DISCUSSION PAPER SERIES

No. 7657

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LABOUR ECONOMICS

Centre for Economic Policy Research

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Available online at: **www.cepr.org/pubs/dps/DP7657.asp**

ISSN 0265-8003

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Discussion Paper No. 7657
January 2010

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This Discussion Paper is issued under the auspices of the Centre's research programme in **LABOUR ECONOMICS**. This paper was produced as part of the SCIFI-GLOW Collaborative Project supported by the European Commission's Seventh Framework Programme for Research and Technological Development, under the Socio-economic Sciences and Humanities theme (Contract no. SSH7-CT-2008-217436). Any opinions expressed here are those of the author(s) and not those of the Centre for Economic Policy Research. Research disseminated by CEPR may include views on policy, but the Centre itself takes no institutional policy positions.

CEPR Discussion Paper No. 7657

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ABSTRACT

Does university quality drive international student flows?

We examine whether the (research) quality of a country's higher education system drives macro-flows of foreign tertiary students in Europe. We use various measures on the quality of a country's higher education system in an extended gravity model. We find that quality has a positive and significant effect on the size and direction of flows of students exchanged between 18 European countries.

JEL Classification: F22, I23 and J61
Keywords: higher education, international student mobility, quality indicators and university rankings

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* Financial support from the Belgian Federal Government (PAI 06/09) and the FWO is gratefully acknowledged. The views expressed in this paper do not necessarily reflect the views of the Katholieke Universiteit Leuven, Bruegel or CEPR. We wish to thank the participants of the MSI Brown Bag seminar series, the IAP meeting 2009, the DRUID Summer Conference 2009, the SCIFI-GLOW research meeting 2009, the EEA Conference 2009 and the EARIE Conference 2009 for their helpful suggestions and comments. All errors remain for the authors.

Submitted 21 January 2010

I. Introduction

European policy makers by now widely advocate the importance of higher education for Europe. Building an efficient and effectively integrated Higher Education Area is seen as an indispensable part of Europe's policy agenda for knowledge-based growth. The Bologna process tries to improve the comparability and compatibility of Europe's diverse higher education systems, thus facilitating the mobility of students, graduates and higher education staff. Through fiercer competition for the best students and researchers between a larger number of institutions, the overall quality of European higher education is hoped to increase. However, for this beneficial effect to occur, two conditions must be satisfied: students should not only be internationally mobile, but they should also be guided by quality in their choice of university.

The purpose of this paper is to examine whether quality of the higher education system drives the international mobility of students at the European level. We use an extended gravity model to assess the extent to which flows of students between a sample of European countries can be related to the quality of universities. We use different measures as quality indicators, ranging from the impact of a country's scientific publications, over the number of universities a country has in the top 200 of the Shanghai ranking to the number of universities a country has in the Times Higher Education ranking. We find that the first two quality indicators have a positive and significant effect on the size and direction of student flows, whereas the third does not have an additional significant impact after controlling for the 'UK-effect'.

The remainder of this paper is organized as follows: section 2 provides an overview of the relevant literature on student mobility. Methodology and data are discussed in section 3, the empirical results in section 4. Section 5 concludes.

II. Literature review

Various strands of literature consider the factors influencing the choice of higher education. The consumption perspective treats the choice to pursue higher education as purely dependent upon price and income. Students take into account the circumstances in which they will study. Larger costs to study at higher-quality

institutions may thus deter the choice to study at these institutes, particularly for financially constrained individuals. In the signaling perspective to education (Spence, 1973), institutions simply sort out those who are intrinsically productive from those who are intrinsically less productive. Institutions offering higher quality education will be more valuable to students, when they succeed in sorting better.

