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Michel Beine, CREA, Université du Luxembourg
Marco Delogu, CREA, Université du Luxembourg
Lionel Ragot, Université Paris Ouest

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For editorial correspondence, please contact: crea@uni.lu
University of Luxembourg
Faculty of Law, Economics and Finance
162A, avenue de la Faïencerie
L-1511 Luxembourg

UNIVERSITÉ DU LUXEMBOURG

The Role of Fees in Foreign Education: evidence from Italy and the UK.*

Michel Beine[a] , Marco Delogu[b] and Lionel Ragot[c]

[a] University of Luxembourg, IZA, CREAM and CES-Ifo,

[b] University of Luxembourg and University of Louvain,

[c] University Paris Ouest, EconomiX and CEPII.

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Abstract

This 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 students migration flows at the university level for Italy and the UK. The particular institutional setting of the two destination countries allows 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 quality of education. The estimations find also support for an important role of additional destination-specific variables such as host capacity, expected return of education and cost of living in the vicinity of the university.

JEL Classification: F22, H52, I23, O15.

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

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1 Introduction

Foreign higher education has become an increasingly important phenomenon nowadays. The degree of mobility of prospective student 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 sake of completing their graduate and postgraduate studies in renowned universities are today very usual in any country and city of most industrial countries. While there were 0.6 millions international students in 1975, this number amounted to 3.5 millions in 2005. In spite of the turmoil due to the financial crisis, the global quest for talented workers has pushed these numbers further up, with a 50% increase between 2005 and 2015 (OECD (2015)). Even if 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 striking development of foreign education is an important economic phenomenon for the destination countries. For many developed countries like the United States, the UK, 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 scale and in turn to act as important research institutions. Many cities in the main destination countries of foreign students favor the development of their university thus trying to take 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 of quest for talented workers in which industrialized countries are engaged today. In fact, student migration might be seen as a concealed phenomenon of brain drain. Governments attract promising students and provide through foreign education the skills corresponding to their domestic labour market. By employing various schemes such as special transition visas, governments of destination countries allow those students to stay in the country and integrate more easily the national labour market. Understanding the determinants of the location choice for prospective students is therefore of utmost importance for conducting appropriate policies aiming at attracting talented international students.

This paper contributes to the literature devoted to the identification of the factors influencing the choice in terms of location made by students to complete their education abroad. In particular, we assess the importance of the various determinants of foreign students using data at the university level for two European countries, namely the UK and Italy for the academic year 2011/2012. Unlike in other European countries such as France, Belgium or Germany, the British and Italian universities display significant variation in the tuition fees across institutions. This in turn allows to study the role of the fees for foreign students in choosing one specific location, on top of the other institutional characteristics such as quality, host capacity, expected income and cost of living. We compile and use data of foreign student flows between (almost) all countries of the world as origins, and each university at destination of the two countries of destination under investigation. Our econometric investigation, derived from a traditional Random Utility Framework (RUM) adapted to student migration, pays special attention to the role of tuition fees. We empirically deal with the endogeneity of student fees with two proposed different solutions across the countries of destination.

We find support for a role of university quality, a result already found in some previous work (Beine et al. (2014); Van Bouwel and Veugelers (2013)). We also find a clear role for the host capacity of the university as well as the expected return of education of the city where education is acquired, in line with the spirit of the migration model of foreign education (Rosenzweig (2008)). Regarding the role of tuition fees, we first stress the importance of dealing with endogeneity of these fees in isolating their impact on the location choice of foreign students. When dealing with that issue, we find a negative and significant effect of tuition fees 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 of why students decide to go abroad to complete their higher education. The first model, from an 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 lots of examples of that type of motivation. The second one, the migration model, suggests that students might favour foreign education because it raises the prospects of attractive jobs in the country (or the place) where education was obtained. As said before, this motivation is in line with the evidence that previous students tend to have easier access to the domestic labour market.[1] Our theoretical model, based on the RUM approach, integrate this type of arguments.

While the education and the migration models are about the decision to study abroad, a large part of the literature has been devoted to the location choice. Our paper definitely belongs to this strand. 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. They stress the importance of networks (Dreher and Poutvaara (2005)) and skill premia (Rosenzweig (2006)). Other studies combine various origins and destinations carrying out estimations in the context of 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 between 18 European countries and assess the role of the university quality, 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 network, quality and fees in explaining the size of the bilateral flows of foreign students. They also find a role for quality and network. Regarding fees, while they fail to identify a negative impact of tuition fees, they show that the positive impact of fees that is obtained in "*naive*" regressions might

[1] For instance, in the United States, the H1B visa is subject to a cap (65000 per year nowadays), with an additional 20000 quota for foreign students having graduated with an MBA or higher from a US University.

be due to endogeneity.[2]

This paper aims at contributing to the literature devoted to the identification of the factors influencing the location decision of foreign students. One of main value added of the paper is that we conduct our analysis at the university level as the destination. So far, the contributions of the literature devoted to the international mobility of students have exclusively focused on factors observed at the country level. While a cross-country analysis is important to understand the reasons of the uneven distribution of students across countries of destination, information at the country level conceals significant variation across universities of the same country. For instance, the average national quality of universities might not provide an accurate reflection of the attractiveness of the country as a provider of tertiary education. Foreign students might concentrate for instance in the upper tier of the universities of 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 to explain inflows of foreign student to that country. This requires to make use of the information at the university level. The same applies to fees. Average level of fees might not mean anything for students since they might end up in rather 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 ignore the first step in the decision making process (the choice of the destination country), we identify very precisely the various university-specific factors that lead students to choose between institutions in a given destination. Such an investigation is unique in the literature in that respect.

The second related contribution is our focus on the role of tuition fees for the location choice of foreign students. the literature has failed to find a clearly 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 a pure cost component for prospective students. High fees obviously signal quality and a commitment of the institution to provide to the students 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 of different sources (government of the origin country, university of destination, association promoting bilateral contacts, ...). While this is not true for all students, the partial coverage of fees by grants might explain the insignificant impact that is sometimes observed (Beine et al. (2014) for instance).

On the contrary, obtained positive impacts of fees or even zero impact might be spurious

[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.

