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Highlights

- This working paper studies the determinants of international students' mobility at the university level.
- We obtain evidence for a clear and negative effect of fees on international student mobility and confirm the positive impact of the quality of the education.
- The estimations also support the important role of additional destination-specific variables such as host capacity, the expected return of education and the cost of living in the vicinity of the university.

Abstract

This working paper studies the determinants of international students' mobility at the university level, focusing specifically on the role of tuition fees. We derive a gravity model based on a Random Utility Maximization model of location choice for international students in the presence of capacity constraints of the hosting institutions. The last layer of the model is estimated using new data on student migration flows at the university level for Italy and the United Kingdom. The particular institutional setting of the two destination countries allows us to control for the potential endogeneity of tuition fees. We obtain evidence for a clear and negative effect of fees on international student mobility and confirm the positive impact of the quality of the education. The estimations also support the important role of additional destination-specific variables such as host capacity, the expected return of education and the cost of living in the vicinity of the university.

Keywords

Foreign students, Tuition fees, Location choice, University Quality.

JEL

F22, H52, I23, O15.

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CEPII
113, rue de Grenelle
75007 Paris
+33 1 53 68 55 00

www.cepii.fr
Press contact: presse@cepii.fr

RESEARCH AND EXPERTISE
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The Role of Fees in Foreign Education: Evidence From Italy and the United Kingdom

Michel Beine,* Marco Delogu † and Lionel Ragot‡

1. Introduction

Foreign higher education has become an increasingly important phenomenon these days. The degree of mobility of prospective students wishing to acquire their educational skills abroad has been constantly on the rise for more than 50 years. Large numbers of foreign students emigrating for the explicit purpose of completing their graduate and postgraduate studies at renowned universities are today a usual situation in any country and city of most industrial countries. While there were 0.6 million international students in 1975, this rose amounted to 3.5 million in 2005. Despite the turmoil caused by the financial crisis, the global quest for talented workers has pushed these numbers up further, with a 50 per cent increase between 2005 and 2015 (OECD (2015)). Even though these global numbers obviously hide some uneven developments, the number of students emigrating abroad to complete their education has increased in all origin regions of the world. For more than 15 years, foreign students have represented the fastest growing category of international migrants.

The dramatic expansion of foreign education is an important economic phenomenon for the destination countries. For many developed countries such as the United States, the United Kingdom (U.K.), France and Australia, foreign education has become a real industry. Attracting students from abroad and charging significant tuition fees allow their universities to climb up the educational ladder and, in turn, to act as important research institutions. Many cities in the main destination countries for foreign students favor the development of their university, thus trying to benefit from the various spillovers that these institutions generate for the public and private sector. For governments, attracting foreign students is also an important objective in the global race for talented workers, a race in which industrialized countries are engaged today. In fact, student migration might be seen as a concealed phenomenon of the brain drain. Governments attract promising students and provide, through foreign education, the skills needed and valued by their domestic labor market. By employing various schemes such as special transition visas,

*University of Luxembourg, IZA, CREAM and CES-Ifo
†University of Luxembourg and University of Louvain
‡University Paris Nanterre, EconomiX and CEPII (lragot@u-paris10.fr)
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governments of destination countries allow those students to stay in the country and integrate more easily into the national labor market. Understanding the determinants of location choice for prospective students is therefore of utmost importance when developing appropriate policies for attracting talented international students.

This paper contributes to the literature on the identification of factors influencing students' decision about where to study when they want to study abroad. In particular, we assess the importance of various determinants of foreign students, using data at the university level for two European countries, namely, the U.K. and Italy for the academic year 2011-2012. Unlike other European countries such as France, Belgium or Germany, British and Italian universities show significant variation in the tuition fees across institutions. This in turn allows us to study the role of fees for foreign students when choosing one specific location; this is in addition to other institutional characteristics such as the quality of education, host capacity, expected income and cost of living. We compile and use data on foreign student flows between (almost) all countries of the world - the origin country - and each university in the two countries under investigation - the destination countries. Our econometric investigation, derived from a traditional Random Utility Model (RUM), adapted to student migration, pays special attention to the role of tuition fees. We deal empirically with the endogeneity of student fees with two proposed different solutions across the destination countries.

We find support for the role of the quality of the university, a result already found in some previous work (Beine et al. (2014); Van Bouwel and Veugelers (2013)). We also find that the host capacity of the university plus the expected return on education in the city where the education is acquired are important, in line with the spirit of the migration model of foreign education (Rosenzweig (2008)). Regarding the role of tuition fees, we first stress the need to deal with the endogeneity of these fees by isolating their impact on the location choice of foreign students. When dealing with this issue, we find that tuition fees have a negative and significant effect on the choice of a specific university, a result new to the existing literature.

Our paper is related to the extensive literature on foreign education. At the theoretical level, as reminded by Rosenzweig (2006, 2008), there are basically two complementary explanations for why students decide to go abroad to complete their higher education. The first model with a human capital perspective, states that students go abroad because of a lack or even absence of education infrastructure in their home country. Foreign education in medicine provides many examples of that type of motivation. The second model, the migration model, suggests that students might favor foreign education because it increases the prospects of attractive jobs in the country (or the place) where the education was obtained. As mentioned before, this motivation is in line with the evidence that previous students tend to have easier access to the domestic labor market in the destination country.[1] Our theoretical model, based on the RUM approach, integrates this type of argument.

[1]For instance, in the United States, the H1B visa is subject to a cap (65000 per year at present), with an additional 20,000 quota for foreign students having graduated with an MBA or higher from a U.S. University.

While the education and migration models are about the decision to study abroad, much of the literature has been devoted to the location choice. Our paper belongs to this category. Most of the literature makes use of country-level data and combines a multi-origin approach. Bessey (2012) focuses on foreign students in Germany, finding that the stock and the flow of students of the same nationality are positively correlated. Dreher and Poutvaara (2005) and Rosenzweig (2006) look at the determinants of foreign education in the United States. The papers stress the importance of networks (Dreher and Poutvaara (2005)) and skill premium(Rosenzweig (2006)). Other studies combine various origins and destinations, carrying out estimations with a gravity model. Perkins and Neumayer (2014) consider many origin (151) and destination countries (105) over a couple of years and evaluate the role of geographic factors. Van Bouwel and Veugelers (2013) look at student migration among 18 European countries and assess the role of university quality, which was evaluated through the number of institutions appearing in the most widely known international university rankings. They show that quality matters but tend to find a positive impact of tuition fees. Beine et al. (2014) derive a gravity specification and focus on the 13 main destinations for foreign education. They estimate the role of determinants such as networks, quality and fees in explaining the extent of the bilateral flows of foreign students. Regarding fees, while they fail to identify a negative impact of tuition fees, they do show that the positive impact of fees obtained in "*naive*" regressions might be due to endogeneity.[2]

The aim of this paper is to contribute to the literature on identifying the factors influencing the location decision of foreign students. Up until now, the literature has focused on factors observed at the country level. Thus, one of main value-added of the paper is that we conduct our analysis with universities as the destination. While a cross-country analysis is important to understand the reasons for the uneven distribution of students across destination countries, information at the country level conceals significant variation among universities of the same country. For instance, the average national quality of universities might not accurately reflect the attractiveness of the country as a provider of tertiary education. Foreign students might concentrate, for instance, on the upper tier of universities in the country. If this is true, the fact that a country hosts many universities of relatively modest quality might not be an important factor, at least explaining inflows of foreign students to that country. This means that we have use information at the university level. The same applies to fees. The average level of fees might not mean anything for students since they might end up relatively good universities charging relatively high fees. To overcome this limitation, we study the role of these factors, observed at the university level in a given country. While we do ignore the first step in the decision-making process (choice of the destination country), we identify very precisely the various university-specific factors that lead students to choose among institutions in a given destination country.

[2]Other interesting papers of the literature using dyadic flows include Abbott and Silles (2015), Jena and Reilly (2013), González et al. (2011), Kahanec and Králiková (2011). Gravity models have also been used to explain student mobility between regions of the same country. See for instance Agasisti and Dal Bianco (2007) for Italy. Alecke and Mitze (2013) and Bruckmeier and Wigger (2013) exploited German data and give a special attention to the role of tuition fees.

Such an investigation is unique in the literature in that respect.

The second related contribution is our focus on the role of tuition fees in the choice of location by foreign students. The literature has failed to find a clear negative impact of fees on the size of student inflows. This contrasts with the literature focusing on native students.[3] Of course, failure to find a negative impact does not mean that these results are spurious per se. Indeed, fees include more than the pure cost component for prospective students. High fees obviously signal quality and the institution's commitment to providing students with all the necessary means to absorb the delivered learning. Fees, for instance, increase the accountability of education providers with respect to students. Another possible explanation is that fees can be covered by grants. This is especially true for foreign students who can benefit from grants from different sources (government of the origin country, university of destination, non-for profit organisation promoting bilateral contacts, etc.). While this might not be the situation for all students, the partial coverage of fees by grants might explain the insignificant impact of fees that is sometimes observed (see, for example, Beine et al. (2014)).

On the other hand, results showing positive or even zero impact of fees might be spurious due to the high degree of endogeneity of fees. Fees are higher when universities succeed in attracting many students, which leads to reverse causality issues. Fee levels might be correlated with factors such as unobserved amenities in the destination countries (for example, Australian universities due to their pleasant environment might charge higher fees) or with unobserved institutional factors at the country level (regulation of subsidized institutions). This calls for a causal identification accounting for the possible endogenous status of the observed fees in the econometric regression. We pay specific attention to this issue and take two specific approaches. For Italy, we use a classical instrumental variable (IV) approach. We instrument the tuition fees by the status of the university (private *vs.* public). Private institutions tend to charge higher fees to cover specific costs and to offset the lower public subsidies compared with public institutions. Our exclusion restriction assumes that students have no particular preferences for private *vs.* public institutions beyond the costs and the quality of education (for which we control in the regression) when choosing a specific university. We further show (see Section 5.1.2), that the obtained negative impact of fees is robust to reasonable deviations from the strict exclusion restriction by employing methods described in Conley et al. (2012). However, for the U.K., we are unable to employ such an instrument because there is no clear-cut distinction between private and public institutions. Rather than the IV strategy, we use the fact that British institutions faced caps on tuition fees that they could charge to natives students and to European students. These caps are almost all binding in the sense that all universities put tuition fees at a level equal to the maximum allowed by the law. Significantly, the cap did not apply for first-degree students originating from the EU who are enrolled in Scottish universities - the Scottish authorities cover tuition fees for Scottish and EU students. By restricting our investigation to students coming

[3]Alecke and Mitze (2013) study how an increase in the level of tuition fees charged in Germany affected the internal mobility of students. Bruckmeier and Wigger (2015) address the same increase, focusing on how it relates to the time of graduation.

from EU countries, we can estimate the impact of fees in a context in which endogeneity is alleviated. The estimates of our model generate interesting findings in terms of push and pull factors. To the best of our knowledge, this paper is the first one that pays particular attention to the effect of fees. Specifically, we find evidence of a significant and negative impact of this variable on international students' mobility. We check the robustness of our findings by estimating several variants of our baseline specification. For Italy, in Section 5.1.3 we include in the set of determinants a dummy variable that captures the availability of English teaching programs at the destination university. Our baseline result regarding the impact of tuition fees gets additional confirmation, namely, that the coefficient is still negative and significant but larger in absolute value. For both countries (Section 5.3), we estimate a specification closer to the estimation of a multinomial logit model. The results there obtained are in line with the baseline ones.

Finally, we look carefully at the technical and econometric details of the empirical investigation. First, we use a micro-founded model based on the RUM approach with an explicit role for capacity constraints. Using such a framework facilitates the choice of the specification. While this has been advocated by many authors in the general literature devoted to economic international migration (Beine et al. (2015, 2011); Grogger and Hanson (2011)), the use of a theoretically consistent specification in the student literature has been very limited. Second, given the high prevalence of zero bilateral flows in the data set, the use of Poisson ML estimators is much favored (Silva and Tenreyro (2006)) in order to provide unbiased estimates of the key variables. Furthermore, we combine Poisson estimations with the use of instrumental variable, attempting to account for the two main biases arising in the estimation of gravity models.

The paper is structured as follows. Section 2 develops a small theoretical model that is useful for deriving the estimable gravity equations. Section 3 is devoted to the exposition and clarification of the data that we use in the econometric estimations. Section 4 presents the estimable gravity equations and discusses the main econometric issues, including the treatment of the zeros for the dependent variable and the way we deal with endogeneity issues. Section 5 presents the results while Section 6 concludes.

2. Theoretical Background

This section describes briefly the model used to derive a tractable students' migration equilibrium equation that is estimated using data from Italian and U.K. universities. The theoretical model is based both on the human capital literature and on the random utility maximization approach to migration. Here we provide the main equations reflecting the structure of the model. (The full model is provided in the Appendix A.)

Education is considered an investment in future earnings and employment (Becker (1964)) for rational students who seek to maximize their lifetime earnings. The quality of education may affect their expected returns to education (Card and Krueger (1992)).

Following the Random Utility Model (RUM) approach (McFadden (1984)), the prospective student migrant compares the present value of future earnings if he/she decides to study in a university at home with the present value of future earnings if he/she studies at a university abroad. If the increase in the present value of the future income is greater than the cost of migrating, plus other education costs, the student decides to move to the university yielding the highest net present value. Nevertheless, this is conditional because universities have enrollment capacity constraints. The equilibrium condition giving the number of students coming from a given country and studying in a given university is the result of the self-selection factors captured by the traditional RUM model (students' choice) and of the out-selection factors related to the capacity constraints of each university.

2.1. Students' Choice

The set of destination countries is $D = \{d_1, ..., d_{n_d}\}$ with n_d the number of destination countries (j is the index for destination country) and the set of origin countries is $O = \{o_1, ..., o_{n_o}\}$ with n_o the number of origin countries (o is the index for the origin country). Countries can be inside both D and O. The set of universities in country d is $U^d = \{u_1^d, u_2^d, ..., u_{n_u^d}^d\}$ with n_u^d the total number of universities in country d (u^d is the index for university). The set of students in each country o who aspire to undertake studies in higher education is $S^o = \{s_1^o, s_2^o, ..., s_{N_s^o}^o\}$, with N_s^o the total number of young people in country o who aspire to study. The index for student is s.

