level needed are not available, I built a *wage differential* based on the survey data.[14] In fact, among the variables provided in the survey, there is the net monthly wage that the employed graduate declares to earn. Clearly, as using the graduate's wage was not possible given its endogeneity, I calculated an average NUTS-3 wage using the province where the graduates work in 2007 as grouping variable and the carry-over coefficients of the original universe provided by the ISTAT as individual weights (*weight*):

$$wage_r = \left. \sum_{i=1}^{nr} w_i * weight \middle/ \sum_{i=1}^{nr} weight \right. \qquad\qquad r = 1...103 \qquad\qquad i = 1…33,850$$

where *i* is the graduate who in 2007 declares him/herself employed. Then, I introduced into the PL equation a wage gap based on the difference between the weighted average wage in the province of migration and in the province of origin. Hence:

$$wagedifferential_i = wage_{r=destination} - wage_{r=origin} \qquad i = 1...47,300$$

Finally, the third group of variables includes the proxies for university quality (iii). Among these variables, two are included in both equations (AL and PL): (1) the ranking of the university attended by the student (*SAS_ratingtot*), and the average number of professors per student (*lecturer_per_student*). In the case of migration to study (AL), to account for the quality of university supply in the source region I also included the average ranking (*AVG_ratingtot_o*) and the average number of professors per student (*AVG_lecturer_per_student_o*) of the universities located in the NUTS2 region to which the province of origin of the student belongs. Finally, in both equations I control for the

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[14] Clearly, endogeneity is a problem if the wage of the individual is included as an exogenous variable. In fact a higher wage might be a consequence of the migration choice (and of individual characteristics, university background, etc.).

dimension of the university (*Dimension 1*, *Dimension 2,* and *Dimension 3*).

Table 2

3. COMMENTS AND RESULTS

Before commenting on the effects of the explanatory variables included in the final model, it might be useful to stress that several other variables have turned out to be not statistically significant. Among them there are some individual and family background characteristics of the graduate, such as secondary school-leaving certificate mark, bachelor final mark with *summa cum laude*, and mother's level of education and profession. Besides, some of the explanatory variables which were significant at the first stage, turned out to be not significant in the case of migration after graduation: graduates' sex and residence in contiguous provinces. These findings suggest that individuals were already being selected at the first stage on the base of these characteristics.

Table 2 reports a description of all the variables included in the final system of equations. Table 3 illustrates the estimation results for migration to study (AL), while table 4 provides those for migration after graduation (PL). Both tables report coefficients and marginal effects of the explanatory variables, together with their standard errors. As robustness check, in the case of AL migration table 3 reports the results of the estimation of three different models, while in the case of PL migration, table 4 reports results for five different models. In both cases, the first model is a "control" one, as only the variables accounting for university quality have been inserted. In the second model, individual characteristics and family background are added. In the following models, control variables for regional characteristics and economic opportunities (in both migration models), and graduate's university performance and field of

study (only in the post-lauream migration model) are added. The number of observations reported in the tables refers to the survey sample for which all information was available, though estimate results can be extended to the whole universe of 2004' Italian graduates (about 260,000 graduates) as I used the carry-over coefficients of the original universe (ISTAT, 2009) as individual weights[15]. As heteroschedasticity is endemic with individual data, a robust estimator is used. In what follows, results are commented separately for the two sequential migration choices analyzed.

3.1. *ANTE LAUREAM* MIGRATION CHOICE

Results strongly confirm university research and teaching quality as fundamental explanatory variables of student's migration choice. Firstly, the higher the quality of university research and the number of professors per student (*AVG_ratingtot* and *AVG_prof_per_stud*) in the region (NUTS2) of origin of the student, the lower his/her migration probability. The corresponding marginal effects indicates that (1) a 1-point increase in the average rating of the universities located in the region of origin of the student provides a 0.8 point decrease of his/her probability to migrate to study elsewhere, while (2) a 1-point increase in the average number of lecturer per student provides a 3 point decrease. At the same time, the probability the student will migrate is positively affected by the research and teaching quality (*SAS_ratingtot* and *prof_per_stud*) of the University of destination. The corresponding marginal effects indicate that a 1-point increase in VTR rating provides a 0.7 point increase in the probability of migrating after graduation. At the same time, a 1-point increase in the number of lecturers per student decreases the probability of migrating by 1.2 points.