[3]Alecke and Mitze (2013) studies 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 its relation with the time of graduation.

due to the high degree of endogeneity of fees. Fees are higher when universities succeed to attract a lot of students, which leads to reverse causality issues. Fee levels might be correlated to unobserved factors such as unobserved amenities in the destination countries (e.g. Australian universities might charge higher fees due to their nice environment) or by 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 that taking 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 degree of public subsidies, compared to 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 for 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). For the UK, such an instrument is not possible to implement since there is no clear-cut distinction between private and public institutions. Rather than the IV strategy, we make use of the fact that British institutions faced caps on the tuition fees that they could charge to natives and European students. These caps are almost all binding in the sense that all universities put tuition fees level equal to the maximum allowed by the law. Importantly, the cap did not apply for first degree student originating from EU enrolled in Scottish universities. The Scottish authorities indeed cover tuition fees for Scottish and EU students. By restricting our investigation to students coming 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 pull and repulsive factor. To the best of our knowledge this paper is the first one devoting a specific attention to the effect of fees. Specifically, we find evidence for 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 the determinants a dummy variable that captures the availability of English-teaching programs at the university of destination. Our baseline result for the impact of tuition-fees get additional confirmation, namely the coefficient is still negative and significant but larger in absolute value. For both countries in 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. Reference to 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 useful to derive 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 gives a sketchy description of the model used to derive a tractable students' migration equilibrium equation that is estimated using data from Italian and UK universities. The theoretical model is based both on the human capital literature and on the Random Utility Maximisation Approach to migration. We provide here the main equations reflecting the structure of the model. The full model is provided in the Appendix.

Education is considered as 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)).

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 an university at home to the one obtained from studying in an university abroad. If the increase in the present value of the future income is greater than the cost of migrating as well as other education costs, students decide to move to the university yielding the highest net present value. Nevertheless, this is conditional because Universities have enrolment 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 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 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 (VS^s_{o,d,u^d}), expressed as VS^s_{o,d,u^d}, is separated into two parts. One part is deterministic and varies by 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 labour income of student s graduated from university u^d. These labour incomes depend in turn on w_{u^d} the value of average earnings in area u^d, Q_{u^d} the quality of education where 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 $CM_{o,d}$ which depends on the dyadic distance sensu lato 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 of university u^d (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:

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

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

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

$$P_{o,d,u^d} = P_{o,u^d|d,h} P_{o,d,|h} P_{o,h} \tag{3}$$

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

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

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

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

$$M_{o,d,u^d} \quad = \quad P_{o,d,u^d}N_s^o = P_{o,u^d|d,m}P_{o,d,|m}P_{o,m}N_s^o \tag{5}$$

where N_s^o is number of people in country o wishing to study. Likewise, $M_{d,u^d} = \sum_{o \neq d} P_{o,d,u^d}N_s^o$ is the *ex-ante* enrolment demand, i.e. the total number of foreign students wishing to study in university u^d. Universities have enrolment policy which can lead to a number of foreign students enrolment lower than M_{d,u^d}. To derive the actual number of foreign students enrolment we need to explain their enrolment behaviour.

2.2 Universities' behaviour

We assume that all universities have the same enrolment behaviour. In the short term, the enrolment behaviour of university u^d is determined by the foreign students' enrolment capacity $EC_{u^d}^{\beta_5}$, where β_5 defined the share of total enrolment 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 students enrolment capacity can be constrained for university u^d, with the actual number of foreign students ($\tilde{M}_{d,u^d}$) 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 defined how this ex-post allocation can be done.

2.3 Equilibrium allocation with enrolment 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 that the total world enrolment capacity is not binding. Any student who wants to study abroad could be enrolled in an university, but not necessary 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

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

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), an allocation is feasible

[4]The formula 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 $\hat{P}_{o,m}$.

assuming two allocation rules. (1) A *Free allocation* rule for unconstrained universities implying that a student preferring university u^d will be enrolled in that university. (2) A *No priority* rule for constrained universities stating that the student with a stronger preference for university u^d compared to another student will have proportionally more chance to be allocated ex-post to this university. With these assumptions, the ex-post allocation in an ex-ante non constrained university in country d can be modified by the re-allocation implied by the constraints on university in country d or other countries. In this case, we should estimate, using an iterative algorithm, all the probabilities for each universities in each country. This goal is irrelevant because it implies the availability of the data for all universities in the world. Nevertheless, this limitation can be overcome if we assume that each university in one country 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 others countries (see annex on the theoretical model).

2.4 Estimable equilibrium equation

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

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

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 :

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

.

Before passing to the econometric specification corresponding to equation (9), a couple of 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 comprised 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 origin country and could be included in a fixed effect controlling for all factors that are specific to the country of origin of the foreign students. Finally, $\ln(M_{d,u^d})$, the ex-ante demand from foreign students to each university of country d is unobserved to 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 that we use to estimate equation (9). The section details the sources, the development of some indicators such as the one capturing university quality, and provides descriptive statistics for each of them. Table 6.6, in the Appendix, provides a summary of the data used in the econometric analysis.

3.1 International students flows

In order to measure $\tilde{M}_{o,d,u^d}$ in equation (9), we take advantage of the data of bilateral flows of international students from all countries of the world to Italy and UK 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 into institutional programs, such as the ERASMUS students, do not comply with our definition of international students and are therefore excluded from the data. Two reasons lead us to exclude these students from the analysis. First, bilateral agreements constraint the student's choice in terms of location. Second, in some curricula, attending a period of study abroad can be compulsory.

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

Table 1 reports some descriptive statistics on the number of foreign students for the two countries. United Kingdom hosts more than the 10% of the foreign students at the world level (OECD (2015)), and represents the second most popular destination after the US. Consequently, international students represent a consistent share of students enrolled in UK higher institutions, which amounts to 13.55% 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% of the total students' population. These students originate from 168 different countries.

Figure 1 shows the distribution of the share of foreign students across universities for

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

[6]In the empirical part, we pay attention of not loosing the information relative to the empty corridors. The total number of observation is then equal to the number of universities multiplied by the number of origin countries.

Table 1: Descriptive Statistics of Foreign Student Flows (year 2011)

	Italy	UK
Number of universities (a)	79	163
Origin countries (b)	168	210
Number of observations (axb)	13272	34230
% of zeroes**	68.64%	60.16%
Total number of students (Host capacity)* (c)	1710701	2518640
Number of foreign students* (d)	62512	341389
Foreign student in % 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.