The closest link between student education choices and quality of education is provided by the human capital theory of education (e.g. Becker, 1964; Freeman, 1986). In this perspective, individuals consider education as an investment decision. They will undertake the costs of higher education in order to increase their future earnings and employment opportunities. Education directly increases productivity: students of a given type acquire more valuable skills by obtaining more education. Krueger & Lindahl (2001), surveying the evidence on monetary returns from education, in the form of an education wage premium, conclude that education is indeed more than just a proxy for unobserved ability, confirming the productivity enhancing effects of higher education as witnessed by higher educational wage premia. Within a human capital perspective, students will prefer to attend a high-quality institution, as long as the higher costs are compensated by higher returns, as a degree from a renowned university is likely to enhance their salary prospects and open doors to interesting jobs (Brewer et al., 1999). At least in the US, students are indeed found to match universities along quality (Hoxby, 2005; Epple *et al.*, 2006).

When looking at the choice of schooling in a different location than the home country, extra costs of mobility have to be factored into the decision of the student. All else equal, mobile students should be more sensitive to the quality dimension, as they need to be compensated for the higher costs by higher expected returns. The literature on student mobility can roughly be divided into two strands: the literature on international student mobility, and the literature on domestic student mobility, i.e. on migration of students across regions within a country. Although our study is concerned with the former type of student mobility, we start with the latter strand of the literature, as this includes the quality dimension as an influencing factor more prominently than the former studies.

Most of the domestic mobility studies analyze student flows on the level of an individual institution, for which information on higher education quality is easier to incorporate. Unfortunately, the evidence of the effect of university quality on the number of students a university attracts from outside its home region is mixed. Abbott

and Schmid (1975) find that university prestige accounts for only a modest proportion of interstate migration of students in the United States. Sá et al. (2004) find no evidence that students are guided by university quality in their locational choice of study for Dutch universities. Faggian et al. (2007) find that Scottish and Welsh students that are able to enter a high-quality university in their home region are less likely to move away for higher education. By contrast, Ono (2001), finds that quality differentials significantly increase the likelihood that Japanese students move away from their home region for higher education. Similarly, McCann and Sheppard (2001) show that better higher education institutions generate more migration for a sample of UK graduates.

In the studies on international student mobility, the quality dimension has received much less attention. A large part of the econometric studies has been concerned with flows of students from developing countries to industrialized countries, trying to understand their determinants and effects. Survey studies discuss the motivations of students to go abroad as well as the external factors that encourage or inhibit this mobility, on the personal, institutional and national level. Table 1 provides an overview of the results from these empirical studies. For the sending country, domestic opportunities for higher education and economic strength are factors commonly found to limit outward student mobility. For the host country, proximity to and close relations with the sending country (e.g. in the form of trade relations or former colonial links) are factors that commonly attract students from a particular sending country. Employment and permanent migration opportunities also influence a host country's appeal to foreign students.

Evidence from survey analysis supports the importance of quality dimensions. Differences in quality between a foreign degree and a domestic one is found to be one of the main motivations for students to go abroad for students from developing countries, (Gordon and Jallade, 1996; Kemp et al., 1998; Aslanbeigui and Montecinos, 1998; Mazzarol and Soutar, 2000; Bourke, 2000, Szelényi, 2006). But as higher education quality differentials are likely to be much bigger between developing and industrialized countries than among industrialized countries, it remains to be seen

TABLE 1
Overview of studies on the determinants of international student mobility