Migration research suggests that the probability of a student-graduate moving between regions will be positively related to his/her human capital characteristics (Faggian *et al.*,

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[15] Results without individual weight are available on request.

2007a and 2006; Sjaastad, 1962), as well as to interregional differences in both regional employment and wage opportunities, and quality of life in the region of destination (Faggian *et al.*, 2007a; Faggian and McCann, 2006). In line with the findings of these empirical works, the results reported in Table 3 confirm the role of student's characteristics and family background. The probability of migrating to study decreases as student's age increases (e.g., Gross and Paul, 1986; Demet and Tansel, 2009), and is lower for female students. The slightly lower likelihood of female migration is confirmed by previous empirical evidence on Italian graduates (Bacci *et al.*, 2008; SVIMEZ, 2009; Ciriaci, 2006 and 2005). These results however are at odds with recent empirical evidence on the UK (Faggian *et al.*, 2007b), but this is likely due to country-specific reasons such as the extent to which migration may partially compensating for gender differences in the ease of accessing labour markets (Faggian *et al.*, 2007b), or by country differences in returns to migration, and by cultural reasons.

 Father's level of education has an interesting impact on the ante-lauream migration choice: the higher the level of education attained by the student's father, the higher the incentive to migrate. In general, this suggests that the family 'push' factor is likely due to socio-economic reasons: the higher the level of father's education, the higher the family income.

TABLE 3

In terms of push and pull variables, the results suggest that the probability that an individual will migrate is strongly influenced by the quality of life in the destination province (*Qo*Ld). Moreover, the higher the standard of living in the province of origin of the student (SoLo), the more likely the individual will migrate to the other macro area to study. In other words, individuals who want to study far away from 'home' need more economic support from their

families. *Ceteris paribus*, the higher the standard of living in the source province, the higher the probability the family can afford the cost of supporting the student to study 'abroad'. Furthermore, as expected giving the role of distance in migration choices, students living in contiguous provinces, namely along the "boarder" between the two macro area, are more likely to migrate. The importance of the socio-economic environment is corroborated by the significance of the ratio between value added in the destination province and Italian value added. This last variable could be seen as a proxy for the attractiveness or economic size (Glaeser, 2008) of a province with respect to the others. Hence, the higher the relative value added of the province where the university is located, the higher the probability the individual will migrate there.

3.2. POST LAUREAM MIGRATION CHOICE

In line with previous works (Dotti *et al*., 2010; Bacci *et al*., 2008; Faggian *et al*., 2007a; DaVanzo, 1983 and 1976; DaVanzo and Morrison, 1981; Vanderkamp, 1971), the choice made at the moment of choosing where to study is highly and positively correlated with subsequent migration behaviour. Namely Italian graduate's likelihood to migrate after graduation is higher if the individual already migrated to study: the latent variable introduced to consider the ante-lauream choice is positive and significant (see Table 4). Besides, results confirm the explanatory power of university quality for student's migration choice: both research quality (*SAS_ratingtot*) and teaching quality (*Lecturer_per_student*) of the university attended by the graduate are significant and enter the equation with a negative sign. That is to say, the higher the research quality of the university attended and the quality of teaching, the lower the probability he/she will leave the province where he/she studied. In line with previous Italian empirical evidence (Ciriaci and Muscio, 2010; Zinovyeva and Sylos Labini,

2008), these results suggest that university quality act as a signal to firms affecting positively the probability that the individual finds a job in the province where he/she studied, and reducing the need to migrate. Di Pietro and Cutillo (2006) found for instance that those Italian graduates who graduated from more research-oriented universities obtain better results in terms of employability that those graduated from less research-oriented ones. Clearly, my results also imply that the relevant migration decision is that made at the moment of deciding where to study. Students who move away from their province of residence to pursue university studies in the other macro-area are much more likely to find employment there (generally in the Centre-North of the country; see Bacci et al., 2008).