Italy and UK separately. Most Italian universities have a share of foreign students below the 10% with respect to their total students' population. Table 2 confirms that the share of foreigners is on average much larger in UK universities, with a large proportion of institutions in which foreign students represent more than 20% of the whole student population. The two UK 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 foreigner students is even larger than 60%. While for Italy the average share is lower, there are still a significant number of universities for which the share is above 5%. This illustrates the importance of the phenomenon of foreign education.

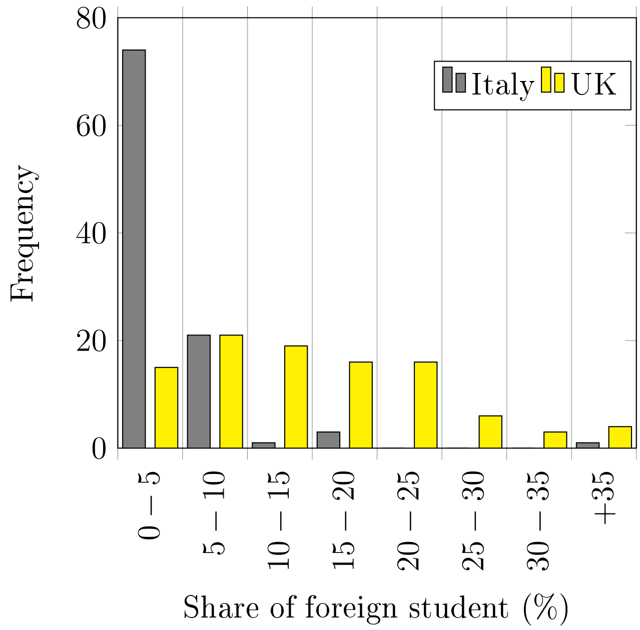


Figure 1: Share of foreign students

	Italy	UK
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%

% of total students

Table 2: Share of foreign students

To gauge how diverse is the foreign students' population in these two countries, we refer to four multigroup segregation measures. Since we are more interested by 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 multigroup 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 of 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 foreign students in the UK. 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 that would have to move (to another university) to match the dispersion of the total students population. The large share of origin groups with a highly dissimilarity index (between 0.9 and 1), in both countries, is due to the large number of origin countries with

[7]The multigroup dissmiliraty index is a weighted averages of origin indices.

very few individuals.

Entropy is another way to measure segregation. It is given by the last two indices, i.e. the Information theory criterion and the relative diversity. In contrast with 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 to the one prevailing in the UK.

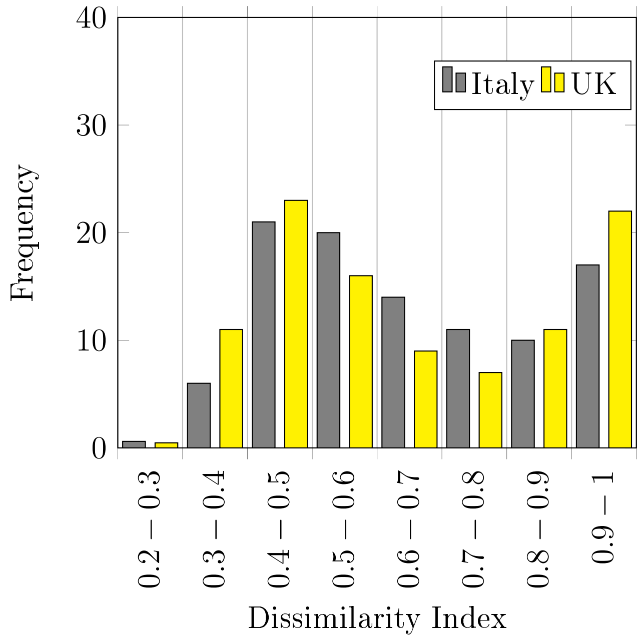


Figure 2: Dissimilarity Indices

	Italy	UK
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 multigroup form

Table 3: Four Multigroup Segregation Measures

3.2 Covariates

3.2.1 Cost of living

Data on cost of living (in equation $(CL_{u^d}9)$) comes from the *Numbeo* website. This website provides, for each city various indexes of the cost of living. 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 manually collected from authoritative sources such as websites of supermarkets, governmental institutions or other surveys. *Numbeoo* applies different techniques to filter out noisy data.

[8]Specifically, the indexes are relative to New York city index which is normalized to 100.

The 163 UK universities are based in 87 different locations. *Numbeoo* provides information for 39 cities out of 87. For the remaining locations, we compute the closest city in terms of geodesic distance to the ones for which the data is available and we take the respective cost of living index of that city. The same approach was used for the Italian dataset. 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.

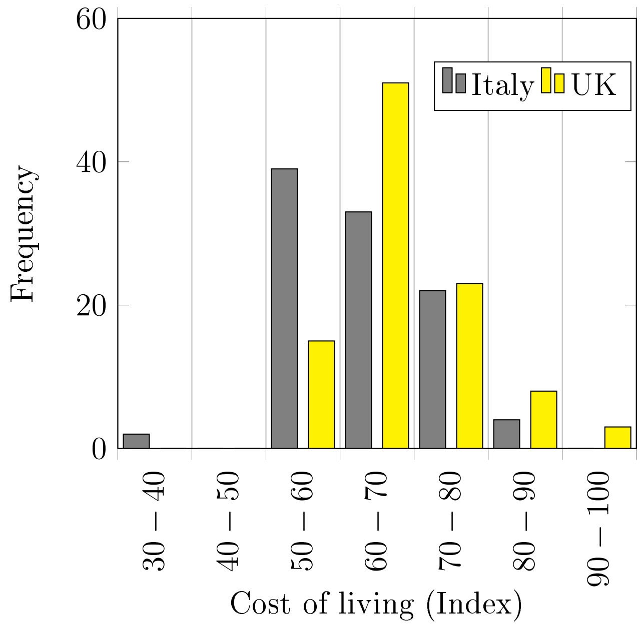


Figure 3: Cost of living

	Italy	UK
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

3.2.2 Expected income

We proxy expected income (w_{u^d} in equation (9)) at destination either using the GDP per capita of the city of destination or, when the data is 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.