Authors	*Type of study*	*Countries*	*Effect of quality*	*Other variables*
Lee and Tan (1984)	Regression analysis	From 103 countries to U.S., France and U.K.	Not included	Excess demand (+), share of science (-), staff-student ratio (-), real cost per student (+), per capita income (+), cost of living (+), GNP growth rate (+), English language (+), colonial links (+), distance (-)
Cummings (1984)	Regression analysis	From 34 countries to the U.S.	Not included	Population (-), HR capacity (+), financial capacity (+), domestic opportunities (-), previous overseas students (+), interdependence (+)
Agarwal and Winkler (1985)	Regression analysis	From 15 developing countries to the U.S.	Not included	Income (+), educational opportunity (-), English speaking (+), French speaking (+/-), probability of migration (+/-)
McMahon (1992)	Regression analysis	From 18 developing countries to the U.S.	Not included	Economic strength (-), global trade (+), state priority on education (+), availability (-), relative economic strength (+), U.S. trade (+), U.S. aid (-), U.S. institutional support (-)
Thissen and Ederveen (2006)	Regression analysis	19 European countries	+	Population (+), GDP per capita (+), unemployment (-), tuition difference (.), linguistic distance (.), religious distance (-), cultural distance (.), physical distance (-)
Bessey (2007)	Regression analysis	From 172 countries to Germany	Not included	Stock of students (+), distance (-), population (+), GDP per capita (+), freedom (+), contiguity (-), landlocked (+)
Szelényi (2006)	Case study interviews	26 Brazilian, Italian and Chinese students in the U.S.	+	n/a
Kemp, Madden and Simpson (1998)	Survey analysis	(Prospective) Students from Taiwan and Indonesia	+	n/a
Aslanbeigui and Montecinos (1998)	Survey analysis	528 foreign students in the U.S.	+	n/a
Mazzarol and Soutar (2000)	Survey analysis	Prospective students from Taiwan, India, China and Indonesia	+	n/a
Bourke (2000)	Survey analysis	From 23 mostly developing countries to Ireland	+	n/a

whether the survey evidence support for the importance of quality dimensions from a limited set of developing countries, remains valid for flows within industrialized countries. Few of the regression analysis type of studies have explicitly factored in quality differentials as a driver of international student flows. Only Thissen and Ederveen (2006), include in their regression analysis of intra-EU student mobility, a measure of quality among their list of determining factors. Although it is not the focus of their analysis, they find that a positive quality differential significantly increases the enrolment of foreign students. Other studies do include traits of a country's higher education system that are possibly correlated to its quality, such as the staff-student ratio (Lee and Tan, 1984), educational opportunities (Cummings, 1984; Agarwal and Winkler, 1985; McMahon, 1992) and government spending on higher education (McMahon, 1992).

In conclusion, although the theoretical human capital literature and the survey evidence support the importance of quality considerations in the decision to pursue higher education (abroad), the econometric analysis of the importance of quality among the factors driving (international) student mobility is less well-established, producing no robust findings as of yet, especially for more developed countries such as those in the European Higher Education Area.

III. Methodology and data

The model

We analyze the impact of higher education quality on student flows between countries with a gravity model, regularly used in economics to study bilateral trade flows, but also migration flows. Its basic specification is

$$F_{ij} = C\frac{S_i^{\alpha} \times S_j^{\beta}}{D_{ij}^{\gamma}} \qquad (1)$$

with F_{ij} the flow of people from country j to country i, C a constant factor, S_i and S_j the respective sizes of countries i and j and D_{ij} the distance between these countries. For flows of people, the most often used measure of size is the relevant population, in casu the relevant student population. Big sending countries simply have more students to send out,

whereas big host countries have more infrastructure to absorb a larger number of incoming students. Distance is usually measured by the distance between both countries' capital cities. The closer the host country is to the sending country, the more students it is expected to attract. Not only are travel expenses lower with decreased distance, but also cultural and linguistic distance is expected to be smaller, thus lowering the adjustment costs a student experiences when moving to another country.

In empirical applications, it is common to use the loglinearized form of the gravity equation. This form is easy to estimate with OLS and the coefficients have a convenient elasticity interpretation. Typically, additional explanatory variables are added to increase the explanatory power of the model. These relate to characteristics of the host country (HC_i), the sending country (SC_j)and include variables describing the relationship between the host and sender (R_{ij}).