Utility derived from studying in university u^d located in country d of student s from country o, expressed as VS^s_{o,d,u^d}, is separated into two parts. One part is deterministic and varies by the origin and university destination pair, VS_{o,d,u^d}. This deterministic and observable component of utility is logarithmic. The other part is stochastic and captures unobserved components of the individual utility associated with each university choice (ϵ^s_{o,d,u^d}).

$$\begin{aligned} VS^s_{o,d,u^d} &= VS_{o,d,u^d} + \epsilon^s_{o,d,u^d} \\ &= ln\left(\frac{(IW_{o,d,u^d})^{\beta_1} A_d^{\gamma_1}}{\delta_{o,d,u^d}}\right) + \epsilon^s_{o,d,u^d} \end{aligned} \tag{1}$$

where IW^s_{d,u^d} is the discounted sum of the annual expected labor income of student s who graduated from university u^d. The labor income depends in turn on w_{u^d} the value of average earnings in area u^d; Q_{u^d} the quality of education where the education has been attained; and $\bar{Q}_d$ the average quality of education in the country d. $\delta_{o,d,u^d}(> 1)$ is an iceberg total cost factor. This iceberg cost includes a country-pair specific cost $CM_{o,d}$ that depends on the dyadic distance, in the broad sens, between the two countries. It also depends on the cost of education in university

u^d which is given by the level of tuition fees (CS_{u^d}). Finally, the cost also depends on the cost of living in the city where the university u^d is located (CL_{u^d}). A_d are some country-specific unpriced amenities.

Following the random utility approach to discrete choice problems (McFadden (1984)), the probability that student s from country o chooses university u^d in country d is given by:

$$\begin{aligned} P_{o,d,u^d} &= Prob[VS^s_{o,d,u^d} > VS^s_{o,i,u^i}], & \forall u^i \neq u^d \text{ and} \forall i \in D \\ &= Prob[VS_{o,d,u^d} - VS_{o,j,u^i} > \epsilon^s_{o,i,u^i} - \epsilon^s_{o,d,u^d}], & \forall u^i \neq u^d \text{ and} \forall i \in D \end{aligned} \quad (2)$$

with ϵ being an independent and identically distributed (iid) extreme-value distributed random term.

Following Train (2003), this probability can be decomposed into three logit probabilities:

$$P_{o,d,u^d} = P_{o,u^d|d,h} P_{o,d,|h} P_{o,h} \quad (3)$$

The present paper focuses on the determinants of $P_{o,u^d|d,h}$, that is the probability of choosing university u^d conditional on studying abroad and having chosen country u^d. This conditional probability takes a logit form:

$$\begin{aligned} P_{o,u|d,h} &= \frac{\exp(VS_u(X_{u^d})}{\exp I^u(d,h)} \\ &= \frac{\exp(\beta_1 ln\,(w_{u^d}) + \beta_2 ln\,(Q_{u^d}) - \beta_3 \ln(CS_{u^d}) - \beta_4 \ln(CL_{u^d}))}{\exp I^u(d,h)} \end{aligned} \quad (4)$$

where $I^u(d,h)$ is the inclusive value.

At the aggregate level, the total number of people from country o wishing to study at university u^d located in country d, is given by:

$$M_{o,d,u^d} = P_{o,d,u^d} N^o_s = P_{o,u^d|d,m} P_{o,d,|m} P_{o,m} N^o_s \quad (5)$$

where N^o_s is number of people in country o wishing to study. Likewise, $M_{d,u^d} = \sum_{o \neq d} P_{o,d,u^d} N^o_s$ is the *ex ante* enrollment demand, that is the total number of foreign students wishing to study at university u^d. Universities have enrollment policies that can lead to the number of foreign students enrolled being lower than M_{d,u^d}. To derive the actual number of foreign students enrolled, we need to explain their enrollment behavior.

2.2. Universities' Behavior

We assume that all universities have the same enrollment behavior. In the short term, the enrollment behavior of university u^d is determined by the capacity for foreign students' enrollment $EC_{u^d}^{\beta_5}$, where β_5 defines the share of total enrollment capacity EC_{u^d} devoted to foreign students. In the short run, university quality Q_{u^d} and tuition fees CS_{u^d} are fixed. Consequently, the foreign student enrollment capacity can be constrained for university u^d, with the actual number of foreign students being $\tilde{M}_{d,u^d}$, which implies:

$$\tilde{M}_{d,u^d} \leq EC_{u^d}^{\beta_5} \tag{6}$$

We assume that at least one university is constrained. For that university, some students are forced to change their first choice and to enroll in another university. In that case, the total allocation is also constrained and the choices based only on preferences differ from the observed (ex post) allocation. We define how this *ex post* allocation can be done.

2.3. Equilibrium Allocation With Enrollment Capacity Constraints

The process of allocation of *ex ante* demands to the *ex post* constrained positions for foreign students is based on the approach of De Palma et al. (2007). The existence of a feasible allocation requires the total world enrollment capacity not to be binding. Any student who wants to study abroad could be enrolled in a university, but not necessarily in his or her preferred university. The number of *ex post* students from o going to university u^d in country d is given by

$$\tilde{M}_{o,d,u^d} = \tilde{P}_{o,d,u^d} N_s^o = \tilde{P}_{o,u^d|d,m} \hat{P}_{o,d,|m} \hat{P}_{o,m} N_s^o \tag{7}$$

where $\tilde{P}_{o,d,u^d}$ is the (*ex post*) probability that student s coming from country o is enrolled in university u^d in country d[4]. As shown by De Palma et al. (2007), allocation is feasible, assuming two allocation rules. One is the *free allocation* rule for unconstrained universities, implying that a student preferring university u^d will be enrolled in that university. The second rule is the *no priority* rule for constrained universities; this states that the student with a stronger preference for university u^d compared with another student will have a proportionally greater chance to be allocated *ex post* to the preferred university. With these assumptions, the *ex post* allocation in an *ex ante* non-constrained university in country d can be modified by the reallocation implied by the constraints on the university in country d or other countries. In this case, we should estimate, using an iterative algorithm, all the probabilities for each university in each country. However, this goal is unrealistic because it implies that data for all universities in the world are available. Nevertheless, this limitation can be overcome if we assume that each university in one country

[4] The formulas of $P_{o,d,|m}$ and $P_{o,m}$ are not modified by constraints at the university level. However, the calculus of the inclusive value $I_{d,h}^u$ is modified with constraints at the university level, and, therefore the values of $P_{o,d,|m}$ and $P_{o,m}$. These new values are represented by $\hat{P}_{o,d,|m}$ and $\hat{P}_{o,m}$.

faces a binding enrollment capacity constraint. With such assumption, it becomes possible to estimate the allocation in this country, independently of that for all the other countries. (See Appendix A on the theoretical model.)

2.4. Estimable Equilibrium Equation

The assumption that all universities in a given country are constrained by their enrollment capacity - that is, they face a demand higher than their capacity - is not an unreasonable hypothesis for U.K. or Italy. This leads to the equilibrium number of *ex post* students migrating from o to d and studying in university u^d:

$$\tilde{M}_{o,d,u^d} = \frac{EC_{u^d}^{\beta_5}}{M_{d,u^d}} \frac{\exp(VS_u(X_{u^d}))}{\sum_{u=1}^{n_u^d} \exp(VS_u(X_u))} \hat{M}_d^o \tag{8}$$

with $\hat{M}_d^o = \hat{P}_{o,d,|m} \hat{P}_{o,m} N_s^o$.

Taking logs and substituting the components of the utility function $VS_u(X_{u^d})$, we obtained the following estimable equilibrium equation:

$$\begin{aligned} \ln(\tilde{M}_{o,d,u^d}) &= \beta_1 ln(w_{u^d}) + \beta_2 ln(Q_{u^d}) - \beta_3 \ln(CS_{u^d}) - \beta_4 \ln(CL_{u^d}) + \\ &\quad \beta_5 \ln(EC_{u^d}) - \ln(M_{d,u^d}) - \ln(\sum_{u=1}^{n_u^d} \exp(VS_u(X_u))) + \ln(\hat{M}_d^o) \end{aligned} \tag{9}$$

Before proceeding to the econometric specification corresponding to equation (9), some comments are in order. First, β_5 is the average propensity of all universities to apply the capacity constraint to foreign students. Theoretically, this average propensity should be between 0 and 1. Second, the term $\ln(\sum_{u=1}^{n_u^d} \exp(VS_u(X_u)))$ does not vary across universities and will be captured by the constant. Third, $\hat{M}_d^o$ is specific to the origin country and could be included in a fixed effect controlling for all factors that are specific to the foreign student's country of origin. Finally, $\ln(M_{d,u^d})$, the *ex ante* demand from foreign students to each university of country d is not observed by the econometrician. We will therefore discuss its omission in the context of instrumental variable estimation.

3. Data and Descriptive Statistics

This section presents the data used to estimate equation (9). The section details the sources and the development of some indicators such as the one capturing university quality, and provides descriptive statistics for each of them. Table B.1 in the Appendix B provides a summary of the data used in the econometric analysis.

3.1. International Students flows

To measure $\tilde{M}_{o,d,u^d}$ in equation (9), we take advantage of the data on bilateral flows of international students from all countries of the world to Italy and U.K. for the academic year 2011-2012. Following Beine et al. (2014), the international students we consider are the ones who migrated exclusively for the sake of education. Those who spent either one or more semesters abroad in institutional programs, such as the ERASMUS students, do not comply with our definition of international students and are therefore excluded from the data. We omit these students from the analysis for two reasons. First, bilateral agreements constrain the student's choice in terms of location. Second, in some curricula, attending a period of study abroad can be compulsory.

Data on foreign students in the U.K. comes from the Higher Education Statistical Agency (HESA), which provides data on international student flows for 163 U.K. universities.[5] The statistical office of the Italian Ministry of Education (MIUR) provides similar information for 79 higher-education providers in Italy.

Table 1 reports some descriptive statistics on the number of foreign students for the two countries. The U.K. hosts more than the 10 per cent of foreign students at the world level (OECD (2015)) and represents the second-most-popular destination after the United States. Consequently, international students, who come from 210 origin countries, represent a consistent percentage of students enrolled in U.K. higher institutions - 13.55 per cent of all students. The foreign students origin from 210 different countries.[6] Italy is a less-popular destination for international students who represent on average 3.65 per cent of the total student population. These students originate from 168 different countries.

Figure 1 shows the distribution of the share of foreign students across universities for Italy and the U.K. Most Italian universities' share of foreign students is below the 10 per cent level with respect to their total student population. Table 2 confirms that the share of foreigners is, on average, much larger in U.K. universities, where foreign students represent more than 20 per cent of the total student population in a large proportion of institutions. The two U.K. institutions with the largest proportion of foreigners are the London School of Economics and Political Science and the London Business School where the share of foreign students is greater than 60 per cent. For Italy, the average share is lower, there are still a significant number of universities for which the share is above 5 per cent. This illustrates the importance of the phenomenon of foreign education.

[5] Specifically, data are available for institutions located in England, Northern Ireland, Scotland and Wales.

[6] In the empirical part, we pay attention to not loosing the information relative to the empty corridors, i.e. origin-destination pairs with zero migration flow. The total number of observations is then equal to the number of universities multiplied by the number of origin countries.

Table 1 – Descriptive Statistics of Foreign Student Flows (2011)

	Italy	U.K.
Number of universities (a)	79	163
Origin countries (b)	168	210
Number of observations (axb)	13272	34230
% of zeros**	68.64%	60.16%
Total number of students (host capacity)* (c)	1710701	2518640
Number of foreign students* (d)	62512	341389
Foreign student as share of total students* (d/c)	3.65%	13.55%

*Numbers are computed aggregating all origin countries.

**The flow of students coming from country *i* and studying in university *u* is nil.

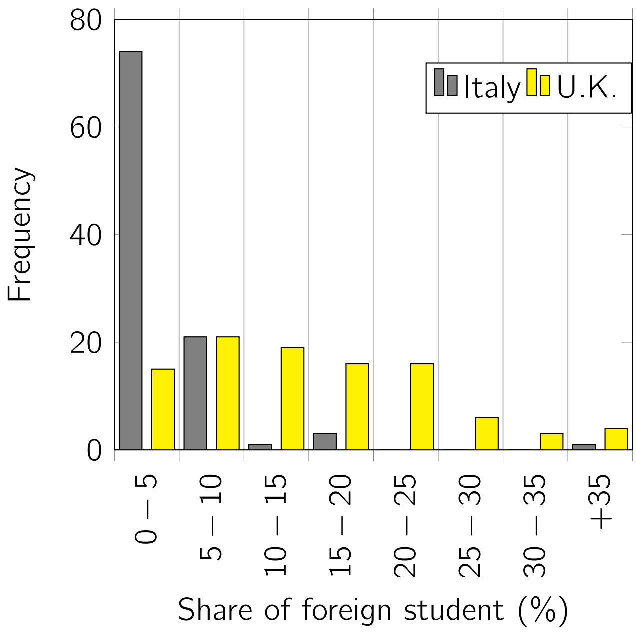


Figure 1 – Share of Foreign Students

	Italy	U.K.
Mean	3.88%	15.33%
Median	2.73%	12.95%
Standard deviation	4,87%	9.35%
Min	0.00%	0.07%
1st Quintile	0.62%	6.48%
2nd Quintile	1.72%	10.58%
3rd Quintile	4.00%	16.87%
4th Quintile	5.64%	22.77%
Max	35.19%	63.51%

Percentage of total students

Table 2 – Share of foreign students

To gauge the diversity of the foreign student population in these two countries, we refer to four multi-group segregation measures. Since we are more interested in the location choice of students than the universities' recruitment policies, we focus on diversity across institutions for each origin country, rather than diversity across origins for each institution.

The four multi-group segregation measures of Table 3 are presented and evaluated in Reardon and Firebaugh (2002). The first two measures, *dissimilarity index* and *gini index*, view segregation as a disproportion in the proportions of each origin across universities. This also refers to the measurement of inequality. The higher the index, the greater the segregation. Both indicate that the two countries display a significant variation in foreign students by origin across institutions. The comparison between the two destinations[7] suggests that foreign students in Italy tend to experience a higher level of segregation than do foreign students in the U.K. Figure 2 provides the distribution of the dissimilarity index for each origin-country birthplace of international students. This evenness index varies between 0 (similar distribution of each origin country and the total student population distribution) and 1 (maximum segregation). It could be interpreted as the share of the students from each origin country that would have to move (to another university) to match the dispersion of the total student population. The large share of origin groups with a high dissimilarity index (between 0.9 and 1), in both countries, is due to the large number of origin countries with very few individuals.

Entropy is another way to measure segregation. It is given by the last two indices in Table 3, that is, the information theory criterion and the relative diversity. In contrast to the previous indicators, segregation is decreasing with the index value. Again, these two other indices suggest that there is a significant degree of segregation in the two countries and that Italy faces a higher level of segregation compared with the level in the U.K.