If we compare the marginal effects of the university quality variables obtained estimating model 4 and model 5, we observe quite a significant reduction in the latter. This is due to the introduction of a control for the economic size/attractiveness of the province where the student graduated from. Therefore it suggested that the two university quality variables used were actually picking up some of the variance due to differences in regional characteristics, which in Italy are strong and persistent. This last point is confirmed also by the fact that if you graduate from a 'mega' or big university (e.g. University of Rome La Sapienza), there is a higher probability of staying where you studied. In fact, this result might be interpreted as the sign of an 'aggregation effect' (Kanbur and Rapoport, 2005; Venables, 2005) as the biggest universities (in terms of number of students) are generally located in the biggest and wealthiest cities, where the opportunities offered to skilled and young graduates are relatively higher. In any case, the variable *SAS ratingtot* is strongly significant and negative and the corresponding marginal effect indicates that a 1-point increase in VTR rating provides a 0.11 point decrease in the probability of migrating after graduation. At the same time, a 1-point increase in the number of lecturers per student decreases the probability of migrating by 0.31

point, an effect that is even larger that of the economic size of the province where the student graduated.

The individual variables which were found to be highly significant are the degree mark, student's age, and being married. The positive selection bias due to the degree mark is in line with previous empirical findings (Ciriaci, 2005 and 2006; Jahne, 2001) and with those of the literature on international migration of highly skilled workers (Borjas and Bratsberg, 1996) which shown that the percentage of migrating graduates is higher among the "best" of them. This result, however, must be interpreted carefully as the dummy included in the model to control for those who graduated with a final mark of 110/110 with summa cum laude turned out to be not significant. At the same time, the sign of coefficient of students' age might suggest that (1) a graduate firstly looks for a job where he/she studied, and only after a while decides to migrate to look for a job somewhere else, and/or (2) an older graduate - who needed a longer than average period to graduate finds – found it more difficult to obtain a job. As a whole, the likelihood of mobility tends to increase linearly over the years: Bacci *et al*. (2008) found that with each additional year after graduation the probability to migrate of Italian graduates increases by 12%. Therefore, what the results suggest is not that the best students are more likely to migrate, but that a higher degree mark works as a signal to firms: the likelihood of migrating after graduation, and after having spent time looking for a job in the province where the university is located, just increases with the degree mark.

In relation to university background, students who graduated after a first degree course are less likely to migrate at the conclusion of their studies. This result might be due to the effect of 'Bologna process' which has changed the Italian degree structure. In fact, from 2000 on Italian universities changed from offering a four year module to a 3+2 model, hence respondents who graduated from a four year course are significantly older than those who

graduated from a first degree course as they enrolled at the latest most in 1999 (although some Italian universities have yet to introduce the reform). Therefore, *ceteris paribus*, students graduating from a first degree course in our study are likely to be younger and to have graduated in a shorter time than those who finished a four year course, resulting in smaller incentive to move and a better change of finding a job in their province of origin. Moreover, it is likely that students graduating from a three year course will prefer to continue to study (+2), rather than moving somewhere else to start working. In terms of family background, while mother's profession and qualifications are not significant, if the student's father is an entrepreneur the probability that the graduate will migrate after graduation is higher, confirming the scarce social mobility that characterizes Italian society (Censis, 2006).

In line with the theoretical and previous empirical evidence, the wage gap between province of destination and province of origin is significant and enters the equation with the expected sign: the higher the wage gap, the higher the probability a graduate will choose to migrate after graduation. Furthermore, the quality of life in the province of destination positively influences the probability of migration.