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

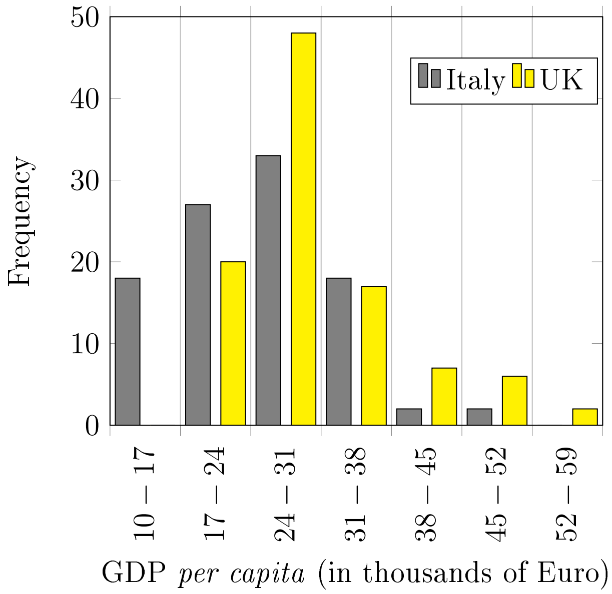


Figure 4: Expected returns of education at destination

	Italy	UK
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* (in thousands of Euro)

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 United Kingdom are some of the few European countries in which tuition fees varies 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 UK, tuition fees charged to European students were subject to a cap, equal to £3375, for institutions based in England, Wales and Northern Ireland.[10] This level is set by the central government. Importantly, the institutional setting was different in Scotland. The government covered the first degree tuition fees for both Scottish and EU students. Students coming from the rest of the UK were subject to a fee equal to £1800. In contrast, universities were allowed to set tuition fees without any cap for non European students in all UK institutions.

The Tuition Reddin Survey provides only information on first cycle tuition fees charged by UK universities, differentiating between the ones charged to European students and to

[10]As of September 2012 this level was increased in England to a new level set between £6000 and a maximum of £9000. See European Commission (2012) for more details.

non European ones. Data is available for 115 institutions out of the 163 that make up the baseline dataset. Table 6 compares the restricted sample with the baseline one.

Table 6: United Kingdom : Benchmark and Restricted Samples (year 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 zeroes	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.

In order to account for the endogeneity of tuition fees, the empirical analysis for the UK mainly focuses only on first cycle international students. Our estimation strategy exploits the particular institutional setting of the UK. See subsection 4.3 for more details. Figure 5 and Table 7 report the distribution of fees in the UK and Italy. For the UK, European students enrolled in Scottish universities have access to higher education for free, while in the remaining UK institutions they were charged an amount equal to £3375.[11]

Italian universities differ from UK institutions by their legal status, as they classified either as private or public institutions. In contrast with 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 raised by a university cannot overcome 20% of the funding received by this university from the Italian Ministry of Education. Conversely, for italian private institutions, the aforementioned limit does not apply, and they do charge

[11]The only important exception is the University of Buckingham which is considered as the only private higher education in the UK (Baskerville (2013)). This institution charged EU students an amount close to 9000 €.

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

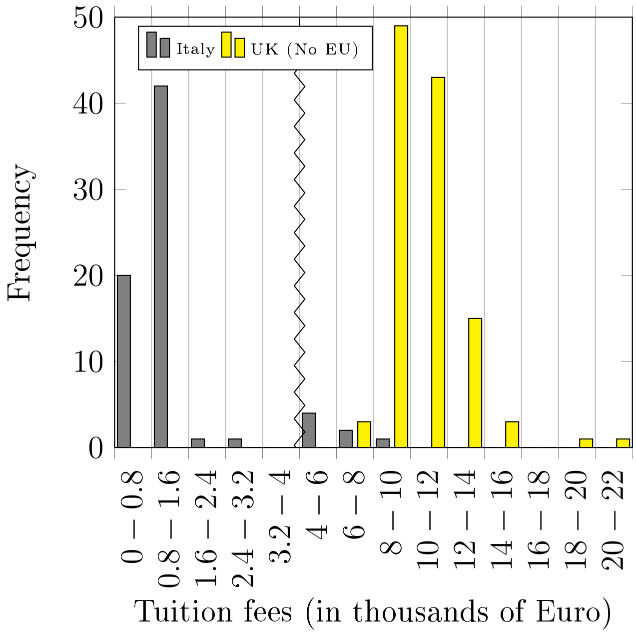


Figure 5: Tuition fees

	Italy	UK*
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 (in thousands of Euro)

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 was missing for few public Italian universities. In that case, we use an average computed at the regional level by an Italian association of consumer (*FederConsumatori*). Data relative to private institutions is available for 9 out of the 17 institutions that make up the baseline dataset. Figure 5 reports the distribution of tuition fees for Italian universities. Only private institutions charged average fees above the level of 2000 €.

3.2.4 University quality

Equation (9) involves the quality of University (Q_{u^d}) as a determinant of expected income generated by edcation and hence of inflows of foreign students. In line with Beine et al. (2014) and Perkins and Neumayer (2014) we proxy university quality exploiting the Top 500 Shanghai ranking, referring to the one relative to year 2011 (ARWU). This ranking

[12]Only other five European countries treat equally non European students: Czech Republic, Hungary, Iceland, Liechtenstein and Norway (European Commission (2012)).

[13]We include first degree and master degree students.

determines the best 500 universities in the world.[14] Although the index is widely known among international students and firms, 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 the position in the ranking and the relative score which 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, whereas if the university is included, the index takes its position into account and is given by $(500 + 2) - ranking$. The implicit assumption is that the index increases in a linear way with the ranking.

The ranking indicator has nevertheless some limitations. It assumes that quality is reflected in a linear way by the position in the ranking. In other terms, it disregards the fact that the score on which the ranking is based might be quite similar between a set of universities.[15] In order to account for the specific empirical distribution of the score, we also use the score of the Shanghai ranking instead of the position. Our quality measure takes a value equal to *score* if the university appears in the top 500 ranking. Otherwise, the index is simply equal to 0. 31 universities from the UK and 20 Italian high education institutions were included top 500 ARWU ranking for the year 2011.