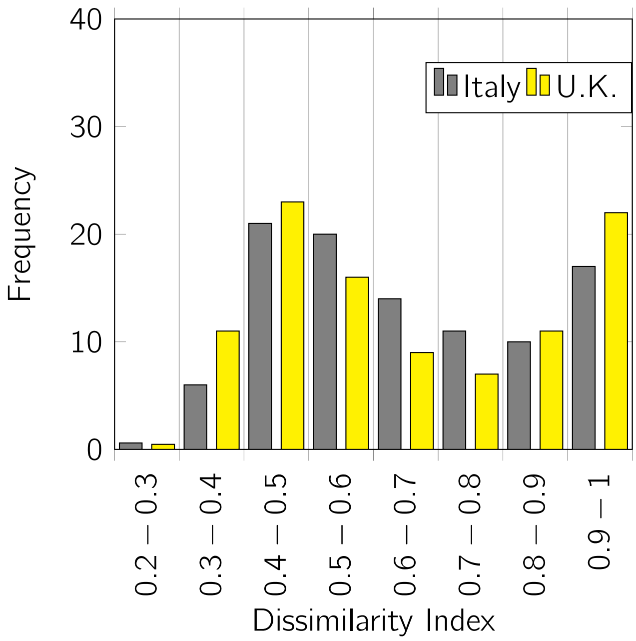


Figure 2 – Dissimilarity Indices

	Italy	U.K.
Dissimilarity (Sakoda (1981))	0.383	0.333
Gini (Reardon (1998))	0.511	0.451
Information theory (Theil (1972))	0.289	0.963
Relative diversity (Carlson (1992))	2.284	6.119

The reference is the original citation for multi-group form

Table 3 – Four Multigroup Segregation Measures

[7]The multigroup dissimiliraty index is a weighted average of origin indices.

3.2. Covariates

3.2.1. Cost of Living

Data on cost of living (CL_{u^d}, in equation (9)) come from the *Numbeo* website. This website provides various indexes of the cost of living for each city. We use the "Consumer Price plus Rent index" for the year 2011.[8] *Numbeo* computes the index, relying either on user input data or on data collected manually from authoritative sources such as websites of supermarkets, governmental institutions or other surveys. *Numbeo* applies different techniques to filter out noisy data.

The 163 U.K. universities are based in 87 different locations. *Numbeo* provides information for 39 cities of the 87. For the remaining locations, we compute the closest city in terms of geodesic distance to the ones for which the data are available and we take the respective cost of living index of that city. The same approach was used for the Italian data set. Figure 3 provides the distribution of the indicator for both countries. Table 4 provide the moments and the quantiles of the distribution. Both suggest that the cost of living considerably varies across cities in both destination countries.

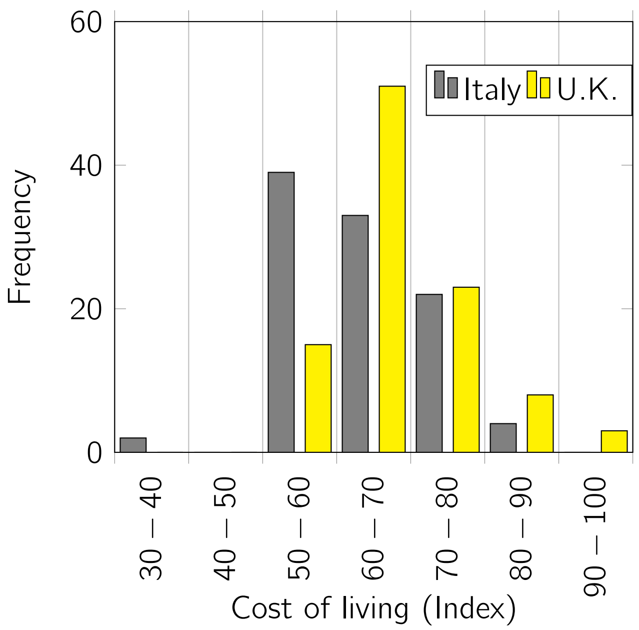


Figure 3 – Cost of Living

	Italy	U.K.
Mean	64.09	69.00
Median	62.06	67.91
Standard deviation	9.13	8.82
Min	36.17	54.94
1st Quintile	57.21	62.69
2nd Quintile	59.99	66.29
3rd Quintile	64.12	69.61
4th Quintile	73.37	76.41
Max	88.20	98.83

Index, base 100 for New-York city

Table 4 – Cost of Living

[8]The indexes are relative to New York city index that is normalized to 100.

3.2.2. Expected Income

We proxy expected income (w_{u^d} in equation (9)) at destination either by using the GDP per capita of the city of destination or, when the data are not available, the one relative to the district in which the city is located. We compute this measure using both GDP and population data provided by EUROSTAT.[9] Figure 4 and Table 5 suggest that the income distribution across locations is quite heterogeneous across cities in both countries.

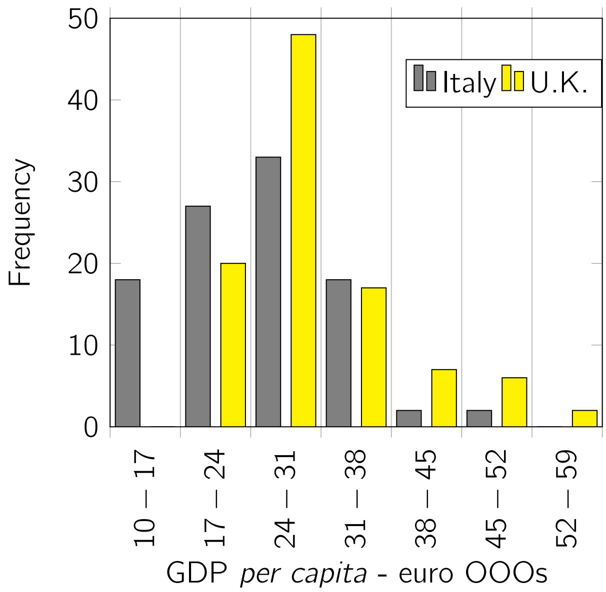


Figure 4 – Expected returns of education at destination

	Italy	U.K.
Mean	25.54	30.16
Median	24.55	27.53
Standard deviation	7.85	8.21
Min	14.61	18.09
1st Quintile	17.56	24.14
2nd Quintile	23.41	26.61
3rd Quintile	28.49	28.95
4th Quintile	31.36	35.70
Max	51.51	54.21

GDP *per capita*, euro OOOs

Table 5 – Expected returns of education at destination

3.2.3. Tuitions Fees

The cost of education CS_{u^d} in equation (9) is captured by the level of tuition fees. Italy and the U.K. are two of the few European countries in which tuition fees vary across institutions. The European Commission (European Commission (2012)) reports key information on tuition fees charged by European universities during the academic year 2011-2012.

For the U.K., tuition fees charged to European students were subject to a cap, equal to £3,375, for institutions based in England, Wales and Northern Ireland.[10] This level is set by the central government. Significantly, the institutional setting was different in Scotland. The government covered first-degree tuition fees for both Scottish and EU students. Students coming from the

[9] We exploit the data provided at the Nuts 3 level of the REGIO dataset.

[10] As of September 2012, the level was increased in England to an amount between £6,000 and a maximum of £9,000 . See European Commission (2012) for more details.

rest of the U.K. were subject to a fee equal to £1,800. In contrast, universities in the U.K. were allowed to set tuition fees in U.K. institutions without any cap for non-European students.

The Reddin Survey of University Tuition Fees provides information only on first-cycle tuition fees charged by U.K. universities, differentiating between the ones charged for European students and those charged for non-European ones. Data are available for 115 institutions of the 163 that make up the baseline data set. Table 6 compares the restricted sample with the baseline one.

Table 6 – U.K. - Benchmark and Restricted Samples (2011)

	All institutions (163)		Restricted sample (115)	
	All degrees	First degree	All degrees	First degree
Host capacity	2518640		2066290	
Foreign students	341389	All=185208 EU=63237	309406	All=171696 EU=56692
% of zeros	60.1%	All = 68.1% EU=38%	52.1%	All = 61.6% EU = 16.72%

Note. Numbers refer to number of students enrolling in 2011.
All degrees include bachelor and master students.

To account for the endogeneity of tuition fees, the empirical analysis for the U.K. focuses only on first-cycle international students. Our estimation strategy exploits the particular institutional setting of the U.K. (See Subsection 4.3 for more details.) Figure 5 and Table 7 report the distribution of fees in the U.K. and Italy. For the U.K., European students enrolled in Scottish universities have access to higher education for free while, in the remaining U.K. institutions, they were charged an amount equal to £3,375.[11]

Italian universities differ from U.K. institutions in their legal status, as they are classified either as private or public institutions. In contrast to most continental European countries, tuition fees charged by Italian public universities are not uniformly determined by the central government. According to the Italian law (Decree of the President of the Republic of 25.07.1997, №306), the total amount of fees collected by a public university cannot exceed 20 per cent of the funding received by this university from the Italian Ministry of Education. Conversely, for Italian private institutions, this 20 per cent limit does not apply, and they do charge higher fees. Tuition fees

[11]The only important exception is the University of Buckingham, which is considered as the only private higher education in the U.K. (Baskerville (2013)). This institution charged EU students an amount close to £9,000.

in Italian public universities depend on many determinants, in particular, on the student's family income and on the year of enrollment. Furthermore, Italian institutions do not charge higher tuition fees for non-European students.[12]

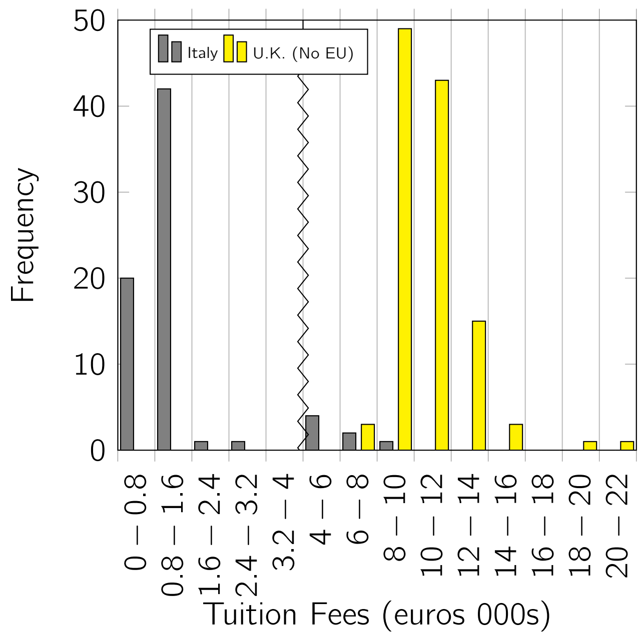


Figure 5 – Tuition fees

	Italy	U.K.*
Mean	1.41	10.57
Median	0.94	10.14
Standard deviation	1.57	2.03
Min	0.05	7.45
1st Quintile	0.63	9.10
2nd Quintile	0.84	9.80
3rd Quintile	1.00	10.67
4th Quintile	1.16	11.70
Max	8.26	21.25

* for non-EU students

Table 7 – Tuition Fees (euros, 000s)

Our primary source of data on (average) tuition fees in Italy is based on a survey conducted by the economic newspaper "*Il Sole 24 Ore*".[13] Data were missing for a few public Italian universities. In that case, we used an average computed at the regional level by an Italian consumer association (*FederConsumatori*). Data relative to private institutions are available for 9 of the 17 institutions that make up the baseline data set. Figure 5 reports the distribution of tuition fees for Italian universities. Only private institutions charged average fees above the level of € 2,000.

3.2.4. University Quality

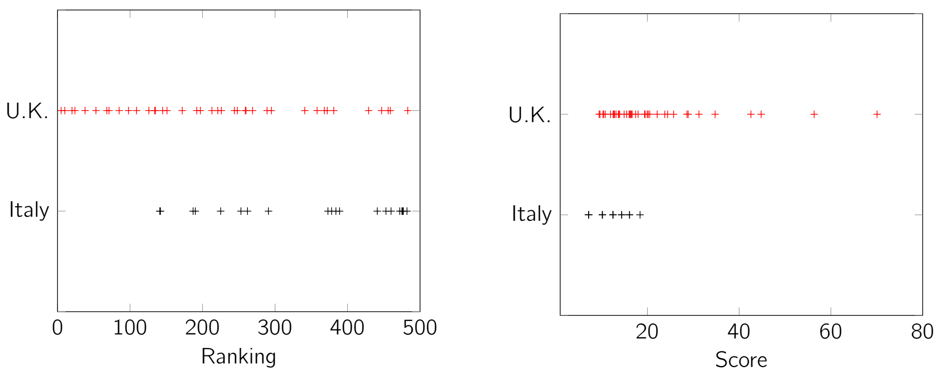
Equation (9) involves the quality of university (Q_{u^d}) as a determinant of expected income generated by education and hence of inflows of foreign students. In line with Beine et al. (2014) and Perkins and Neumayer (2014), we proxy university quality by exploiting the Top-500 Shanghai ranking for the year 2011 (ARWU). This ranking determines the 500 best universities in the world.[14] Although the index is widely known among international students and firms,

[12]Only other five European countries treat equally non-European students: the Czech Republic, Hungary, Iceland, Liechtenstein and Norway (European Commission (2012)).
[13]We include first-degree and master-degree students.
[14]The ARWU considers every university that has any Nobel Laureates, Fields Medalists, highly cited publications or papers published in Nature or Science. 1000 universities are considered and the best 500 are included in the

its use is subject to discussion. The index should basically be interpreted as a measure of how international students perceived quality of education.

For any university appearing in the ranking, we know both its position in the ranking and the relative score that is obtained. By exploiting this information, we compute two quality indexes. The first one is obtained by a simple rescaling of the ARWU ranking. Specifically, if the university does not appear in the ARWU list, our index takes a value equal to 1; if the university is included, the index takes its position into account and is given a value of $(500+2)-ranking$. The implicit assumption is that the index increases in a linear fashion along with the ranking.

The ranking indicator, nevertheless, has some limitations. It assumes that quality is reflected in a linear way by the position of the university in the ranking. In other terms, it disregards the fact that the score on which the ranking is based might be quite similar in a set of universities.[15] So, to account for the specific empirical distribution of the score, we also use the score of the Shanghai ranking of the position. Our quality measure takes a value equal to the *score* if the university appears in the top-500 ranking. Otherwise, the index is simply equal to 0. Thirty-one universities from the U.K. and 20 Italian higher education institutions were included in the top-500 ARWU ranking for the year 2011.



(a) Ranking **(b)** Score

Figure 6 – Indicators of University Quality

Figure 6 plots the two indicators of quality for each country. Panel (a) provides the ranking indicator for the U.K. (in red) and for Italy (in black). Panel (b) does the same for the score indicator. The figures suggest that, at least from an empirical point of view, it is important to use both indicators to account for the potential difference in the way they reflect quality.

ranking. For a full explanation on the index development, please see http://www.shanghairanking.com/ARWU-Methodology-2011.html.

[15]For instance, while the first university (Harvard) has a global score of 100, universities ranked between position 2 and 5 have scores between 72.6 and 70.0. Universities ranked in positions 51 to 100 have scores between 31.7 and 24.2, suggesting that the distribution is significantly skewed to the right.