TABLE 4

4. CONCLUSIONS AND POLICY IMPLICATIONS

The empirical evidence in this study suggests that the quality of universities' research activities and of teaching are fundamental explanatory variables in the migration choice of the most young and skilled part of Italian labour force. Obviously, enhancing university quality is a necessary, but not sufficient condition to attract and keep human capital, especially in

source regions. Wage differentials, geographical differences in young labour force 'employability', differences in quality of life and, more generally, in the social and economic environment in the host and source provinces, are all important determinants of migration choices.

The reported findings also suggest that the most relevant migration decision for regional human capital accumulation is that made at the moment of choosing the university where to study, as students tend, after graduation, to stay and work where their completed their education (generally in the Centre-North of the country). For instance, about one quarter of those students who, before the enrolment at the university were resident in South Italy enrol in a Centre-Northern university and, after graduation, only one third of them returns "home", while the remaining two thirds remain in the Centre-North. As clearly shown by the data, the higher the quality of the university supply in the region to which the province of origin of the student belongs the lower the probability he/she will choose to migrate to study in the other macro-area. That is to say, if the student can choose a "good" university close to his province of origin, he/she will remain there. Similarly, the higher the quality of the university a student graduated from, the lower the probability he/she will move after graduation. These findings imply that, *ceteris paribus*, investing in the quality of university supply may contribute to "keep" young skilled students and graduates *in loco*. Given the fact that Southern graduates are those more likely to move to study and to work to Centre-North Italy, investing in the quality of Southern universities may contribute to enhance South Italy attractiveness and a brain exchange among the two Italian macro areas, bearing in mind the potential impact of Italian interregional labour mobility on local growth (Fratesi and Percoco, 2009).

Undoubtedly, government can do a great deal to mitigate the causes of brain drain

through the design of measures aimed at increasing skilled workers' «employability» and attracting students and return migrants. Systemic interventions are needed first to stimulate demand for skilled labour through proper fiscal policy measures, second to favour a stronger interaction between universities and firms within the «space». The task will not be easy and will take time. Many of the benefits for source regions, in fact, can only be realized in the longer term and require investment in science and technology infrastructure and the development of opportunities for young skilled workers. As stressed in the literature on national and international brain drain, developing centres of excellence for scientific research and framing the conditions for innovation and high tech entrepreneurship can make a region attractive to both home and foreign young students. Such policies embrace promotion of entrepreneurship, training and education, mechanisms influencing the allocation of capital, public research and its links with business. There is the need, in source regions, to develop an adequate technological, scientific and business environment that will provide satisfying opportunities for returning individuals who have upgraded their skills abroad and/or serve to persuade these skilled people to remain in their home regions. High quality universities in peripheral regions, such as Southern ones in Italy, would help to produce highly qualified and young labour force as well as new knowledge to be used and adapted by local firms.

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Table 1. Correlation coefficients.

	Sas ratingtot	Avg ratingtot	Avg_lecturer per_student	Lecturer per_student	QoL	SoL	Value added ratio	Wage differential	Contig_is
Sas_ratingtot	1.0000								
Avg_ratingtot	0.6100	1.0000							
Avg_lecturer_per_student	0.4433	0.7260	1.0000						
Lecturer_per_student	0.4860	0.3544	0.4878	1.0000					
QoLd	0.4309	0.5204	0.4368	0.2241	1.0000				
SoLo	-0.4859	-0.7370	-0.5622	-0.2399	-0.6782	1.0000			
Value added ratio	0.2639	0.1396	-0.0071	-0.1214	0.3357	-0.3693	1.0000		
Wage differential	0.0619	0.0576	0.0426	0.0058	0.3131	-0.0531	0.0852	1.0000	
Contig_is	-0.0233	-0.0495	-0.3204	-0.1489	-0.1071	0.1271	-0.0968	0.0056	1.0000

Table 2. Definition of variables.