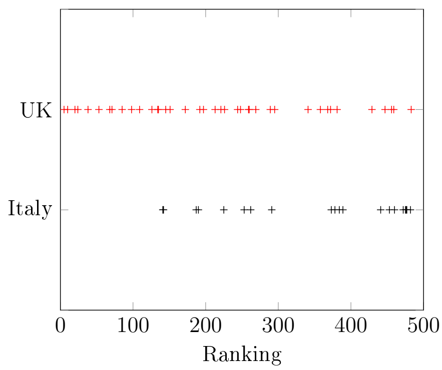
Figure 6 plots the two indicators of quality for each country. Panel (a) provides the ranking indicator for the UK (in red) and Italy (in black). Panel (b) does the same for the score indicator. The figures suggest that, at least from an empirical point of view, it is important to use both indicators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

3.2.5 Host capacity

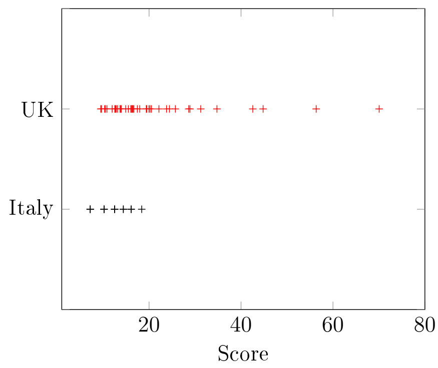
The specificity of our RUM model is that it takes into account the capacity constraints of the universities. The constraints in terms of host capacity of foreign students (EC_{u^d} in equation (9)) is captured by the total number of students enrolled at the university of destination

[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 ranking. For a full explanation on the index development the interest reader is referred to 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 between the top 50 and the top 100 have scores between 31.7 and 24.2, suggesting that the distribution is significantly skewed to the right.



(a) Ranking



(b) Score

Figure 6: Indicators of university quality

during the academic year considered. Even if the median is the same for both countries (see Table 8), distributions (see Fig 7) highlight significant differences. United Kingdom has smaller size universities than Italy (with an average of 14575 against 21932 students enrolled) and a relatively smaller standard deviation. In Italy, the number of Universities over 40000 students is high and close to the number of Universities with less than 5000 students, while such huge capacity is very rare in the UK.

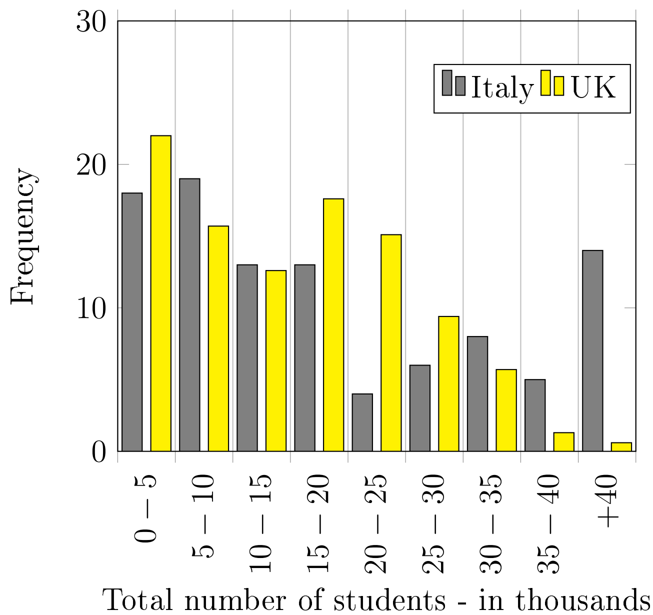


Figure 7: Host capacity

	Italy	UK
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 said before this is applied to two countries separately, namely Italy and the UK, 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 that are specific to the country of origin of the foreign students. It includes $\ln(\hat{M}_d^o)$ 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 which is supposed 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 in the same analysis several countries of destination, i.e. to pool universities of different countries. Beyond the limitations in data availability, this is not desirable for several reasons. The main reason is that pooling universities of different countries would lead to a clear rejection of the IIA hypothesis which is implicit in the estimation of (10). The rejection of the IIA hypothesis would occur by the fact that the choice structure involves two countries that might be considered as nests in the decision process.

Given that is very likely that the degree of substitution between two universities vary with respect to the country of destination, we eventually prefer 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 terms, 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 inclusion of 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 origins before the impact of the constraints associated to the educational capacities. While in theory this is observable for each university, this is unobservable 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 share of zero values for the bilateral migration flows. In our sample, for the year 2011 under investigation, we have 61.6% of zero values for the bilateral flow of first degree foreign students for the UK. The corresponding proportion for Italy is 68.84%. 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 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) shows that Poisson regressions are robust to different pattern of heteroskedasticity. We follow this route in the subsequent estimation and use the Poisson estimates as the benchmark ones. However, our tables will report the Scaled OLS estimates of model (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 independently on the size 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 to 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 to some unobserved characteristics of the university such as the quality of amenities on the campus or of 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. This 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 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 capturing whether the university is private or not. The underlying assumption is that private universities have a higher control on tuition fees. They tend to increase fees not only because of the costs but also because they receive less subsidies. Furthermore, they are not constrained by the regulation in terms of 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 have not particular preferences for private or public universities on top of quality, host capacity, cost of living and income of the destination area. This seems to be a reasonable assumption and is confirmed by the examples of many successful public universities in the US such as Berkeley or Michigan state university.[17]

For the UK, 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 instrument such as the share of the budget subsidized by the central government turned out to be a

[16]Another way of seeing this endogeneity problem is from equation (9). In fact, 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).

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

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

weak instrument, and generate inconsistent results.[19] Instead of a traditional IV, we deal with endogeneity taking advantage of the institutional context of universities in the UK. During the academic year 2011/2012 UK universities were in fact subject to caps on the amount of fees that they could charge to 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 of the caps applied to universities. Scottish universities were subject to lower caps compared to those applied to other institutions in the UK. Moreover, the cap set by the Scottish government applied only for the non Scottish UK students. The Scottish government covered first degree tuition fees to 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 UK universities set tuition fees charged to EU students equal to the £3375 cap.[20] It follows that restricting the sample to European countries as origins, we therefore estimate model (10) in a context in which fees are clearly exogenous. Furthermore, the comparison of the results obtained with the full sample of origin countries or countries originating outside the EU allows 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, for Italy, we present also results based on the combination of these techniques with the use of instrumental variable.