3.2.5. Host Capacity

The specificity of our RUM model takes into account the capacity constraints of the universities. The constraints in terms of host capacity of foreign students (EC_{u^d} in equation (9)) is captured by the total number of students enrolled at the university of destination during the academic year considered. Even if the median is the same for both countries (see Table 8), the distributions (see Figure 7) highlight significant differences. The U.K. has smaller universities than does Italy (with an average of 14,575 and 21,932 students enrolled, respectively) and a relatively smaller standard deviation. In Italy, the number of universities over 40,000 students is high and close to the number of universities with fewer than 5,000 students, while such huge capacity is very rare in the U.K.

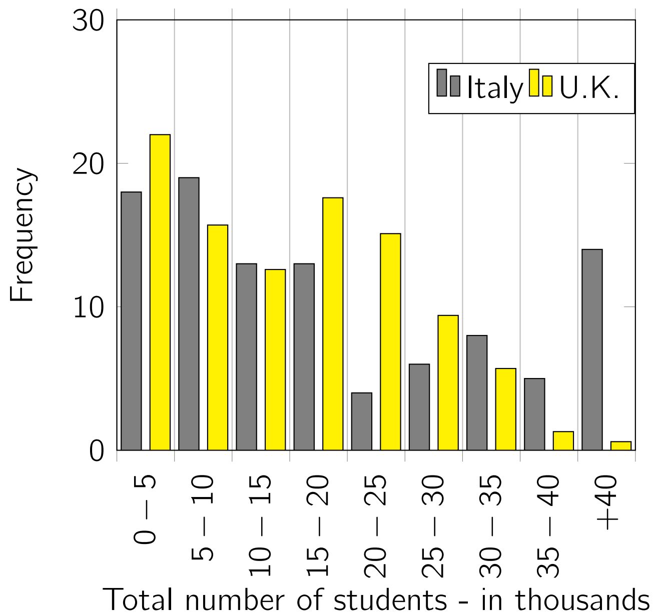


Figure 7 – Host Capacity

	Italy	U.K.
Mean	21932	14575
Median	14807	14860
Standard deviation	21721	5619
Min	405	290
1st Quintile	5789	3252
2nd Quintile	10735	10698
3rd Quintile	17672	17400
4th Quintile	33961	23480
Max	113040	40680

Total number of students

Table 8 – Host Capacity

4. Econometric Specification

4.1. From Theory to Econometric Specification

Our econometric specification is based on equation (9) that provides the determinants of choosing a specific university, conditionally upon studying abroad in a specific destination country. The benchmark estimated equation takes the following form:

$$\begin{aligned} \ln(\tilde{M}_{o,d,u^d}) &= \alpha + \alpha_d + \beta_1 ln(expreturn_{u^d}) + \beta_2 ln(quality_{u^d}) + \beta_3 \ln(fees_{u^d}) + \\ &\quad \beta_4 \ln(livingcost_{u^d}) + \beta_5 \ln(hostcapacity_{u^d}) + \epsilon_{d,u^d} \end{aligned} \tag{10}$$

.

where $\tilde{M}_{o,d,u^d}$ denotes the observed number of students coming from country o and studying in university u^d in country d. As noted above, this is applied separately to two countries, namely, Italy and the U.K., and to one specific academic year, 2011-2012. The data are therefore dyadic and time-invariant in nature.

$fees_{u^d}$, $livingcost_{u^d}$, $quality_{u^d}$, $hostcapacity_{u^d}$, and $expreturn_{u^d}$ stand respectively for CS_{u^d}, CS_{u^d}, Q_{u^d}, EC_{u^d} and w_{u^d} in equation (9). α_d is a set of fixed effects controlling for all factors specific to the country of origin of the foreign students. It includes $\ln(\hat{M}^o_d)$ in equation (9). Given that we focus on a specific country in separate regressions, α_d also controls for bilateral factors between the origin country and the university. α is a constant term that includes the theoretical term $\ln(\sum_{u=1}^{n_u^d} \exp(VS_u(X_u)))$ from equation (9) that does not vary across institutions. ϵ_{d,u^d} is an error term that is assumed to be independently and identically distributed.

Before we proceed to the estimation, a couple of comments are in order. First, we make clear that equation (10) corresponds to the last stage of the migration process of foreign students. Previous stages concern (i) the decision to study abroad or domestically, and (ii) the choice of the country of destination. This paper focuses only on the last stage. Another possibility would have been to integrate several destination countries in the same analysis, that is, to pool universities of different countries. Beyond the limitations in data availability, this is not desirable for several reasons. The main objection is that pooling universities of different countries would lead to a clear rejection of the IIA hypothesis implicit in the estimation of (10). The rejection of the IIA hypothesis would occur because the choice structure involves two countries that might be considered as nests in the decision process. Given that it is very likely that the degree of substitution between two universities varies with respect to the country of destination, we prefer in the end to estimate the model separately for each country of destination. This issue is also related to the well-known problem of multilateral resistance of migration (Bertoli and Fernández-Huertas Moraga (2013); Beine et al. (2015)). In other words, pooling several countries and integrating the choice of the destination country would entail the estimation of a nested logit model with two potential nests. This is obviously beyond the scope of this paper and is left for future investigation.

Second, equation (10) omits the term $\ln(M_{d,u^d})$ in equation (9) which is unobservable. This term indeed captures the total demand to university u^d coming from all origin countries before the impact of the constraints associated with the educational capacities. While in theory this is observable for each university, it is not available to the econometrician and will be included in the error term. This in turn might lead to estimation biases that we will discuss in the identification strategy, especially in the IV procedure. (See section 4.3.)

4.2. Econometric Method

Another issue is the prevalence of a high percentage of zero values for the bilateral migration flows. In our sample, for the year 2011 under investigation, we have 61.6 per cent zero values for the bilateral flow of first-degree foreign students for the U.K. The corresponding proportion for Italy is 68.84 per cent. The presence of a high proportion of zero values is well-known to generate biases in the key estimates using traditional panel fixed-effect estimates (Silva and Tenreyro (2006). The use of $log\left(1 + \tilde{M}_{o,d,u^d}\right)$ as the dependent (so-called scaled OLS) allows us to solve the selection problem due to the drop of the zero observations. Nevertheless, the scaled OLS estimation technique would give inconsistent estimates in the presence of heteroskedasticity. Silva and Tenreyro (2006) show that Poisson regressions are robust to different patterns of heteroskedasticity. We follow this route in the subsequent estimation and use the Poisson estimates as the benchmark. However, our tables will report the scaled OLS estimates of equation (10) for robustness checks.

4.3. Dealing With Endogeneity Concerns

In the model of Section 2, tuition fees are exogenous and decided by university authorities independent of numbers of students or other characteristics. In reality, the exogenous nature of fees in specification (10) is questionable on several grounds. First, fees might depend on the attractiveness of the university: successful universities attracting a large number of (foreign) students can easily raise the tuition fees compared with other universities. This leads to a reverse causality issue between student flows and fees. While the bilateral nature of N_{iju} mitigates this aspect, it is important to deal with the potential endogeneity of fees.[16]

On top of that, fees might be correlated with some unobserved characteristics of the university such as the quality of amenities on campus or in the hosting city. Another possibility is that universities set quotas for foreign students that are unknown to the econometrician. This can in turn lead to a quantity-price trade-off and induce a positive correlation between fees and quotas. The source endogeneity of tuition fees also calls for a specific treatment. This paper tackles the endogeneity of fees differently for each country of destination by taking advantage of the two different institutional contexts.

For Italy, we deal with the endogeneity of fees by using a traditional IV approach. Basically, we use the public *vs.* private status of the university as an instrument of tuition fees, following a similar solution adopted in Beine et al. (2014) at the country level. In particular, we create and use a dummy variable that captures the status (private *vs.* public) of the university. The underlying assumption is that private universities have a higher control over tuition fees. They tend to increase fees not only because of the costs but also because they receive fewer subsidies.

[16] Another way of looking at this endogeneity problem is contained in equation (9). In fact, the fee level (CS_{u^d}) in each university is likely to be positively correlated with the *ex-ante* total foreign demand M_{d,u^d}, which is omitted from equation (10).

Furthermore, they are not constrained by the regulation in terms of the cap that applies to public universities. We should expect a positive correlation between the private status and the level of tuition fees. In terms of exclusion restriction, the underlying assumption is that foreign students should not have particular preferences for private or public universities on top of the quality of education, host capacity, cost of living and income at the destination area. This seems to be a reasonable assumption and is confirmed by examples of many successful public universities in the U.S. such as Berkeley or Michigan State university.[17]

For the U.K., unfortunately, the traditional IV solution is not possible. Indeed, the status of the university is not as clear-cut as in the Italian case.[18] Some alternative instruments such as the share of the budget subsidized by the central government turned out to be weak instruments and generated inconsistent results.[19] Therefore, instead of a traditional IV, we deal with endogeneity by taking advantage of the institutional context of universities in the U.K. During the academic year 2011-2012, U.K. universities were in fact subject to caps on the amount of fees they could charge native and European first-cycle students. Those caps did not apply to students originating from outside the EU. On top of that, there is some regional variation in the tuition caps applied to universities. Scottish universities were subject to lower caps compared with those applied to other institutions in the U.K. Moreover, the cap set by the Scottish government applied only to non-Scottish U.K. students. The Scottish government covered first-degree tuition fees for both natives and European students, thus allowing them to get first-cycle education in Scottish universities for free (European Commission (2012)). In contrast, the other U.K. universities set tuition fees for EU students that are equal to the £3,375 cap.[20] It follows that, in restricting the sample to European countries as origin countries, we can estimate equation (10) in a context in which fees are clearly exogenous. Furthermore, the comparison of results obtained with the full sample of origin countries with results from countries originating outside the EU allows us to gauge, in a simple way, the degree of endogeneity of fees in using specification (10).

5. Results

We present the results separately for the two countries under investigation. For each set of estimates, we present results obtained using scaled OLS and Poisson. On top of these benchmark results, we also present results for Italy that are based on the combination of these techniques with the use of instrumental variable.

[17]In a robustness check, we look at the impact of reasonable deviations from the exclusion restriction on the estimation of the effect of the fee. See Table 11 below.

[18]The same does not hold for U.K. According to Baskerville (2013) the only U.K. private institution is the university of Buckingham. All the others are defined as independent legal entities.

[19]Results are available upon request.

[20]The only exception is the University of Buckingham; see section 3.2.3.

5.1. Italy

We consider the case of Italian universities, first presenting the benchmark results. We then consider two robustness checks specific to Italy. We first conduct new econometric procedure that account for possible deviations from the exact validity of the exclusion restriction in the IV estimation employing the methods of Conley et al. (2012). After this, in Section 5.1.3 we extend the baseline specification, including a variable that captures the existence of English teaching programs. Section 5.3 contains an additional robustness analysis, common to the two destination countries.

5.1.1. Benchmark Regressions

The inclusion of origin-country fixed effects allows us to control for the role of the usual push factors (for instance, GDP at origin) as well as the influence of bilateral determinants (colonial links, proximity, languages). The estimates reported in Table 9 are in line with a traditional view of the role of fees and of quality.

Table 9 – Italy - Benchmark Estimates of Determinants

Variables	Scaled OLS	Poisson	Scaled OLS	Poisson
Fees	-0.082***	-0.174**	-0.085***	-0.167**
	(0.01)	(0.06)	(0,01)	(0.06)
Cost of living	0.046	-0.625	-0.011	-0.741
	(0.06)	(0.41)	(0,06)	(0.41)
Quality (ranking)	0.080***	0.143***	-	-
	(0.01)	(0.02)		
Quality (score)	-	-	0.114***	0.234***
			(0.01)	(0.04)
Host capacity	0.156***	0.552***	0.162***	0.560***
	(0.01)	(0.06)	(0.01)	(0.06)
Income	0.625***	1.585***	0.656***	1.612***
	(0.03)	(0.16)	(0.03)	(0.16)
Origin FE	Yes	Yes	Yes	Yes
R^2	0.569	-	0.568	-
Pseudo R^2	-	0.743	-	0.744
Nber Obs	11928	11928	11928	11928

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In particular, both types of estimation techniques deliver a negative and significant role for fees in the choice of a university, in line with the view that fees are part of the cost function of foreign education. Estimates vary little with respect to the two quality indexes. Nevertheless, a couple of comments are in order. First, while fees appear to have a negative role, failure to account for their possible endogeneity leads us to take these results with caution. Second, while the benchmark results suggest significant and intuitive roles for fees, the quality of the university, host capacity and the expected income in the area, we fail to find any evidence of a role for the cost of living. Since all estimates are potentially biased by the presence of endogenous fees, it is also important to check whether this result survives after an explicit treatment of endogeneity through IV estimates. These are reported in Table 10.

The estimates of Table 10 provide interesting insights. First, the use of instrumental variable estimation leads to a significant correction in the estimate of the influence of tuition fees. Endogeneity of fees might be due either to reverse causality (that is, attractive universities are more likely to charge higher fees) or to some positive correlation of fees with unobserved factors of attractiveness (for example, universities with better amenities tend to charge higher fees). In both cases, this results in a positive correlation between fees and the error term of model (10), resulting in an upward biased estimate of the impact of tuition fees. A comparison of tables 9 and 10 shows that the use of instrumentation corrects the bias in the expected direction, with a more negative impact of fees on the university choice. This holds for both estimation techniques.

Table 10 – Italy - Instrumental Variable Estimates of Determinants

Variables	Scaled IV	Poisson IV	Scaled IV	Poisson IV
Fees	-0.246***	-0.580***	-0.248***	-0.543***
	(0.02)	(0.12)	(0.02)	(0.12)
Cost of living	-0.132*	-1.419**	-0.191**	-1.410**
	(0.06)	(0.47)	(0.06)	(0.45)
Quality=ranking	0.081***	0.153***		
	(0.01)	(0.02)	-	-
Quality=score	-	-	0.119***	0.250***
			(0.01)	(0.06)
Host capacity	0.128***	0.483***	0.133***	0.501***
	(0.01)	(0.06)	(0.01)	(0.06)
Income	0.878***	2.211***	0.908***	2.166***
	(0.04)	(0.25)	(0.04)	(0.24)
Origin FE	yes	yes	yes	yes
R^2	0.562	-	0.560	-
F first stage	5014.4	-	5057.6	-
Nber Obs	11928	11928	11928	11928

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Instrument: dummy variable indicating private institution.

Second, the IV results lead to a significant change in all the estimates of the determinants of the choice of university except for quality. Correcting the impact of fees could suggest that the non-IV Poisson estimate tends to overestimate the true impact or, in other words, underestimate the impact in absolute terms. Such a bias is consistent with, for instance, a positive correlation between fees and unobserved amenities. It is also consistent with a phenomenon of reverse causality (attractive universities are more expensive). The IV estimates of (10) support the role of all possible determinants of the model, suggesting that the choice of a particular university results from a complex assessment of benefits and costs as outlined in the theoretical RUM framework of Section 2. Interestingly, the estimates for Italy suggest that foreign students explicitly take into account the cost of the living and the expected income for the city of destination. The estimated elasticity suggests that a 10 per cent increase in the tuition fee tends to decrease the average bilateral flow to that university by about 5.5 per cent.