We use the following augmented loglinearized gravity model:

$$log\,(F_{ij}) = log(C) + \alpha\, log(S_i) + \beta\, log(S_j) - \gamma\, log(D_{ij}) + \theta(R_{ij}) + \zeta\, log(HC_i) + \eta\, SC_j + \delta\, QUAL_i + \varepsilon_{ij} \quad (2)$$

The following subsection describes our dependent variable (F_{ij}) in more detail. Among the set of independent variables, we focus on the importance of quality of higher education in the host country, correcting for other host and sending country characteristics. Our main variable of interest will therefore be the quality of the higher education system of the host country as a pull factor, but in the analysis we will also look at the quality of the higher education of the sending country as a push factor and whether the quality differential or the gap in quality between the sending and the host country matters. To measure quality of the higher education system we will use various indicators. These will be detailed in the third subsection. The last subsection discusses the other explanatory variables included in the analysis.

The data on flows of international students (F_{ij})

For flows of international students we use the joint Unesco Institute for Statistics (UIS)/OECD/Eurostat database on education (available through Eurostat). Countries supply data on the basis of commonly agreed definitions through yearly questionnaires.

We focus on a subset of 18 European countries[1] that all belong to the European Higher Education Area, though only 16 belong to the European Union. We use a cross-section of the bilateral flows between these 18 countries for the year 2005, which leaves a maximum number of 306 observations.[2]

Students whose nationality differs from that of the country in which they enroll, are counted as foreign students. There are two shortcomings to this type of measurement. First, children of immigrants who were born and educated in a country but who nevertheless still retain their parents' foreign nationality, are counted as foreign students, though they are not internationally mobile in the sense that is relevant for the analysis in this paper. This results in an overestimation of the number of internationally mobile foreign students enrolled in a country, particularly for countries with high migration flows. Second, students who spend a semester or an entire academic year abroad as part of an exchange program, are not counted in this database. A student that participates in the ERASMUS program, for example, remains enrolled at his home institution while spending time abroad, and is therefore not counted as an internationally mobile foreign student. This results in an underestimation of the number of students that have at least some experience with being internationally mobile. But as quality considerations can be expected to be different for a student deciding to enroll for an entire program abroad, than for a student deciding where to spend one or two semesters, we prefer to exclude this source of heterogeneity in the data.

Education is divided into levels according to the International Standard Classification of Education (ISCED).[3] For this analysis, we are interested in students in tertiary education, which corresponds to levels 5 and 6 in the ISCED. The first stage of tertiary education is level 5, further subdivided into A and B categories. The former contains those programmes with a theoretical orientation that give access to advanced research programmes. The latter contains programmes which are practically oriented or occupationally specific. The second stage of tertiary education, which leads to an advanced research qualification, is level 6. These programmes require the submission of a dissertation based on original research which constitutes a contribution to knowledge in the relevant field.

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[1] Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

[2] Although the data are also available for an -albeit limited- range of years, the variation across time in this range is very limited, as we will report infra. This strong persistency in the short run prohibits a useful panel data analysis.

[3] More information on the ISCED classification can be found in Appendix A.

We exclude students at ISCED level 5B from the population, as these students are enrolled in more practically oriented courses and are therefore very different in profile than the other tertiary students. They are less likely to become internationally mobile in search of high-quality education, as reflected by the small volume of international students exchanged at this level. The largest number of students is exchanged at ISCED level 5A. We also analyze international student flows at ISCED level 6, and compare the determinants of international mobility patterns across these two groups. Student flows at this level appear to be more concentrated towards the UK than at the ISCED level 5A, with the UK absorbing 36% of incoming student flows at ISCED level 6 as opposed to 24% from a comparable sample at ISCED level 5A. This observation is in line with the finding that students become increasingly concentrated over time in the Anglo-Saxon countries (Oswald and Rahlsmark, 2008).

The United Kingdom is the largest net importer of foreign students, receiving almost 70,000 students at ISCED level 5A, but sending out only 7,000 in 2005 (see figure 1). Germany is the second major destination of foreign students in Europe, with an inflow of over 60,000 students. However, it also sends out more than 40,000 students, making it a comparatively smaller net importer than the UK. Other net importers of foreign students are Austria, Belgium, Denmark, the Netherlands, Sweden and Switzerland. Major source countries of foreign students are mainly situated in southern and eastern Europe. Greece and Poland are major exporters of tertiary students, both sending out large numbers of students and receiving very few in return. Italy, Spain, Portugal and France[4] receive somewhat larger inflows of students, but nevertheless send out significantly more of their own, making them net exporters alongside the Czech Republic, Finland, Hungary and Norway.