5.1 Italy

We first consider the case of Italian universities. We start with the presentation of the benchmark results. Then we consider two robustness checks that are specific to Italy. We first conduct some new econometric procedure accounting for possible deviations from the exact validity of the exclusion restriction in the IV estimation employing the methods of Conley et al. (2012). In Section 5.1.3 we extend the baseline specification including a variable

[19]Results are available upon request.
[20]The only exception is the University of Buckingham, see section 3.2.3.

that captures the existence of English-teaching programs. Section 5.3 presents, 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 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.

In particular, both types of estimation techniques deliver a negative and significant role for fees on the propensity of choosing this 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 an important and intuitive role for fees, for quality of the university, for host capacity and for 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.

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

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

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 to either reverse causality (i.e. attractive universities are more keen to charge higher fees) or some positive correlation of fees with unobserved factors of attractiveness (e.g. 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 a significant change in all the estimates of the determinants of university's choice except quality. The correction of the impact of fees could suggest that the non-IV Poisson estimate tends to overestimate the true impact, or in other terms 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) provide a support for a 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 suggests that foreign students explicitly take into account the cost of the living and the expected income at the city of destination. The estimated elasticity suggests that a 10% increase in the tuition fee tends to decrease the average bilateral flow to that university by about 5.5%.

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 in their location choice. For instance, it could be that foreign students believe that private universities are better organized and provide better services to students in terms of advices, personal tutoring and other aids. It could also be that students believe that private universities are more accountable to students for the quality of teaching. The higher 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 delivered 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) which 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, i.e. for asymmetric deviations from the exclusion restrictions (see Conley et al. (2012) for details).[21] We consider two alternative procedures. The first one, coined '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]

Table 11 focuses on the estimation of the elasticity of foreign students to tuition fees for different values of 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 corresponds 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 (resp. negative) values corresponds to the view that foreign

[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.

[23]The other estimates of equation (10) are not reported here to save space but are available upon requests. They are in general unaffected by the alternative procedure compared to the benchmark estimations.

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.

students value more (resp. less) private universities.

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 % level only for values of the parameter over 0.3 in aboslute term. This means that even if the mere private status of the university deters or attracts on average less than 0.3% of foreign students coming from each origin country, our IV estimates support a negative effect of tuition fees. Over that value, our estimates become less significant, albeit still negative at a 10% 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 to issue a different point estimate of the impact of tuition 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 university of destination. Given the importance of English as 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 different characteristics than the other ones, inducing 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 take care of such a concern, we extend the specification (10) by including in the set of covariates a dummy variable capturing the availability of English-speaking 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 master 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.

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

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

[26] The information is retrieved from the website of the Italian association of Dean, *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. On 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 the tuition fees prevailing in the university. Nevertheless, the correction remains somewhat modest, which suggests that, if any, the bias from omitting this variable is rather small.

Table 13: Italy: IV estimates accounting for the availability of English-speaking 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

In contrast with Italy, universities in the UK cannot be distinguished between public or private institutions. This prevents the use of the instrument capturing the public *vs* private status of the university. We deal with the issue of the endogeneity of fees taking benefit of the institutional context, namely exploiting the regional variation in the first-cycle tuition fees 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, i.e. those that are subject to caps on fees. For the reasons exposed above, restricting the sample to EU countries as origins should solve the endogenous nature of tuition fees. In contrast, if using all countries or the non EU origins should lead to results subject to the endogeneity bias. A comparison between the results based on different samples allows to shed some light on the magnitude of the bias associated to 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 EU countries as origin only, we find some support in favour of a negative impact of tuition fees. This finding therefore confirms the negative impact found in the case of Italy. The estimated elasticity is much lower in terms of magnitude than for Italy. This might be due to the fact that we focus on bachelor students that are less mobile than master students.

Table 14: UK - 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 failure to deal with the endogeneity of tuition fees lead 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 an overestimation of the impact of fees, 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 have in practice additional dimensions that the pure cost component outlined in the theoretical framework of 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 be nevertheless 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 signalling effect of fees. Our results for the different samples suggest rather that the positive impact obtained in previous work is in great part driven by endogeneity issues.

Table 15: UK - 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 that our baseline sample contains only first cycle students. The prospects of finding a good job are much more obvious for master students compared to bachelor students. First cycle in higher education primarily aims at providing a good training to favour the access to graduate studies rather than to provide a degree directly usable on the job market.

The elasticity of quality is also found to be lower than for 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 that the differences across bachelors are not that great. To check this conjecture we run similar regressions using master students' flows instead of first-cycle students.[27] Tables 19 and 20 in the Appendix[28] report the result obtained. Once we use only master student flows, the coefficient on income becomes both positive and highly significant. Interestingly the quality coefficients turn being both positive and highly significant for both estimation techniques. Consequently, the failure of the regressions

[27] Fees for master students are unregulated in UK, hence the reader should not rely on the coefficients on fees there obtained.

[28] Table 21 in the Appendix reports the estimation results using the whole flows of international students to UK (first degree and master students).

reported in tables 14 and 15 to find such an evidence could be driven by the fact that first-degree students are less likely to change location, for instance to take benefit of job opportunities.

Nevertheless, even for master students, the coefficient relative to the cost of living remains positive.[29] It may be the case that in the UK, our measure of 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 some IV estimation, instrumenting the cost of living. The presentation of the instrumentation strategy and the results are exposed in the Appendix. The results suggest that the positive coefficient obtained in Tables (14-20) might be once again driven by endogeneity.

5.3 Robustness check: Scaled Regressions

One concern related to model (10) is that it does not match perfectly 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 decreases the attractiveness of the other ones proportionally. If, for example, the ranking of Cambridge tends to increase, this should lead to an larger inflows of foreign students to Cambridge and to a decrease in the intakes in Oxford. The same holds for the other covariates, including also the 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, i.e. varies across each pair and is specific to each origin country. We scale all variables in the specification by the level prevailing in the university of destination which hosts the maximal number of students from origin country io. In practice, for each origin country, o, we determine the university that hosted during the academic year 2011/2012 the largest number of international students. This variable is labeled by $(u_d)^*$.[30]

The extended model that we consider takes the following form:

[29] In the appendix, we report results obtained by employing IV for the cost of living. We fail to find conclusive results.