5.1.2. Deviations From the Exclusion Restriction

The exclusion restriction of our instrumental variable might be subject to discussion. While we control for a set of determinants such as host capacity and quality, it could be that some foreign students take into account the status of the university when choosing a location. For instance, it could be that foreign students believe that private universities are better organized and provide better services for students in terms of advice, personal tutoring and other aids. It could also be that students believe private universities are more accountable to students for the quality of teaching. The greater attractiveness of private institutions seems to be the prevailing dominant view. Nevertheless, this view is not the only one. For instance, it might be expected that there is a higher recognition of degrees conferred by public universities, suggesting that the private status of some institutions might deter more than attract some students. In that case, there might be a positive or negative correlation of our status variable and the error term of equation (10), invalidating the exclusion restriction of the IV procedure.

To cope with such a concern, we conduct a new econometric procedure introduced by Conley et al. (2012) that accounts for possible deviations from the exclusion restriction. The idea is to consider the parameter capturing that restriction (the coefficient of the instrumental variable in the structural equation) as a random parameter drawn for a given distribution. The procedure allows for possible means different from zero, that is, for asymmetric deviations from the exclusion restrictions. (See Conley et al. (2012) for details.)[21] We consider two alternative procedures. The first one, named "union of confidence interval" (UCI), provides an alternative IV estimation assuming only a support for the exclusion parameter. The other one, called "local to Zero estimation", assumes a normal distribution with a given mean and standard deviation. Table (11) reports the results of the UCI procedure.[22]

[21]Note that this procedure is particularly appealing in our context since it applies to situations in which the instrument is strong.

[22]The results of the Local to Zero estimation yields similar conclusions and can be obtained upon request.

Table 11 – Italy - Estimated Impact of Tuition Fees With Plausibly Endogenous Instrument.

(1)	(2)	(3)	(4)	(5)
min deviation	max deviation	estimate	std. deviation	t-ratio
Symmetric intervals				
−0.1	0.1	-0.248***	0.057	-4.36
−0.2	0.2	-0.248***	0.096	-2.59
−0.3	0.3	-0.248*	0.134	-1.85
Asymmetric intervals				
−0.3	0	-0.134*	0.076	-1.77
−0.2	0	-0.172***	0.057	-3.03
0	0.2	-0.324***	0.057	-5.67
0	0.3	-0.362***	0.076	-4.73

Estimated equation: equation (10). Instrument: status (private/public) of university.
Estimation method: union of confidence intervals (Conley et al. (2012)).
Columns (1) and (2) provide the minimum and maximum values of the parameter capturing the deviation from the exclusion restriction.
Column (3) provides the mean estimate of the fee elasticity.
Column (4) provides the standard deviation of the estimate.

Table 11 focuses on the estimation of the elasticity of foreign students to tuition fees for different values in the range of possible values taken by the key parameters capturing the deviation from the exclusion restriction.[23] The higher the range of admissible values, the less precise the estimated coefficient. Symmetric ranges around zero correspond to an agnostic view of the possible deviation of the exclusion restriction of the status of the university as an instrument. A range of positive (negative) values corresponds to the view that foreign students value private universities more (less).

Results of Table 11 suggest that the negative and significant elasticity of tuition fees in the traditional IV estimation is robust to deviations from the exclusion restriction. The significance level drops below the 5 per cent level only for values of the parameter over 0.3 in absolute terms. This means that, even if the private status of the university deters or attracts (on average) less than 0.3 per cent of foreign students coming from each origin country, our IV estimates support a negative effect of tuition fees. Above that value, our estimates become less significant, albeit still negative at a 10 per cent significance level. The bottom panel of Table 11 also reports results obtained with asymmetric intervals of values of the deviation parameter. By restricting the range of possible deviations, the estimation of the effect becomes slightly more precise. Also, accounting for asymmetry allows us to issue a different point estimate of the impact of tuition

[23]The other estimates of equation (10) are not reported here due to space restrictions but are available upon requests. In general, they are unaffected by the alternative procedure compared with the benchmark estimations.

fees. The results support the negative impact of tuition fees. Interestingly, our estimations show that if foreign students are more attracted by private Italian universities (which seems the prevailing view), the impact of tuition fees becomes even *more* negative.

5.1.3. Accounting for English-Teaching Programs

One concern related to the previous specification is that it neglects the existence of teaching programs provided in English at the destination university. Given the importance of English as an international language, the existence of such programs can be a determinant for foreign students in their location and enrollment choice.[24] Furthermore, it is possible that universities with English teaching programs can display characteristics different from other universities, prompting some correlation with other covariates such as the quality or the fees. If it is the case, the previous estimates might be biased.[25]

To address such a concern, we extend specification (10) by including in the set of covariates a dummy variable capturing the availability of English teaching programs at the university level. This dummy variable, labeled $EngDummy$, takes a value equal to 1 if the university u provided at least one bachelor or masters program in English for the academic year 2011-2012 and 0 otherwise.[26] According to this data source, 39 Italian universities were providing at least one program taught in English during the academic year 2011-2012.

Table 12 reports the results obtained using scaled OLS and Poisson. Table 13 reports the same results with IV estimation, instrumenting the tuition fees as before.

[24]Interestingly, Kahanec and Králiková (2011) find that the availability of English teaching programs acts as a pull factor.

[25]Note that, if the correlation between availability of English teaching courses is positively correlated with either education quality or tuition fees, this would lead to upward biased coefficients.

[26]The information is retrieved from the website of the Conference of Italian University Rectors (Fondazione Crui). See https://www.crui.it/images/documenti/2012/courses_english.pdf.

Table 12 – Italy: Accounting for the Availability of English Teaching Programs

Variables	Scaled OLS	Poisson	Scaled OLS	Poisson
Fees	-0.085***	-0.200**	-0.089***	-0.201**
	(0.01)	(0.06)	(0.01)	(0.06)
Cost of living	0.014	-0.743	-0.011	-0.865 *
	(0.06)	(0.42)	(0.06)	(0.41)
Quality (ranking)	0.079***	0.126***	-	-
	(0.01)	(0.02)	-	-
Quality (score)	-	-	0.114***	0.225***
	-	-	(0.01)	(0.04)
Host capacity	0.148***	0.527***	0.152***	0.513***
	(0.01)	(0.06)	(0.01)	(0.06)
Income	0.622***	1.583***	0.652***	1.603***
	(0.03)	(0.16)	(0.03)	(0.16)
EngDummy	0.049***	0.345***	0.057***	0.382***
	(0.01)	(0.09)	(0.01)	(0.09)
Origin FE	yes	yes	yes	yes
R^2	0.570	-	0.568	-
Pseudo R^2	-	0.746	-	0.747
Nber Obs	11928	11928	11928	11928

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Several comments are in order after comparing the results of tables 12 and 13 with those of the benchmark regressions (tables 9 and 10). First, the new results turn out to be slightly different, without changing any main conclusion regarding the impact of the fees and the other determinants. In this respect, the results are unchanged. Second, the availability of English teaching programs acts as a pull factor for foreign students in Italy. Third, the inclusion of this variable corrects the estimates in the expected direction. In particular, the coefficient of fees and quality tend to decrease in all regressions, suggesting that the existence of English teaching programs is positively correlated with the quality and tuition fees prevailing in the university. Nevertheless, the correction remains somewhat modest, which suggests that the bias (if any) from omitting this variable is rather small.

Table 13 – Italy: IV Estimates Accounting for the Availability of English Teaching Programs

Variables	Scaled IV	Poisson IV	Scaled IV	Poisson IV
Fees	-0.261***	-0.666***	-0.263***	-0.626***
	(0.02)	(0.12)	(0.02)	(0.12)
Cost of living	-0.188**	-1.806***	-0.252***	-1.756***
	(0.06)	(0.52)	(0.06)	(0.49)
Quality=ranking	0.080***	0.137***	-	-
	(0.01)	(0.02)	-	-
Quality=score	-	-	0.118***	0.242***
	-	-	(0.01)	(0.04)
Host capacity	0.114***	0.446***	0.117***	0.437***
	(0.01)	(0.06)	(0.01)	(0.06)
Income	0.888***	2.365***	0.916***	2.282***
	(0.04)	(0.28)	(0.04)	(0.27)
EngDummy	0.072***	0.364***	0.080***	0.412***
	(0.01)	(0.09)	(0.01)	(0.09)
Origin FE	yes	yes	yes	yes
R^2	0.561	-	0.560	-
F first stage	5537	5560	-	-
Robust Score	145	146.3	-	-
Robust Regression	148	149.6	-	-
Nber Obs	11928	11928	11928	11928

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Instrument: dummy variable indicating private *vs.* public institution.

5.2. United Kingdom

Universities in the U.K., unlike those in Italy, cannot be distinguished as either public or private institutions. This prevents our using the instrument capturing the public *vs.* private status of the university. We deal with the issue of endogeneity of fees by making use of the institutional context, namely, by exploiting the regional variation in the first-cycle tuition fee caps. We run regressions based on model (10) for various sub-samples in terms of origin countries. We first restrict the analysis to first-cycle students, that is, those who are subject to caps on fees. For the reasons given above, restricting the sample to EU countries as origin countries should solve the endogenous nature of tuition fees. In contrast, if we use all countries or the non-EU origin countries, this should lead to results subject to the endogeneity bias. A comparison between the results based on different samples allows us to shed some light on the magnitude of the bias associated with the endogeneity of tuition fees. Based on this strategy, tables 14 and 15 present the results of the estimation of model (10) for the three sub-samples of origin countries and for the two estimation techniques. Table 14 presents the results with the indicator of quality based on the ranking, while Table 15 reports the findings obtained with the score indicator.

The estimation results of tables 14 and 15 yield basically two lessons. First, using only EU countries as origin countries, we find some support in favor of a negative impact of tuition fees. This finding therefore confirms the negative impact found in the case of Italy. The estimated elasticity for the U.K. is much lower in terms of magnitude than for Italy. This might be due to the fact that we focus on bachelor-degree students who are less mobile than masters students.

Table 14 – U.K. - Determinants of Student Migration, First-Cycle Students From EU Countries.

	Scaled OLS			Poisson		
Variables	All	EU	No EU	All	EU	No EU
Fees	-0.064***	-0.086***	0.114***	-0.078***	-0.084***	0.432*
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.21)
Cost of living	0.560***	1.956***	0.339***	0.993***	1.220***	0.809**
	(0.04)	(0.19)	(0.04)	(0.20)	(0.32)	(0.25)
Quality (ranking)	0.037***	0.077***	0.024***	0.073***	0.032*	0.070***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.02)
Host capacity	0.290***	0.742***	0.233***	0.892 ***	0.862***	0.933***
	(0.01)	(0.03)	(0.01)	(0.05)	(0.06)	(0.07)
Income	0.104***	-0.057	0.102***	-0.015	0.027	-0.096
	(0.02)	(0.10)	(0.02)	(0.12)	(0.15)	(0.16)
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.661	0.581	0.621	-	-	-
Pseudo R^2 -	-	-	-	0.706	0.464	0.737
Nber Obs	24360	2900	21460	21228	2900	18328

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Second, the results for the sample of non-EU regions suggest that the failure to deal with the endogeneity of tuition fees leads to significant biases in the estimation of their impact. Once again, as in the Italian case, failure to deal with the endogenous nature of fees leads to overestimating their impact, which in turn is consistent with reverse causality and positive correlation between fees and unobserved amenities for instance. Focusing on the Poisson regressions, the results obtained with the non-EU countries exhibit a positive and a barely significant effect of tuition fees. While fees can in practice have additional dimensions that the pure cost component outlined in Section 2 (such as a signal of quality or a mitigation of the cost through coverage by education grants), such a strong and positive impact would nevertheless be difficult to rationalize. While we do not account for the existence of education grants, our estimations account for the variation in the quality of universities, which rules out the signaling effect of fees. Our results for the different samples instead suggest that the positive impact obtained in previous work is in great part driven by endogeneity issues.

Table 15 – U.K. - Determinants of Student Migration, First-Cycle Students From EU Countries (Score Indicator of Quality).

	SCALED OLS			Poisson		
Variables	All	EU	No EU	All	EU	No EU
Fees	-0.064***	-0.087***	0.110***	-0.079 ***	-0.084***	0.395
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.22)
Cost of living	0.555***	1.947***	0.336***	0.974***	1.219***	0.787***
	(0.04)	(0.19)	(0.04)	(0.20)	(0.32)	(0.25)
Quality (score)	0.059***	0.127***	0.038***	0.116***	0.056**	0.111***
	(0.00)	(0.01)	(0.00)	(0.02)	(0.02)	(0.02)
Host capacity	0.289***	0.739***	0.233***	0.888 ***	0.857***	0.930***
	(0.01)	(0.03)	(0.01)	(0.05)	(0.06)	(0.07)
Income	0.103***	-0.061	0.102***	-0.017	0.021	-0.089
	(0.02)	(0.10)	(0.02)	(0.12)	(0.15)	(0.16)
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.661	0.581	0.621	-	-	-
Pseudo R^2 -	-	-	-	0.722	0.465	0.736
Nber Obs	24360	2900	21460	24360	2900	18328

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Tables 14 and 15 also exhibit counter intuitive results for both the cost of living and income. The fact that the income coefficient is not significant could be due to the fact that our baseline sample contains only first-cycle students. The prospects of finding a good job are much more better for masters students than for bachelor-level students. First cycle in higher education primarily aims at providing a good training to improve access to graduate studies rather than providing a degree that is "usable" right away on the job market.

The elasticity of quality is also found to be lower in the U.K. than in Italy. It might be the case that first-cycle students react less to quality of the university as bachelor programs are quite similar across universities and the differences among bachelor programs are not that great. To check this conjecture, we run similar regressions using masters students' flows instead of first-cycle students.[27] Tables C.2 and C.3 in the Appendix[28] report the results obtained. Once we use only masters student flows, the coefficient on income becomes both positive and highly significant. Interestingly, the quality coefficients become both positive and highly significant for

[27]Fees for masters students are unregulated in U.K.; the reader should therefore not rely on the coefficients on fees there obtained.

[28]Table C.4 in the Appendix C reports the estimation results using the whole flows of international students to U.K. (both first-degree and masters students).

both estimation techniques. Consequently, the failure of the regressions reported in tables 14 and 15 to find such evidence could be driven by the fact that first-degree students are less likely to change location, for example, to benefit from job opportunities.