Variable	Description	Source
AL migrant	Dummy variable taking on the value one if the individual migrate to study, zero otherwise.	ISTAT, 2009.
PL migrant	Dummy variable taking on the value one if the individual migrate after graduation, zero otherwise.	ISTAT, 2009.
Sas_ratingtot	Average rating of the University attended	MIUR, CIVR, 2007
Avg_ratingtot	Average rating of the Universities located in the region (NUTS2) of origin of the individual.	MIUR, CIVR, 2007
Avg_lecturer_per_student	Average number of professors per student of the Universities located in the region (NUTS2) of origin of the individual.	MIUR, CIVR, 2007
Lecturer_per_student	Average number of professors of the University attended.	MIUR, CIVR, 2007
University_private	Dummy variable taking on the value one if the university is private, zero otherwise.	MIUR, CIVR, 2007
Dimension 1	Dummy variable taking on the value one if the university is small (up to 10,000 students), zero otherwise.	MIUR, CIVR, 2007
Dimension 2	Dummy variable taking on the value one if the university is small (10,000 to 15,000 students), zero otherwise.	MIUR, CIVR, 2007
Dimension 3	Dummy variable taking on the value one if the university is small (15,000 to 40,000 students), zero otherwise.	MIUR, CIVR, 2007
Dimension 4	Dummy variable taking on the value one if the university is small (more that 40,000 students), zero otherwise.	MIUR, CIVR, 2007
Gender	Dummy variable taking on the value one if the individual is a female, zero otherwise.	ISTAT, 2009.
Age	Age of the individual in classes (increasing from 1 to 8)	ISTAT, 2009.
Married_or_divorced	Dummy variable taking on the value one if the individual is a married or divorced/separated, zero otherwise.	ISTAT, 2009.
Father's profession	Dummy taking on the value one if the individual's father is a self employed or entrepreneur, zero otherwise.	ISTAT, 2009.
Father' education	Indicator of the level of education attained by the individual's father.	ISTAT, 2009.
Master level degree	Dummy taking on the value one if the individual concluded a 3+2 course of study, zero otherwise.	ISTAT, 2009.
3 year course	Dummy taking on the value one if the individual concluded a first level degree, zero otherwise.	ISTAT, 2009.
Degree mark	Mark obtained by the graduate.	ISTAT, 2009.
Scientific_area	Set of 14 dummy variables. Field of study of the graduate.	ISTAT, 2009.
Wage differential	Differential in terms of average individual's monthly wage between the county of origin and that of destination after graduation.	ISTAT, 2009.
Value added ratio	Ratio between the value added of the county where the individual studied and the national value added.	ISTAT, various years
QoL	Index of the quality of life in the county where the individual is resident at the moment of the interview, namely the present residence.	Il sole24 ore, various years
SoL	Index of the standard of living in the county of origin of the individual.	Il sole24 ore, various years

Table 3. Descriptive statistics.