Measuring the quality of countries' higher education

Measuring the aggregated quality of a country's higher education system is a challenge, as a country's universities are heterogeneous with respect to quality. We use several different indicators to measure a country's higher education quality. First, we measure the quality of a country's research through citations received to its scientific publications. Most of the scientific publications are authored by researchers affiliated to universities.

[4] In this paper, we are only looking at student flows exchanged between the countries in our sample. If we would look at total inflows of foreign students, France would probably be a net importer of foreign students due to its large intake of students from Africa.

The quality of a country's scientific output should therefore reflect the quality of its university faculty more generally. It is not unlikely that proximity to excellent research enhances the educational quality of a university. Students that have the opportunity to get to know top quality research and researchers first-hand may thus have an advantage over their peers that do not.

Publication and citation data are taken from the National Science Foundation's Science and Engineering Indicators 2004. Citation data refer to citations made in 2003 to articles published in 1999, 2000 and 2001. To correct for the size of the country, we include as a quality measure the share of a country's citations in total world citations, relative to the share of a country's publications in total world publications. If this ratio is above 1, then a country's research on average attracts more citations than the rest of the world's publications. We label this indicator '***relative impact'***. In bibliometrics, citations are widely regarded as an indicator of the quality of a publication. However, it reflects a specific perspective on research quality, namely through its visibility in the scientific community. It may therefore be too specific for prospective students when evaluating their enhanced returns from studying in a higher quality country.

Our second measure of quality is based on the Academic Ranking of World Universities, also referred to as the Shanghai ranking. Compared to the 'relative impact' measure, the ***Shanghai Ranking*** uses a broader set of indicators to measure the quality of universities. This ranking, compiled annually by Shanghai Jiao Tong University, ranks universities on the basis of alumni and staff winning Nobel prizes and Fields medals, the number of ISI highly cited researchers, the number of articles published in Nature and Science, the number of articles in the Science Citation Index Expanded and the Social Science Citation Index and the size of the university. We count the number of universities a country has in the top 200 of this ranking.[5] This allows taking into account the 'quantity' of high-quality institutions present in a country. It may not be enough that a country has a reputation of research quality to attract large numbers of foreign students – there also need to be enough available places at high quality institutions to make large incoming student flows possible. Although the Shanghai ranking stirs heavy debates on its 'correctness' to measure quality, it attracts a lot of media-attention. It may therefore be one of the information sources prospective students are likely to use when they decide which university in which country to apply for.

[5] We check sensitivity of results to including the top 500 (see infra).

Both the 'relative impact' and the 'Shanghai ranking' measure research quality of a country's universities as opposed to their teaching quality. Another well-known university ranking is the ranking of the Times Higher Education Supplement (THES). This ranking puts more emphasis on teaching quality. It is based on peer review, recruiter review, citations per academic staff, staff per students, and the proportion of international staff and students. As a third indicator, we therefore use the number of universities a country has in the **THES ranking**. This indicator should proxy better for the 'quantity' of high teaching quality institutions.

From the countries in our sample, the UK dominates clearly both rankings with 19 institutions in the Shanghai ranking and 24 in the THES ranking. For continental Europe, both rankings differ somewhat, although not dramatically. In the Shanghai ranking, Germany occupies the second position with 16 universities, followed by the Netherlands with 7. In the Times Higher Education ranking, the second place goes to the Netherlands with 10 universities, and the third is shared by France and Germany with 9 each. Both rankings are unanimous on the lowest scoring countries: the Czech Republic, Greece, Hungary, Poland and Portugal each have 0 universities in either ranking. The picture provided by the relative impact indicator is more nuanced. The Netherlands, Denmark and Switzerland outshine the UK with scores above 1.1. The bottom group remains unchanged, though, with the Czech Republic, Greece, Hungary, Poland and Portugal receiving the lowest scores, all below 0.7.