Nevertheless, even for masters students, the coefficient relative to the cost of living remains positive. It may be the case that, in the U.K., our measure of the cost of living is highly related with unobserved amenities at destination, generating endogeneity of this variable. To take care of that issue, we carry out IV estimation, instrumenting the cost of living. The instrumentation strategy and the results are in the Appendix C. The results suggest that the positive coefficient obtained in tables (14-C.3) might be once again driven by endogeneity.

5.3. Robustness Check: Scaled Regressions

One concern related to model (10) is that the model does not perfectly match the idea of the multinomial logit defined in the theoretical model (see Section 2). In particular, in a multinomial logit set-up, one increase in the attractiveness of a given university proportionally decreases the attractiveness of the other ones. If, for example, the ranking of Cambridge tends to increase, this should lead both to a larger inflow of foreign students to Cambridge and to a decrease in the foreign students intake in Oxford. The same holds true for the other covariates, including tuition fees.

To deal with this, we change the estimated specification (10) by scaling all variables by a reference level. The reference level is chosen at the dyadic level, that is, it varies across each pair and is specific to each origin country. We scale all variables in the specification by the level prevailing at the university at the destination that hosts the greatest number of students from origin country o. In practice, for each origin country o, we determine the university that hosted the largest number of international students during the academic year 2011-2012. This variable is labeled by $(u_d)^*$.[29]

The extended model that we consider takes the following form:

$$\left(ln \left(\frac{N_{u_d}}{N_{(u_d)^*}} \right) \right) = \alpha + \alpha_d + \beta_1 * ln \left(\frac{fees_{u_d}}{fees_{(u_d)^*}} \right) + \beta_2 * ln \left(\frac{livingcost_{u_d}}{livingcost_{(u_d)^*}} \right) + \beta_3 * ln \left(\frac{quality_{u_d}}{quality_{(u_d)^*}} \right) + \beta_4 * ln \left(\frac{hostcapacity_{u_d}}{hostcapacity_{(u_d)^*}} \right) + \beta_5 * ln \left(\frac{expreturn_{u_d}}{expreturn_{(u_d)^*}} \right) + \epsilon_{d,u_d} \tag{11}$$

Table 16 presents the results for Italy, while Table 17 reports those for the U.K. The tables are directly comparable with the ones reporting the benchmark regressions, that is, tables 9, 10 and 14.

[29]When the largest flow from a given country of origin is shared among several universities, we scale each covariate by the average values among these universities. We apply this strategy for both destination countries, Italy and the U.K.

Table 16 – Italy, Scaled Estimations

	Benchmark Estimates		IV	
Variables	Scaled OLS	Poisson	Scaled OLS	Poisson
$Fees_{(ui)*}$	-0.025***	-0.106*	-0.066***	-0.167**
	(0.00)	(0.04)	(0.01)	(0.06)
Cost of $living_{(ui)*}$	-0.013	0.181	-0.058 ***	-0.741
	(0.02)	(0.24)	(0.02)	(0.41)
$Quality_{(ui)*}$	0.035***	0.140***	0.037***	0.140***
	(0.00)	(0.02)	(0.00)	(0.02)
Host $capacity_{(ui)*}$	0.046***	0.560***	0.038***	0.527***
	(0.00)	(0.04)	(0.00)	(0.04)
$Income_{(ui)*}$	0.200***	1.517***	0.264***	1.812***
	(0.01)	(0.10)	(0.01)	(0.13)
Origin FE	yes	yes	yes	yes
R^2	0.393	-	0.385	-
Pseudo R^2	-	0.174	-	-
Nber Obs	11857	11857	11928	11928

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 17 – U.K.: Scaled Regressions, First-Cycle Students

	SCALED OLS			Poisson		
Variables	All	EU	No EU	All	EU	No EU
$Fees_{(ui)*}$	-0.065***	-0.087***	0.129***	-0.081***	-0.092***	0.197
	(0.01)	(0.01)	(0.04)	(0.01)	(0.01)	(0.11)
Cost of $living_{(ui)*}$	0.637***	1.947***	0.392***	1.069***	1.778***	0.844***
	(0.05)	(0.19)	(0.05)	(0.12)	(0.21)	(0.15)
$Quality_{(ui)*}$	0.068***	0.127***	0.045***	0.061***	0.105***	0.027*
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Host $capacity_{(ui)*}$	0.335***	0.739***	0.275***	0.837 ***	0.818***	0.857***
	(0.01)	(0.03)	(0.01)	(0.03)	(0.04)	(0.04)
$Income_{(ui)*}$	0.120***	-0.061	0.123***	0.301***	0.004	0.355***
	(0.03)	(0.10)	(0.03)	(0.07)	(0.11)	(0.16)
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.611	0.451	0.642			
Pseudo R^2	-	-	-	0.096	0.088	0.091
Nber Obs	20996	2900	18096	20996	2900	18096

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Columns 2 and 3 of Table 16 report the baseline estimates of model (11) for Italy. Columns

4 and 5 contain the results obtained applying the IV strategy employed in Section 5.1. In all estimations, we use the "*Score*" as indicator of quality.[30]

Table 16 provides additional evidence of the negative impact of fees on international student inflows. Also, the estimates of the other covariates almost perfectly mirror the results obtained when considering the baseline model (10). For the U.K., as before, we apply specification (11) for the subset of the first-degree students. The results, shown in Table 17, confirm the negative impact of fees for students coming from EU countries. Furthermore, as before, the positive impact of fees for non-EU students is confirmed, evidence once again that the results are affected by endogeneity issues.

6. Conclusions

This paper revisits the issue of the determinants of student migration. In contrast to the existing literature that has focused up to now on country-specific factors, we look at the determinants at the university level. This allows us to address specifically the role of important factors such as tuition fees or the quality of the university. The impact of those factors is difficult to grasp in country-level studies due to the high heterogeneity among institutions in many countries. While the analysis considers a set of university-specific factors, we pay special attention to the role of tuition fees in the inclination of foreign students to choose a specific university. So far, the existing literature has obtained mixed results concerning the impact of tuition fees.

We build our empirical investigation on a nested logit model capturing the decision to choose a specific university abroad. We focus on the last decision nest, that is, the choice of a specific university for a student, conditional on going abroad and conditional on choosing a specific destination country. This choice is constrained by binding capacity constraints on the side of hosting universities. Our model allows the identification of the main factors such as tuition fees, quality of the university, host capacity, expected return on education at destination and cost of living. We estimate the role of those factors, using data at the university level for two countries - the U.K. and Italy. One of the important issues at the econometric level is the endogeneity of fees. We propose two different solutions for each country. For Italy, we use a classical IV approach based on the status (private *vs.* public) of the universities. For the U.K., we use the regional variation in the caps on fees imposed by authorities for native and European students obtaining their first degree.

Our analysis generates interesting and new findings. First, we find evidence of the negative role of a university's tuition fees on the flow of students choosing to study in that university. The typical estimate implies that an increase in tuition fees of 10 per cent would reduce the bilateral flow by about 5 per cent, suggesting a non-negligible effect in terms of magnitude. Surprisingly, this negative and significant role is new in the literature. We stress the importance of dealing with the endogeneity of tuition fees. Failure to account for endogeneity results in a positive

[30] Estimations with the "*Ranking*" as a proxy of university quality are available upon request and give similar results.

and significant result. While such a positive impact is not to be ruled out at a theoretical level, it is nevertheless difficult to rationalize in practice. The negative impact of fees is found to be robust to a set of robustness checks, including the role of English teaching programs in Italy, deviations from the exclusion restriction in the IV procedure and alternative specification consistent with the multinomial logit model. While tuition fees are found to have some influence on the location of foreign students, our analysis also emphasizes and confirms the role of other important factors. We find support in favor of the role of the university's quality. Also, the expected return to education after graduation is found to be important. This last result is in line with the implications of the migration model of foreign education.

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Appendix

A. Student Migration in a RUM Model With Capacity Constraints

This section derives a tractable students' migration equation from a simple theoretical model based on the human capital literature and on the random utility maximization approach to migration. Education is considered an investment in future earnings and employment (see Becker (1964)) for rational students who seek to maximize their lifetime earnings. The quality of education may affect their expected returns to education (Card and Krueger (1992)). The prospective student migrant compares the present value of future earnings if he/she decides to study in a university at home with the present value of future earnings if education is obtained at a university abroad. If the increase in the present value of the future income is greater than the cost of migrating (plus the other education costs), students would move to the university yielding the highest net present value. This is conditional because each university might face capacity constraints or impose quotas on foreign students. Therefore, there is a role for capacity constraints.

In the model, studying at home does not rule out migration after graduation for the sake of working in another country. Similarly, studying abroad facilitates access to the local labor market but does not preclude the possibility of returning home or migrating, after graduation, to a third country. A student's location decisions before and after education are not independent but are taken sequentially. We develop here the decision process in terms of education location.

A.1. Students' Choice

The set of destination countries is $D = \{d_1, ..., d_{n_d}\}$ with n_d denoting the number of destination countries (j is the index for destination country. The set of origin countries is $O = \{o_1, ..., o_{n_o}\}$ with n_o the number of origin countries (o is the index for the origin country). Countries can be both inside D as well as inside O. The set of universities in country d is $U^d = \{u_1^d, u_2^d, ..., u_{n_u^d}^d\}$ with n_u^d the total number of universities in country d (u^d is the index for university). The set of young people in each country o who want to pursue studies in higher education is $S^o = \{s_1^o, s_2^o, ..., s_{N_s^o}^o\}$, with N_s^o the total number of young people in country o who wish to study. The index for student is s.

Let the utility derived from studying in university u^d located in country d of student s from country o (VS_{o,d,u^d}^s) be expressed as:

$$VS_{o,d,u^d}^s = VS_{o,d,u^d}\left(IW_{d,u^d}^s, CM_{o,d}, CS_{u^d}, CL_{u^d}, A_d\right) + \epsilon_{o,d,u^d}^s \qquad (12)$$

where IW_{d,u^d}^s is the intertemporal expected value of labor income after graduating from university u^d, $CM_{o,d}$ a vector of country-pair migration costs; CS_{u^d} the cost of education (here the fees of university u^d); CL_{u^d} the cost of living in the city of university u^d and A_d some country-specific unpriced amenities. Utility is separated into two parts. One part is deterministic and varies by origin and university destination pair $VS_{o,d,u^d}\left(W^s_{d,u^d}, CM_{o,d}, CS_{u^d}, CL_{u^d}, A_d\right)$. The other part is stochastic and captures unobserved components of the individual utility associated with each university choice (ϵ^s_{o,d,u^d}).

Although decisions to migrate for educational purposes and for work are taken sequentially, the student forms (simplistic) expectations about working period when he/she decides on the educational location. The expected wage indeed depends indeed on the level and the quality of education which is university-specific. We suppose that students form myopic expectations about the expected wages by referring to the wages prevailing in the local labor market of the university.

The expected intertemporal labor income of student s from country o studying in university u^d located in country d (IW^s_{o,d,u^d}) is defined by:

$$IW^s_{o,d,u^d} = \int_{\underline{T}^s}^{\overline{T}} e^{-\rho t} W^s_{o,d,u^d}(.)dt \qquad (13)$$

with $\underline{T}^s$ as the age of student s upon graduating and $\overline{T}$ as a fixed retirement age. $e^{-\rho t}$ is a discount factor with ρ the rate of time preference. Individuals have the same rate of time preference and the same indirect utility functions.[31] $W^s_{o,d,u^d}(.)$ is the annual expected labor income.

Assuming that individuals' expectations regarding the arguments in $W^s_{o,d,u^d}(.)$ remain at the values observed at $t = 0$ over the remaining lifetime (myopic expectations), IW^s_{o,d,u^d} writes:

$$IW^s_{o,d,u^d} = \frac{\left(e^{-\rho\overline{T}} - e^{-\rho\underline{T}}\right)}{\rho} W^s_{o,d,u^d}(.) \qquad (14)$$

$W^s_{o,d,u^d}(.)$, the annual expected labor income of student s who is a graduate of university u^d in country d is given by:

$$W^s_{o,d,u^d}(w_{u^d}, Q_{u^d}, \bar{Q}_d) = \left(\frac{Q_{u^d}}{\bar{Q}_d}\right)^{\beta_0} w_{u^d}$$

with w_{u^d} the value of average earnings in area u^d; Q_{u^d} the quality of education where the higher education has been attained; and $\bar{Q}_d$ the average quality of education in the country d. β_0 is a strictly positive parameter. A positive difference between the quality of education obtained

[31] In the absence of individual information in our database, we assume thereafter $\forall s\ \underline{T}^s = \underline{T}$.

(Q_{u^d}) and the average quality of education in country d ($\bar{Q}_d$) implies a skill premium (the effective earnings will be greater than the local average earnings). Conversely, a negative difference will result in smaller effective earnings. The expected intertemporal labor income is then defined by:

$$IW^s_{o,d,u^d} = B \left(\frac{Q_{u^d}}{\bar{Q}_d} \right)^{\beta_0} w_{u^d} \tag{15}$$

with our assumption that $B = \frac{\left(e^{-\rho \overline{T}} - e^{-\rho \underline{T}}\right)}{\rho}$ is a constant, and the expected intertemporal labor income is not specific to an individual ($IW^s_{o,d,u^d}(.) = IW_{o,d,u^d} = (.)$).

The deterministic and observable component of utility is logarithmic:

$$VS_{o,d,u^d} = ln \left(\frac{(IW_{o,d,u^d})^{\beta_1} A_d^{\gamma_1}}{\delta_{o,d,u^d}} \right) \tag{16}$$

with $\delta_{o,d,u^d} > 1$ an iceberg total cost factor ($\delta_{o,d,u^d} = \delta(CM_{o,d}, CS_{u^d}, CL_{u^d})$). Migration from country o to locale u^d in country d involves country-pair specific costs and localization specific costs that reduce utility in an iceberg-type way.

We assume that the migration costs depend only on the destination country and not on the specific location within the country. We further assume that $CM_{o,o} = 0$. These migration costs, $CM_{o,d}$ are composed of two parts: fixed costs (C_o) and variable costs ($C_{o,d}$). The fixed part measures the costs of moving, independent of the destination country (home-specific costs) whereas the variable part depends both on origin and on destination (like transportation costs, assimilation costs). The variable migration costs depend on dyadic factors such as physical distance $d_{o,d}$; the cultural and linguistic proximity of the origin and destination countries, such as the use of a common official language ($l_{o,d}$) or the existence of colonial links ($col_{o,d}$). The migration cost function is given by:

$$CM_{o,d} = C_o + C(d_{o,d}, l_{o,d}, col_{o,d}) \tag{17}$$

We assume a fairly simple specification of the total factor cost δ_{o,d,u^d}:

$$\begin{aligned} \ln(\delta_{o,d,u^d}) &= \gamma_2 \ln(C_o) + \alpha_1 \ln(d_{o,d}) + \alpha_2 \ln(l_{o,d}) + \alpha_3 \ln(col_{o,d}) + \beta_3 \ln(CS_{u^d}) + \\ &\quad \beta_4 \ln(CL_{u^d}) - \beta_5 \ln(E_{o,u^d}) \end{aligned} \tag{18}$$

We then have:

$$\begin{aligned} VS_{o,d,u^d} &= \ln(B) + \beta_2 ln\left(Q_{u^d}\right) - \beta_2 ln\left(\bar{Q}_d\right) + \beta_1 ln\left(w_{u^d}\right) + \gamma_1 \ln(A_d) - \gamma_2 \ln(C_o) - \alpha_1 \ln(d_{o,d}) - \\ &\quad \alpha_2 \ln(l_{o,d}) - \alpha_3 \ln(col_{o,d}) - \beta_3 \ln(CS_{u^d}) - \beta_4 \ln(CL_{u^d}) \end{aligned} \tag{19}$$

with $\beta_2 = \beta_0 \beta_1$.