Variable	Obs	Mean	S. E.	Min	Max	Source
Sas_ratingtot	47,291	0.79	0.05	0.52	0.92	continuous
Avg_ratingtot	47,342	0.79	0.03	0.74	0.82	continuous
Avg_lecturer_per_student	47,342	0.03	0.00	0.03	0.05	continuous
Lecturer_per_student	47,291	0.04	0.01	0.01	0.10	continuous
university_private	47,300	0.06	0.23	0.00	1.00	dummy
Dimension 1	47,300	0.27	0.52	0.00	1.00	dummy
Dimension 2	47,300	0.14	3.15	0.00	1.00	dummy
Dimension 3	47,300	0.44	0.34	0.00	1.00	dummy
Dimension 4	47,300	0.15	6.64	0.00	1.00	dummy
gender	47,342	0.53	0.50	0.00	1.00	dummy
age	47,300	7.22	0.70	1.00	8.00	scalar (1-8)
married_or_divorced	47,301	0.27	0.44	0.00	1.00	dummy
Father's profession	47,301	0.05	0.21	0.00	1.00	dummy
Father' education	46,900	3.88	1.30	1.00	6.00	scalar (1-6)
Master level degree	47,300	0.15	0.36	0.00	1.00	dummy
3 year course	47,301	0.44	0.50	0.00	1.00	dummy
Degree mark	47,300	103.22	6.99	66.00	110	continuous
scientific_area_1	47,300	0.04	0.19	0.00	1.00	dummy
scientific_area_2	47,300	0.04	0.20	0.00	1.00	dummy
scientific_area_3	47,300	0.04	0.21	0.00	1.00	dummy
scientific_area_4	47,300	0.24	0.43	0.00	1.00	dummy
scientific_area_5	47,300	0.11	0.31	0.00	1.00	dummy
scientific_area_6	47,300	0.05	0.22	0.00	1.00	dummy
scientific_area_7	47,300	0.03	0.16	0.00	1.00	dummy
scientific_area_8	47,300	0.12	0.32	0.00	1.00	dummy
scientific_area_9	47,300	0.08	0.27	0.00	1.00	dummy
scientific_area_10	47,300	0.08	0.27	0.00	1.00	dummy
scientific_area_11	47,300	0.05	0.21	0.00	1.00	dummy
scientific_area_12	47,300	0.03	0.18	0.00	1.00	dummy
scientific_area_13	47,300	0.03	0.17	0.00	1.00	dummy
scientific_area_14	47,300	0.02	0.15	0.00	1.00	dummy
Wage differential	47,299	-1.45	109.5	-1,219	1,795	continuous
Value added ratio	47,163	0.03	0.03	0.00	0.10	continuous
QoL	46,229	471.3	48.34	566	369	continuous
SoL	46,229	-	-	103	1	Scalar (1-103)

Table 4. Ante Lauream Migration choice. Weighted probit robust results.

	Model1		Model 2		
	Coefficients	Marginal effects	Coefficients	Marginal effects	Coefficients
Pseudo R2		0.18		0.33	
University quality					
SAS_ratingtot	10.456*** (.437)	1.437*** (.055)	10.508*** (.443)	1.431*** (.055)	7.488*** (.571)
Lecturer_per_student	26.638*** (1.827)	2.538*** (.154)	-	-	13.334*** (1.828)
AVG_ratingtot	-14.305*** (.819)	-1.966*** (.112)	-14.351*** (.827)	-1.954*** (.112)	-8.457*** (1.022)
AVG_lecturer_per_student	-98.839*** (5.06)	-13.582*** (.668)	-98.849*** (5.121)	-13.464*** (.668)	-33.783*** (5.579)
Dim_stud1	.521*** (.043)	.098*** (.010)	.525*** (.043)	.098*** (.010)	.523*** (.044)
Dim_stud2	.349*** (.042)	.059*** (.008)	.350*** (.042)	.059*** (.008)	.349*** (.041)
Dim_stud3	.051* (.027)	.007* (.004)	.060** (.027)	.007** (.004)	.058** (.032)
Student's characteristics and family background					
Age	-	-	-.041** (.018)	-.005** (.002)	-.101*** (.020)
Gender	-	-	-.049** (.024)	-.007** (.003)	-.136*** (.026)
Father's education	-	-	.054*** (.010)	.007*** (.001)	.036*** (.011)
Father's profession	-	-	ns	ns	ns
Regional characterics and economic opportunities					
Contig_is	-	-	-	-	1.000*** (.053)
Value added ratio	-	-	-	-	8.816*** (.500)
QoLd	-	-	-	-	.006*** (.000)
SoLo	-	-	-	-	.025*** (.001)
Obs.		47291		46891	
DF		7		11	
AIC		26847.4		26501.5	
BIC		26908.8		26597.8	

***Significant at 0.001; **Significant at 0.05; *Significant at 0.10.

Robust standard errors in brackets.

Table 5. Post Lauream Migration choice. Weighted probit robust results.