[30] When the largest flow characterizing a given sending country, is shared among several universities, for each covariate we scale by the average values among these universities. We apply this strategy for both destination countries, Italy and the UK.

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

Table 16 presents the results for Italy, while Table 17 reports those obtained for the UK. The Tables are directly comparable with the ones reporting the benchmark regressions, i.e. Tables 9, 10 and 14.

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: UK: Scaled regressions, first-cycle students

	SCALED OLS			Poisson		
Variables	all	EU	No EU	all	EU	No EU
$\text{Fees}_{(ui)*}$	-0.065***	-0.087***	0.129***	-0.081***	-0.092***	0.197
	(0.01)	(0.01)	(0.04)	(0.01)	(0.01)	(0.11)
$\text{Cost of living}_{(ui)*}$	0.637***	1.947***	0.392***	1.069***	1.778***	0.844***
	(0.05)	(0.19)	(0.05)	(0.12)	(0.21)	(0.15)
$\text{Quality}_{(ui)*}$	0.068***	0.127***	0.045***	0.061***	0.105***	0.027*
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
$\text{Host capacity}_{(ui)*}$	0.335***	0.739***	0.275***	0.837 ***	0.818***	0.857***
	(0.01)	(0.03)	(0.01)	(0.03)	(0.04)	(0.04)
$\text{Income}_{(ui)*}$	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.[31]

Table 16 provides additional evidence for a negative impact of fees on international students inflows. Also, the estimates of the other covariates almost perfectly mirror the results obtained considering the baseline model (10). For the UK, as before, we apply specification (11) for the subset of first degree of students. The results, gathered 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, confirming 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 with the existing literature that has focused so far on country-specific factors, we look at the

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

determinants at the university level. This allows to address specifically the role of important factors such as the 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 between institutions in many countries. While the analysis considers a set of university specific factors, we give a special attention to the role of tuition fees on the propensity of foreign students to choose a specific university. The existing literature has obtained so far 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, i.e. 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 to identify the main factors such as the tuition fees, the quality of university, the host capacity, the expected return on education at destination and the cost of living. We estimate the role of those factors making use of data at the university level for two countries, namely the UK and Italy. One of the important issues at the econometric level is the endogeneity of fees. We propose two different solutions for each countrys. For Italy, we use a classical IV approach based on the status of the universities. For the UK, we make use of the regional variation in the caps that the authorities impose on the fees for native and European students of the first cycle.

Our analysis generates interesting and new findings. First, we find evidence of a negative role of the tuition fees set by a university on the flow of students choosing to study in this university. The typical estimate implies that an increase of 10% of the tuition fees would reduce the bilateral flow by about 5%, 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 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 play some influence on the location of foreign students, our analysis also emphasizes and confirms the role of other important factors. We find support in favour of a role of the university quality. Also, the expected return of education after graduation, is also 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

6.1 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 Maximisation Approach to migration. Education is considered as 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 an university at home to the one obtained from studying in an university abroad. If the increase in the present value of the future income is greater than the cost of migrating as well as 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. 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.

6.2 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 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 aspire 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 aspire 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:

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

where IW_{d,u^d}^s the intertemporal expected value of labour income after being graduated 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 education purpose and for working are taken sequentially, the student forms (simplistic) expectations on working period in his educational location decision. Expected wage depends indeed on the level and the quality of education which is university specific. We suppose that students form myopic exopectations about the expected wages by referring to the prevailing wages of the local labour market of the university.

The expected intertemporal labour 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 :

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

with $\underline{T}^s$ is the end of education age of student s and $\overline{T}$ is 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.[32] $W^s_{o,d,u^d}(.)$ is the annual expected labour 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:

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

$W^s_{o,d,u^d}(.)$, the annual expected labour 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 (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 labour income is then defined by :

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

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

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

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 localization u^d in country d involves country-pair specific costs and localization specific costs which 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, independently of the destination country (home-specific costs) whereas the variable part depends both on origin and destination (like transportation costs, assimilation costs ...). The variable migration costs depend on dyadic factors such as physical distance $d_{o,d}$, origin and destination countries' cultural and linguistic proximity 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} :

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

Then, we have :

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

with $\beta_2 = \beta_0\beta_1$.

A student s migrates from country o to country d for studying 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:

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

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 8). The set of alternatives faced by student is partitioned into subsets (nests) and subsubsets (subnests). There are 3 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 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 its location (middle-level of the tree). This choice is trivial for the Stay branch (nest $h = s$), the origin country is the only choice (the subnest is defined by o). At the lower-level, student choose the university in which he would like to study. This lower-level consists of all the alternatives of this decision tree, denoted $u = u^o_1, \cdots, u^{n_d}_{n^{n_d}_u}$.

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 on 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 on 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 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 necessary hold for alternatives in different nests). With these assumptions and 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)).