A student s migrates from country o to study in university u^d in d if her utility of choosing u^d is bigger than for all possible universities of any country (including d and o), $VS^s_{o,d,u^d} > VS^s_{o,i,u^i}$ $\forall u^i \neq u^d$ and $\forall i \in D$ (including d) .

Following the random utility approach to discrete choice problems (McFadden (1984)), the probability that student s from country o chooses university u^d in country d is defined by:

$$\begin{aligned} P_{o,d,u^d} &= Prob[VS^s_{o,d,u^d} > VS^s_{o,i,u^i}], & \forall u^i \neq u^d \text{ and } \forall i \in D \\ &= Prob[VS_{o,d,u^d} + \epsilon^s_{o,d,u^d} > VS_{o,j,u^i} + \epsilon^s_{o,i,u^i}], & \forall u^i \neq u^d \text{ and } \forall i \in D \\ &= Prob[VS_{o,d,u^d} - VS_{o,j,u^i} > \epsilon^s_{o,i,u^i} - \epsilon^s_{o,d,u^d}], & \forall u^i \neq u^d \text{ and } \forall i \in D \end{aligned} \tag{20}$$

with ϵ being a iid extreme-value distributed random term.

Following Train (2003), this probability can be decomposed into three logits. Indeed, a convenient way to represent the student's university choice is given by the decision tree (see Figure A.1). The set of alternatives facing the student is divided into subsets (nests) and subsubsets (subnests). There are three levels in this tree structure. In the upper level, the student decides whether to study at home (h=*Stay*) or abroad (h=*Move*). If the choice of this upper-level decision is to move abroad, there is a subsubset (a subnest) of destination countries (*Foreign country* d_1 to *Foreign country* d_{n_d}) from which the student must choose his or her location (middle level of the tree). This choice is trivial for the Stay branch (nest $h = s$) as the origin country is the only choice (the subnest is defined by o). At the lower level, the student chooses the university where he or she would like to study. This lower-level decision consists of all the alternatives of this decision tree, denoted by $u = u^o_1, \cdots, u^{n_d}_{n^{n_d}_u}$.

We assume that the ratio of probabilities of two universities that are in the same nest ($h = s$ or $h = m$) and in the same country is independent of the characteristics of all other universities. (This corresponds to the IIA hypothesis.) For two universities in the same nest $h = m$, but in different foreign countries, this ratio of probabilities is independent of the characteristics of universities in the home country but depends on the characteristics of universities in the same nest ($h = m$) that are located in the same destination country. Finally, the ratio of probabilities of two universities in different nests ($h = s$ or $h = m$) depends on the characteristics of all the other universities in those nests. (IIA does not necessarily hold for alternatives in different nests.) With these assumptions and also assuming that the random terms follow an iid extreme-value distribution, this three-stage discrete choice model can be estimated using a nested logit (Train (2003)).

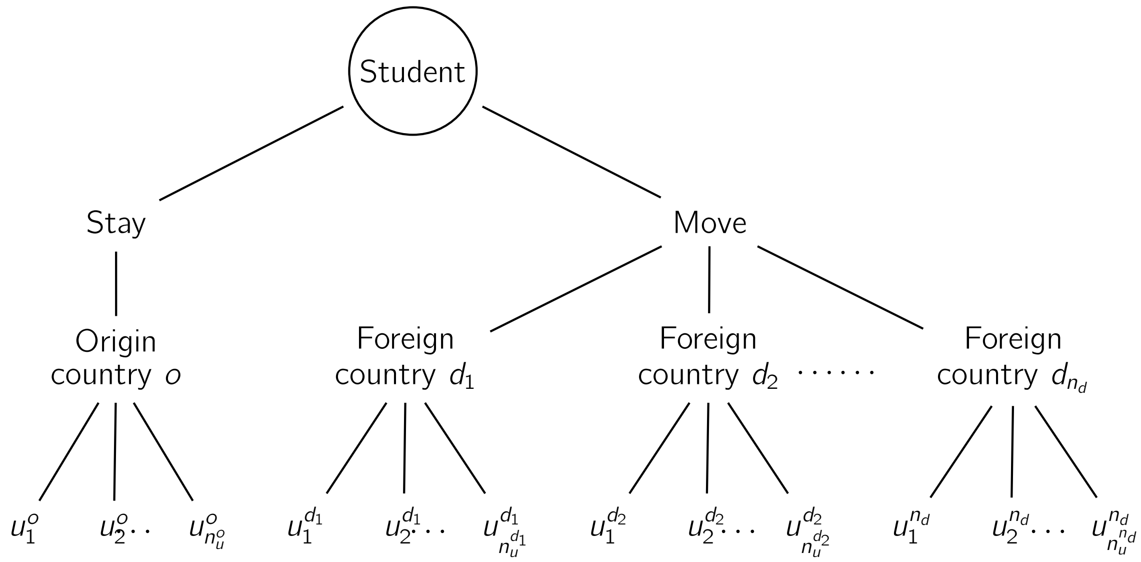

Figure A.1 – Decision Tree for Student's University Choice

The lower-level utility depends on characteristics that vary across universities. The corresponding factors are $X_u = \{Q_{u^d}, w_{u^d}, CS_{u^d}, CL_{u^d}\}$. The middle-level utility depends on factors that vary across countries: $Y_{o,d} = \left\{\bar{Q}_d, d_{o,d}, l_{o,d}, col_{o,d}\right\}$. The upper-level utility depends on factors that vary with the choice of migrating ($h = m$) or staying ($h = s$), $Z_h = \{C_o, A_d\}$. Utility can be rewritten as:

$$VS^s_{o,d,u^d} = \ln(B) + VS_h(Z_h) + VS_{o,d}(Y_{o,d}) + VS_u(X_{u^d}) + \epsilon^s_{o,d,u^d} \tag{21}$$

with

$$\begin{aligned} VS_u(X_{u^d}) &= \beta' \ln(X_{u^d}) = \beta_2 ln\left(Q_{u^d}\right) + \beta_1 ln\left(w_{u^d}\right) - \beta_3 \ln(CS_{u^d}) - \\ &\quad \beta_4 \ln(CL_{u^d}) \\ VS_{o,d}(Y_{o,d}) &= \alpha' \ln Y_{o,d} = -\alpha_1 \ln(d_{o,d}) - \alpha_2 \ln(l_{o,d}) - \alpha_3 \ln(col_{o,d}) \\ VS_h(Z_h) &= \begin{cases} \gamma' \ln Z_d = \gamma_1 A_d - \gamma_2 \ln(C_o) & \text{if } h = m \\ \gamma' \ln Z_s = \gamma_1 A_o & \text{if } h = s \end{cases} \end{aligned} \tag{22}$$

where β, α and γ denote parameters vectors.

With this decomposition of utility, the probability associated with (20) can be written as the product of three standard logit probabilities:

$$P_{o,d,u^d} = P_{o,u^d|d,h} P_{o,d,|h} P_{o,h} \tag{23}$$

where $P_{o,u^d|d,h}$ is the conditional probability of choosing a university u^d given that an alternative in subnest d is chosen; $P_{o,d,|h}$ is the conditional probability of choosing a country d, given that an alternative in nest h is chosen; and $P_{o,h}$ is the unconditional (marginal) probability of choosing to study in a foreign country or in home country o. These probabilities can be expressed as:

$$\begin{aligned} P_{o,u|d,h} &= Prob[VS_{o,d,u^d} - VS_{o,d,u^i} > \epsilon^s_{o,d,u^i} - \epsilon^s_{o,d,u^d}], && \forall u^i \neq u^d \\ &= Prob[VS_u(X_{u^d}) - VS_u(X_{u^i}) > \epsilon^s_{o,d,u^i} - \epsilon^s_{o,d,u^d}], && \forall u^i \neq u^d \\ &= \frac{\exp(VS_u(X_{u^d}))}{\sum_{u=1}^{n_u^d} \exp(VS_u(X_u))} \\ &= \frac{\exp(VS_u(X_{u^d}))}{\exp I^u(d,h)} \end{aligned} \tag{24}$$

for the conditional probability $P_{o,u|d,h}$, and

$$\begin{aligned} P_{o,d|h} &= Prob[VS_{o,d,u^d} - VS_{o,j,u^d} > \epsilon^s_{o,j,u^d} - \epsilon^s_{o,d,u^d}], && \forall j \neq d \\ &= Prob[VS_{o,d}(Y_{o,d}) - VS_{o,d}(X_{o,j}) > \epsilon^s_{o,j,u^d} - \epsilon^s_{o,d,u^d}], && \forall j \neq d \\ &= \frac{\exp(VS_{o,d}(Y_{o,d}) + (1-\lambda^u) I^u(d,h))}{\sum_{j=1}^{n_d} exp(VS_{o,d}(Y_{o,d}) + (1-\lambda^u) I^u(j,h))} \\ &= \frac{\exp(VS_{o,d}(Y_{o,d}) + (1-\lambda^u) I^u(d,h))}{\exp I^d(h)} \end{aligned} \tag{25}$$

for the conditional probability $P_{o,d|h}$. This conditional probability for the degenerate branch (Stay branch), $P_{o,h|s}$, is trivially equal to 1 (a partially degenerate nested logit).

And, for the unconditional (marginal) probability:

$$\begin{aligned} P_{o,h} &= Prob[VS_{o,h,u} - VS_{o,k,u} > \epsilon^s_{o,k,u} - \epsilon^s_{o,h,u}] && \text{with } k \neq h \\ &= Prob[VS_h(Z_h) - VS_h(Z_k) > \epsilon^s_{o,k,u} - \epsilon^s_{o,h,u}] && \text{with } k \neq h \\ &= \frac{\exp(VS_h(Z_h) + (1-\lambda^j) I^j(s))}{\exp(VS_h(Z_h) + (1-\lambda^j) I^j(s)) + \exp(VS_h(Z_k) + (1-\lambda^j I^j(m))} \end{aligned} \tag{26}$$

The inclusive values I^u and I^j are defined by

$$I^u(d,h) = ln(\sum_{u=1}^{n_u^d} \exp(VS_u(X_u))) \quad (27)$$

$$I^j(h) = ln(\sum_{j=1}^{n_d} exp(VS_{o,j}(Y_{o,j}) + (1-\lambda^u)I^u(j,h))) \quad (28)$$

The inclusive value coefficient λ^u measures the correlation among the random terms due to universities' similarity within country d, with $\lambda^u = 0$ denoting no correlation and $\lambda^u = 1$ indicating nearly identical unobserved attributes. Similarly, the inclusive value coefficient λ^j is a measure of correlation among unobserved country-related attributes.

The nested multinomial logit model[32] defined by (23)-(26) connects the levels of the tree outlined in Figure A.1 with each other in the sense that the attributes of the lower-branch alternatives influence the choice among any choice set of upper branches. In a sequential choice model, the levels of the hierarchy would be unrelated.

The aggregate multi-country migration flow equation to university u^d is given by multiplying the number of young people in country o who want to study (N_s^o) with the probability of migration to university u^d of a randomly drawn student of country o (P_{o,d,u^d}):

$$\begin{aligned} M_{o,d,u^d} &= P_{o,d,u^d} N_s^o \\ &= P_{o,u^d|d,m} P_{o,d,|m} P_{o,m} N_s^o \end{aligned} \quad (29)$$

with M_{o,d,u^d} as the number of young people from country o who want to study at university u^d located in country d. It follows that the total number of foreign young people who wish to study at university u^d located in country d is given by:

$$\begin{aligned} M_{d,u^d} &= \sum_{o \neq d} P_{o,d,u^d} N_s^o \\ &= \sum_{o \neq d} P_{o,u^d|d,m} P_{o,d,|m} P_{o,m} N_s^o \end{aligned} \quad (30)$$

[32]More precisely, this is a non-normalized nested logit (NNNL) model (see Hunt (2000)). With the NNNL model, the choice probabilities estimated in system (24-26) are not the same as those given in equation (20). To be identical, we would need to rescale all estimated coefficients associated with low-level alternatives by the estimated inclusive value coefficients (λ^u and λ^j) and rescale all estimated coefficients associated with middle-level variables by the estimated λ^j inclusive value coefficient. In what follows, we assume that this rescaling process is done.

However, as already stated, this number (M_{d,u^d}) is not the number of foreign students who will be enrolled in university u^d, this is the number of foreign students who want to go on to study at university u^d. We call this the *ex ante* enrollment demand. It is not enough that students wish to go to this university, the university must also allow their registration. Universities have enrollment policies that can lead to the number of foreign students enrolled being lower than M_{d,u^d}. To know the actual number of foreign students enrolled we need to explain universities' enrollment behavior.

A.2. Universities' Behavior

We assume that all universities have the same enrollment behavior and, in the short term, it is determined by three factors:

1. Capacity - The capacity for enrolling foreign students is constrained. This capacity, $EC_{u^d}^{\beta_5}$, is a share (defined by β_5) of the total enrollment capacity EC_{u^d}. Universities set quotas on total foreign enrollment (not at the origin level).
2. Quality - The university quality is also fixed (Q_{u^d}).
3. Fees - The fees are fixed in the short term (CS_{u^d}). Universities do not use fees as a method of balancing the enrollment demand with their constrained capacity.

Capacity and quality may change over the long term with investment in capital and staff but they are fixed in the short term. Fees in the long run can also be adjusted according to enrollment demand (when they are not regulated). However, these three factors are fixed in the short term. Therefore, the foreign student enrollment capacity could be constrained for university u^d, and the actual number of foreign students ($\tilde{M}_{d,u^d}$) should verify:

$$\tilde{M}_{d,u^d} = EC_{u^d}^{\beta_5} \tag{31}$$

$\tilde{M}_{d,u^d}$ is the observed allocation, which corresponds to the *ex post* enrollment.