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficients	Marginal effects	Coefficients	Marginal effects	Coefficients	Marginal effects	Coefficients	Marginal effects	Coefficients	Marginal effects
Pseudo R2		0.22		0.32		0.35		0.43		0.39
Latent variable	.533*** (.019)	.027*** (.001)	.615*** (.036)	.017*** (.002)	.647*** (.037)	.014*** (.001)	.626*** (.029)	.013*** (.002)	.773*** (.063)	.010*** (.002)
Wage differential	.006*** (.000)	.0003*** (.000)	.006*** (.000)	.0001*** (.000)	.006*** (.000)	.0001*** (.000)	.002*** (.001)	.00005*** (.000)	.006*** (.000)	.00008*** (.000)
University quality										
SAS_ratingtot	-	-	-10.849*** (.662)	-.291*** (.027)	-10.95*** (.657)	-.237*** (.024)	-14.09*** (.799)	-.293*** (.030)	-8.54*** (.730)	-.110*** (.024)
Professor_per_student	-	-	-16.293*** (2.648)	-.438*** (.070)	-15.16*** (2.637)	-.333*** (.058)	-24.87*** (3.940)	-.517*** (.065)	-23.54*** (2.835)	-.305*** (.071)
Dim_stud1	-	-	-.566*** (.098)	-.009*** (.001)	-.552*** (.099)	-.007*** (.001)	-1.039*** (.145)	-.009*** (.001)	-.348*** (.800)	-.003*** (.001)
Dim_stud2	-	-	-.354*** (.072)	-.007*** (.001)	-.352*** (.073)	-.0002*** (.001)	-.605*** (.094)	-.007*** (.001)	-.362*** (.069)	-.003*** (.001)
Dim_stud3	-	-	ns	ns	ns	ns	-.089* (.053)	-.002* (.001)	-.189* (.052)	-.003* (.001)
Student's characteristics and family background										
Age	-	-	-	-	.201*** (.031)	.005*** (.001)	.186*** (.031)	.004*** (.001)	.279*** (.034)	.004*** (.001)
Married or divorced	-	-	-	-	.341*** (.479)	.009*** (.002)	.308*** (.052)	.008*** (.002)	.325*** (.051)	.052*** (.002)
3 year course	-	-	-	-	-.143*** (.471)	-.034*** (.001)	-.162*** (.051)	-.003*** (.001)	-.197*** (.049)	-.002*** (.001)
Master level degree	-	-	-	-	-.184*** (.068)	-.003*** (.001)	-.182*** (.074)	-.003*** (.001)	-.122* (.069)	-.001* (.000)
Father's education	-	-	-	-	-.099*** (.018)	-.002*** (.000)	-.117*** (.020)	-.002*** (.004)	-.083*** (.019)	-.001*** (.000)
Father's profession	-	-	-	-	.176** (.070)	.005** (.023)	.176** (.079)	.004** (.003)	.184** (.073)	.003** (.003)
Degree mark	-	-	-	-	.131*** (.004)	.0003 (.000)	.012** (.004)	.0002** (.000)	.010** (.003)	.0001** (.000)
Scientific area 1	-	-	-	-	.310** (.106)	.010** (.004)	.276** (.102)	.008** (.004)	.238** (.107)	.004** (.003)
Scientific area 2	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 3	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 4	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 5	-	-	-	-	.204** (.099)	.005** (.003)	.140* (.098)	.003* (.003)	.240** (.100)	.004* (.002)
Scientific area 6	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 7	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 8	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 9	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 10	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 11	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 12	-	-	-	-	ns	ns	ns	ns	ns	ns
Scientific area 14	-	-	-	-	-.079*** (.203)	-.008*** (.001)	-.979*** (.216)	-.008 (.001)	-.579*** (.177)	-.004 (.001)
Regional characterics and economic opportunities										
QoLd	-	-	-	-	-	-	.011*** (.001)	.0002*** (.000)	-	-
Value added ratio	-	-	-	-	-	-	-	-	-15.95*** (1.932)	-.206*** (.039)
Obs.	45389		45389		45389		45389		45389	
DF	3		8		30		31		31	
AIC	12488.1		10864.6		10463.2		9187.3		9832.3	
BIC	12514.3		10934.4		10724.9		9457.7		10102.7	

***Significant at 0.001; **Significant at 0.05; *Significant at 0.10.

Robust standard errors in brackets.