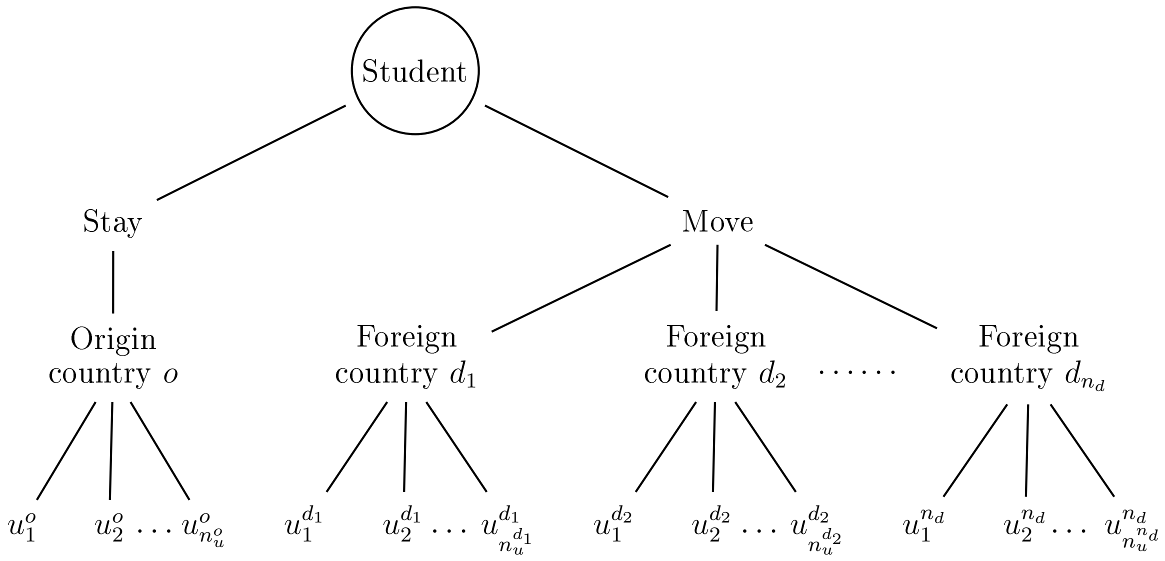

Figure 8: Decision Tree for student's University choice

The lower-level utility depends on characteristics that vary accross university area. 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 accross countries: $Y_{o,d} = \left\{\bar{Q}_d, d_{o,d}, l_{o,d}, col_{o,d}\right\}$. The upper-level utility depends on factor 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,

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

where β, α and γ denote parameters vectors.

With this decomposition of utility, the probability associated to (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 an 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 (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 a 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 countries related attributes.

The nested multinomial logit model[33] defined by (23)-(26) connects the levels of the tree outlined in Figure 8 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 aspire to study (N_s^o) with the migration to university u^d probability of a randomly drawn student of country o (P_{o,d,u^d}) :

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

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

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

However, as already stated, this number (M_{d,u^d}) is not the number of foreign students that will be enrolled in university u^d, this is the number of foreign students who aspire to go on to study in university u^d. We call it in the following the *ex-ante* enrolment demand. It is

[33]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 need to rescalling all estimated coefficients associated with low-level alternatives by the estimated inclusive value coefficients (λ^u and λ^j); and all estimated coefficients associated with middle-level variables by the estimated λ^j inclusive value coefficient. In what follows, we assume that this rescalling process is done.

not enough that students wish to go to this university, this latter must also authorizes their registration. Universities have enrolment policy which can lead to a number of foreign students enrolment lower than M_{d,u^d}. To know the actual number of foreign students enrolment we need to explain their enrolment behaviour.

6.3 Universities' behaviour

We assume that all universities have the same enrolment behaviour. In the short term, the enrolment behaviour of university u^d is determined by three factors :

1. in the short term, the foreign students' enrolment capacity is constrained. This foreign students' enrolment capacity, $EC_{u^d}^{\beta_5}$, is a share (defined by β_5) of total enrolment capacity EC_{u^d}. Universities set quotas on total foreign enrolment (and not at the origin level).

2. in the short term, the university quality is also fixed (Q_{u^d}).

3. the fees are also fixed in the short term (CS_{u^d}). Universities do not use fees as a price that could balance the demand of enrolment to their constrained capacity.

Capacity and quality may change over the long term with investment in capital and staff, but in th short term they are fixed. In the long run, fees can also be adjusted in relation with enrolment demand (when they are not regulated). But in short term these three factors are fixed. Consequently, the foreign students enrolment capacity could be constrained for university u^d, with 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* enrolment.

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

- $M_{d,u^d} \leq EC_{u^d}^{\beta_5}$, the ex-ante enrolment demand for university u^d is lower than their enrolment capacity. The capacity constraint is not binding ex-ante.

- $M_{d,u^d} > EC_{u^d}^{\beta_5}$ which implies $M_{d,u^d} > \tilde{M}_{d,u^d} = EC_{u^d}^{\beta_5}$ the ex-post (observed) enrolment is lower than the ex-ante demand. The constraint is binding, some students are forced to demand to be enrolled in an university which was not their first preference.

it is well known that many universities have turned away applications from foreign students due to capacity constraints, which gives support to 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 defined how this ex-post allocation could be done.

6.4 Equilibrium allocation with enrolment 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 university 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 necessary an ex-post constrained university, and an ex-ante unconstrained university could stay an ex-post unconstrained university or becoming an ex-post constrained university, depending on the scale of the reallocation.

The existence of a feasible allocation requires that the total world enrolment capacity is not 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 an university, but not necessary in his/her preferred university. As we have assumed that at least one university has an enrolment capacity binding, the ex-post total allocation is different to 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[34] 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* which 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 For an unconstrained university $u^d \in \bar{\mathfrak{C}}$,

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

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

[34]Without constraints at the country level, as for example with quotas on student visas (which implies a $\tilde{P}_{o,d,|m}$) or constraints on students emigration (which 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, it doesn't 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 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 assumption they 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, also 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 enrolment 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 fo UK and Italy, by adding the assumption that all the universities in these two countries have their ex-ante enrolment capacity constrained and by using a sequential estimation procedure.

6.5 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 favoured. Our contribution can be seen as the first step of the procedure for the unconstrained solution, i.e. 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 to carry out all the steps. This is due to the fact that the ex-post allocation in an ex-ante non constrained university in country d can be modified by the re-allocation implied by the constraints on universities in country d or others countries. 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 enrolment capacity constraint.

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

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

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

$$
\begin{aligned}
\tilde{P}_{o,u^d|d,m} &= \frac{\exp(VS_u(X_{u^d}) + \ln(\pi_{u^d}))}{\sum_{u=1}^{n_u^d} \left(\exp(VS_u(X_u)) + \ln(\pi_{u^d})\right)}, \quad \text{with} && (37) \\
\pi_{u^d} &= \frac{EC_{u^d}^{\beta_5}}{M_{d,u^d}} \quad \forall u^d && (38)
\end{aligned}
$$

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:

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

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:

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

The discrepancy between the ex-post and the ex-ante flows is greater the higher enrolment 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:

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

.

6.6 Summary of the data

Table 18: 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	UK: HESA. Italy: MIUR.
Fees	(CS_{u^d})	Average fees charged by university u	UK: 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	UK: 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.

6.7 Additional Estimation results

6.7.1 Master degree students only (UK)

Table 19: UK - 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 20: Uk - Master 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

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

6.7.2 First and Master degree students combined (UK)

Table 21 below reports the coefficients estimated using the whole flows of international students to UK, *i.e* flows including first cycle and master students.

Table 21: UK - All students (first and master 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

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