For each university u^d, two configurations are therefore possible:

- $M_{d,u^d} \leq EC_{u^d}^{\beta_5}$ meaning that the *ex ante* enrollment demand for university u^d is lower than its enrollment capacity. The capacity constraint is not binding *ex ante*.
- $M_{d,u^d} > EC_{u^d}^{\beta_5}$ that implies $M_{d,u^d} > \tilde{M}_{d,u^d} = EC_{u^d}^{\beta_5}$ the *ex post* (observed) enrollment is lower than the *ex ante* demand. The constraint is binding, and some students are forced to request enrollment in a university that was not their first preference.

It is well known that many universities have turned away applications from foreign students due to capacity constraints, which supports the assumption that some universities are constrained. In that case, the total allocation is also constrained and the choices based only on preferences (defined by the system (23)-(26)) differ from the observed *(ex post*) allocation consistent with the preferences and with capacity constraints. We should now define how this *ex post* allocation could be done.

A.3. Equilibrium Allocation With Enrollment Capacity Constraints

We do not describe in details the computational method to find the equilibrium solution with capacity constraints. We follow the allocation solution developed by De Palma et al. (2007).

The set of constrained universities is $\mathfrak{C}$ and $\bar{\mathfrak{C}}$ is the set of unconstrained universities, with $\mathfrak{C} \cup \bar{\mathfrak{C}} = U^d$. An *ex ante* constrained university is necessarily an *ex post* constrained university. An *ex ante* unconstrained university could stay an *ex post* unconstrained university or become an *ex post* constrained university, depending on the scale of the reallocation.

The existence of a feasible allocation requires the total world enrollment capacity not be binding. It implies:

$$\sum_{o \neq d} \sum_{d} \sum_{u^d} M_{o,d,u^d} < \sum_{d} \sum_{u^d} EC_{u^d}^{\beta_5} \tag{32}$$

Any student who wants to study abroad could be enrolled in a university, but not necessarily in his/her preferred university. As we have assumed that at least one university has an enrollment constraint, the *ex post* total allocation is different from the total *ex ante* allocation. The (*ex post*) probability that student s coming from country o is enrolled in university u^d in country d is denoted by $\tilde{P}_{o,d,u^d}$. The *ex post* allocation[33] is given by:

$$\begin{aligned} \tilde{M}_{o,d,u^d} &= \tilde{P}_{o,d,u^d} N_s^o \\ &= \tilde{P}_{o,u^d|d,m} \hat{P}_{o,d,|m} \hat{P}_{o,m} N_s^o. \end{aligned} \tag{33}$$

De Palma et al. (2007) show that, under two simple assumptions (allocation rules), the allocation probabilities can still be written as a multinomial logit model but with an additional *correction factor* that expresses an individual allocation ratio. This allocation ratio is defined by π_{u^d}, with $\tilde{P}_{o,u^d|d,m} = \pi_{u^d} P_{o,u^d|d,m}$.

The two assumed rules are the *free allocation rule* and the *no priority rule*.

Free allocation rule: For an unconstrained university $u^d \in \bar{\mathfrak{C}}$,

$$P(\{s \text{ allocated to } u^d | s \text{ prefers } u^d\}) = 1 \qquad \forall s, \ \forall u^d \in \bar{\mathfrak{C}}$$

[33]Without constraints at the country level - for example with quotas on student visas (that implies a $\tilde{P}_{o,d,|m}$) or constraints on students emigration (that implies a $\tilde{P}_{o,m}$)- the formula of $P_{o,d,|m}$ and $P_{o,m}$ are not modified by constraints at the university level. However, this does not mean that their values are not affected by capacity constraints at the university level. When they are taken into account, the calculus of the inclusive value $I_{d,h}^u$ is also modified, and, therefore, the values of $P_{o,d,|m}$ and $P_{o,m}$. These new values are represented by $\hat{P}_{o,d,|m}$ and $\hat{P}_{o,m}$.

No priority rule: The second assumption, the *no priority rule*, concerns the allocation in an *ex post* constrained university. With this rule, if a student ss has a stronger preference (*ex ante*) for constrained university u^d than another student s', student s will also have a proportionally greater chance to be allocated *ex post* to this University.

For an *ex post* constrained university, the individual allocation ratio of university u^d, is the same for all students:

$$\frac{\tilde{P}^s_{o,u^d|d,m}}{P^s_{o,u^d|d,m}} = \frac{\tilde{P}^{s'}_{o,u^d|d,m}}{P^{s'}_{o,u^d|d,m}} = \Phi_{u^d} \qquad \forall s, s' = s^o_1, \cdot, s^o_{N^o_s}, \ \forall u^d \in \mathfrak{C}$$

Under these two assumptions, De Palma et al. (2007) show that the allocation probabilities are given by the adjusted MNL formula:

$$\tilde{P}_{o,u^d|d,m} = \frac{\exp(VS_u(X_{u^d}) + \ln(\pi_{u^d}))}{\sum_{u=1}^{n^d_u} (\exp(VS_u(X_u)) + \ln(\pi_{u^d}))}, \quad \text{with} \tag{34}$$

$$\pi_{u^d} = \begin{cases} \frac{EC^{\beta_5}_{u^d}}{M_{o,d,u^d}} < 1 & \text{if } u^d \in \mathfrak{C} \\ \Omega = \frac{1-\sum_{u\in\mathfrak{C}} \frac{EC^{\beta_5}_{u^d}}{M_{o,d,u}} P_{o,u|d,m}}{\sum_{v\in\bar{\mathfrak{C}}} P_{o,v|d,m}} > 1 & \text{if } u^d \in \bar{\mathfrak{C}} \end{cases} \tag{35}$$

They propose a solution algorithm for the model and, also for when the utility coefficients are unknown. This algorithm can be used in our nested logit model to find the allocation solution and the estimated coefficients with enrollment capacity constraint. The algorithm iteratively estimates the constraints and the individual and aggregate allocation ratios until they converge. While we do not observe $\tilde{M}_{o,d,u^d}$ for each university in the data, we can use this theoretical model and the solution approach proposed by De Palma et al. (2007), for our database for the U.K. and Italy. We do this, both by adding the assumption that all the universities in these two countries have their *ex ante* enrollment capacity constrained and by using a sequential estimation procedure.

A.4. Estimable Equilibrium Equation

The estimation of a nested multinomial logit model can be done by FIML (full information maximum likelihood) or through a sequential procedure. Due to data constraints, the sequential procedure is often favored. Our contribution can be seen as the first step of the procedure for the unconstrained solution, that is, to estimate the coefficients β of probability $P_{o,u^d|d,h}$ (equation 24). For estimating the (constrained) coefficient in the first step, we need to use the iterative procedure proposed by De Palma et al. (2007), which requires us to carry out all the steps. This is because the *ex post* allocation in an *ex ante* non-constrained university in country d can be modified by the reallocation implied by the constraints on universities in country d

or other countries. However, this is not possible due to data constraints. Nevertheless, this limitation can be overcome if we assume that each university in one country faces a binding enrollment capacity constraint.

Consequently, if we assume that in country d we have:

$$\sum_{o \neq d} P_{o,u^d|d,m} P_{o,d,|m} P_{o,m} N_s^o = M_{d,u^d} > EC_{u^d}^{\beta_5} = \tilde{M}_{d,u^d} \qquad \forall u^d \in U^d \tag{36}$$

which implies that

$$\begin{aligned} \tilde{M}_{d,u^d} &= EC_{u^d}^{\beta_5} && \forall u^d \in U^d \\ \sum_{o \neq d} \tilde{P}_{o,u^d|d,m} \hat{P}_{o,d,|m} \hat{P}_{o,m} N_s^o &= EC_{u^d}^{\beta_5} && \forall u^d \in U^d \end{aligned}$$

and

$$\tilde{P}_{o,u^d|d,m} = \frac{\exp(VS_u(X_{u^d}) + \ln(\pi_{u^d}))}{\sum_{u=1}^{n_u^d} (\exp(VS_u(X_u)) + \ln(\pi_{u^d}))}, \quad \text{with} \tag{37}$$

$$\pi_{u^d} = \frac{EC_{u^d}^{\beta_5}}{M_{d,u^d}} \qquad \forall u^d \tag{38}$$

With this allocation rule, equation (33), which determines the *ex post* number of students coming from country o and studying in university u^d in country d, is written as:

$$\begin{aligned} \tilde{M}_{o,d,u^d} &= \tilde{P}_{o,u^d|d,m} \hat{P}_{o,d,|m} \hat{P}_{o,m} N_s^o \\ &= \tilde{P}_{o,u^d|d,m} \hat{M}_d^o \\ &= \pi_{u^d} P_{o,u^d|d,m} \hat{M}_d^o \\ &= \frac{EC_{u^d}^{\beta_5}}{M_{d,u^d}} \frac{\exp(VS_u(X_{u^d}))}{\sum_{u=1}^{n_u^d} \exp(VS_u(X_u))} \hat{M}_d^o \end{aligned} \tag{39}$$

with $\hat{M}_d^o$ being the number of students who would like to study in country d, taking into account the capacity constraints. Using (29), this last equation identifies the factors that reduce the *ex ante* flow of students from country o to university u^d in country d:

$$\tilde{M}_{o,d,u^d} = M_{o,d,u^d} \frac{\hat{P}_{o,d,|m}}{P_{o,d,|m}} \frac{\hat{P}_{o,m}}{P_{o,m}} \frac{EC_{u^d}^{\beta_5}}{M_{d,u^d}} \tag{40}$$

The discrepancy between the *ex post* and the *ex ante* flows is greater, the higher enrollment capacity constraint ($\frac{EC_{u^d}^{\beta_5}}{M_{d,u^d}}$); the higher its impact on the probability that students from country o decide to go to country d ($\frac{\hat{P}_{o,d,|m}}{P_{o,d,|m}}$); and the higher its impact on the probability that students from country o decide to go abroad to study ($\frac{\hat{P}_{o,m}}{P_{o,m}}$).

Taking logs of equation (39) and substituting VS_u by (22), we obtain the following structural gravity equation:

$$\begin{aligned} \ln(\tilde{M}_{o,d,u^d}) &= \beta_1 ln(w_{u^d}) + \beta_2 ln(Q_{u^d}) - \beta_3 \ln(CS_{u^d}) - \beta_4 \ln(CL_{u^d}) + \\ &\quad \beta_5 \ln(EC_{u^d}) - \ln(M_{d,u^d}) - \ln(\sum_{u=1}^{n_u^d} \exp(VS_u(X_u))) + \ln(\hat{M}_d^o) \end{aligned} \quad (41)$$

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B. Summary Data

Table B.1 – Summary Table of Main Data

Variable	Term in (9)	**Definition**	**Source**
International Students	$(\tilde{M}_{o,d,u^d})$	Number of foreign students coming from country *i* and enrolled in university *u*	U.K.: HESA. Italy: MIUR.
Fees	(CS_{u^d})	Average fees charged by university *u*	U.K.: Tuition Reddin Survey and refers to first cycle students. Italy: Newspaper *il Sole24 ore*.
Quality	(Q_{u^d}) (ranking)	Quality of university *u* based on Top 500 ranking	Top 500 Shanghai Ranking ARWU.
Host Capacity	(EC_{u^d})	Total number of students enrolled at university *u*	U.K.: HESA. Italy: MIUR.
Cost of living	(CL_{u^d})	Cost of Living in city/district *j*, where institution *u* is located	Numbeoo dataset.
Expected return	(w_{u^d})	GDP per capita in the district where university *u* is located	GDP at NUTS 3 level, Eurostat.

C. Additional Estimation Results

C.1. Masters-Degree Students Only (U.K.)

Table C.2 – U.K. - Master Students (Quality=ranking)

	Scaled OLS			Poisson		
Variables	All	EU	No EU	All	EU	No EU
Fees	-0.022***	-0.025***	0.068*	-0.028	-0.003	0.131
	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)	(0.24)
Cost of living	0.535***	1.526***	0.379***	1.246***	1.220*	1.171***
	(0.04)	(0.15)	(0.04)	(0.28)	(0.51)	(0.33)
Quality	0.051***	0.111***	0.039***	0.116***	0.123***	0.108***
Ranking	(0.00)	(0.01)	(0.00)	(0.01)	(0.02)	(0.02)
Host capacity	0.276***	0.557***	0.239***	0.958 ***	0.829***	0.987***
	(0.01)	(0.02)	(0.01)	(0.06)	(0.08)	(0.07)
Income	0.175***	0.418***	0.134***	0.114	0.958***	-0.046
	(0.02)	(0.08)	(0.02)	(0.15)	(0.23)	(0.17)
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.619	0.590	0.616	-	-	-
Pseudo R^2 -	-	-	-	0.748	0.564	0.769
Nber Obs	24360	2900	21460	24360	2900	18328

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.3 – Uk - Masters Students (Quality = score)

	Scaled OLS			Poisson		
Variables	All	EU	No EU	All	EU	No EU
Fees	-0.023***	-0.026***	0.063*	-0.030	-0.005	0.128
	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)	(0.25)
Cost of living	0.528***	1.513***	0.374***	1.190***	1.179*	1.114***
	(0.04)	(0.15)	(0.04)	(0.28)	(0.51)	(0.33)
Quality	0.081***	0.179***	0.061***	0.174***	0.190***	0.159***
Score	(0.00)	(0.01)	(0.00)	(0.02)	(0.03)	(0.03)
Host capacity	0.275***	0.554***	0.239***	0.957 ***	0.822***	0.989***
	(0.01)	(0.02)	(0.01)	(0.06)	(0.08)	(0.07)
Income	0.175***	0.413***	0.134***	0.127	0.962***	-0.031
	(0.02)	(0.08)	(0.02)	(0.15)	(0.23)	(0.17)
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.619	0.591	0.616	-	-	-
Pseudo R^2 -	-	-	-	0.746	0.564	0.767
Nber Obs	24360	2900	21460	24360	2900	18328

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

C.2. First- and Masters-Degree Students Combined (U.K.)

Table C.4 – U.K. - All Students (first and masters degree, Quality=ranking)

	Scaled OLS			Poisson		
Variables	All	EU	No EU	All	EU	No EU
Fees	-0.059***	-0.080***	0.134***	-0.063***	-0.063***	0.284
	(0.01)	(0.01)	(0.04)	(0.01)	(0.01)	(0.20)
Cost of living	0.726***	2.199***	0.489***	1.108***	1.270***	0.988***
	(0.05)	(0.18)	(0.05)	(0.20)	(0.36)	(0.25)
Quality	0.056***	0.107***	0.041***	0.093***	0.060***	0.089***
Ranking	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Host capacity	0.382***	0.826***	0.326***	0.919 ***	0.847***	0.959***
	(0.01)	(0.03)	(0.01)	(0.05)	(0.05)	(0.06)
Income	0.171***	0.093	0.157***	0.044	0.269	-0.070
	(0.02)	(0.10)	(0.03)	(0.11)	(0.16)	(0.14)
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.694	0.629	0.667	-	-	-
Pseudo R^2	-	-	-	0.757	0.521	0.784
Nber Obs	24360	2900	21460	21228	2900	18328

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$