Other variables influencing international student mobility

For the size of the host and sender in the basic gravity model, $\boldsymbol{S_i}$ and $\boldsymbol{S_j}$, we include the relevant student population of the host and sending country respectively. The relevant student population is the number of students in ISCED level 5A in the sending or host country. Student data are taken from Eurostat.

$\boldsymbol{D_{ij}}$ is measured by the distance between the capital cities of countries *i* and *j*. Distance is calculated as the bird's eye distance between the capital cities of two countries.[6] The vector $\boldsymbol{R_{ij}}$ further contains two variables that control for the relationship between the host country *i* and the sending country *j*. A first dummy variable indicates whether the host and sender share a language. Migration costs are typically lower if a student migrates to a country where his/her official language is spoken. We therefore

[6] See http://www.geobytes.com/CityDistanceTool.htm .

expect the size of the flow of tertiary students to be larger between countries with a shared language. A second dummy variable indicates whether the host and the sender share a border. Neighboring countries often share a certain cultural and linguistic affinity that further lowers migration costs, thus increasing the flow of tertiary students between these countries.

The vector $\boldsymbol{SC_j}$ controls for sending country characteristics. Most of the literature on international student flows controls for educational opportunities at home to account for the possibility that tertiary students are forced to seek higher education abroad for lack of places in higher education institutions in their home country (Lee and Tan, 1984; Cummings, 1984; Agarwal and Winkler, 1985; McMahon, 1992). In line with this, we include a measure of the educational opportunities in the sending country, with educational opportunities measured as the proportion of students in tertiary education relative to the number of students in upper secondary education (ISCED level 3). For students in advanced research programmes (ISCED level 6) we measure educational opportunities as the proportion of students enrolled at this level relative to students in ISCED level 5. We expect that countries with less educational opportunities send out a larger number of students to other countries. All student data are taken from Eurostat.

Two control variables account for the host country characteristics $\boldsymbol{HC_i}$. First, we control for the higher education expenditure per student. If more money is spent on higher education, more and better professors can be hired, better infrastructure can be built and more resources can be made available to students and researchers. Data on higher education expenditure per student are taken from Eurostat. Second, we include the average amount of tuition in the host country as a measure for the cost of education. The higher the cost of education in a particular country, the less the demand of foreign students for higher education in this country will be. These tuition fees are determined through public intervention in many continental European countries and therefore do not necessarily reflect the full cost of providing higher education. The total cost of education for a student also includes, besides the tuition fees, the cost of books and materials and the cost of living, for which we have no information.[7] As tuition fees nevertheless make up a

[7] A report of the Educational Policy Institute on the affordability and accessibility of higher education (Usher and Cervenan, 2005) makes a fair attempt at measuring the price of higher education, including tuition fees, costs of educational material and living expenses, and subtracting support in the form of grants, loans and tax credits. However, their country coverage is limited to fifteen countries, of which only 9 countries overlap with our sample. Including their more detailed measures of the cost of higher education would lead to a large loss of observations.

sizeable chunk of the cost of higher education, we expect the average tuition fee in the host country to have a negative effect on the size of the incoming flow of foreign students.

Last, regional dummies control for regional characteristics which may influence the size of the outflow or inflow of students.[8] The base group is constituted by continental western Europe (France, Germany, Belgium, the Netherlands and Austria). Additionally, we define four regions: Scandinavia (including Denmark, Norway, Sweden and Finland), the Mediterranean (including Portugal, Spain, Italy, and Greece), the new member states (including those countries that joined the European Union in 2004, i.e. Poland, the Czech Republic and Hungary) and non-European Union (Norway and Switzerland). In addition to these regional dummies, we include a dummy for the United Kingdom, and this for two reasons. First, as English has acquired the status of *lingua franca* in science over the past century, the United Kingdom may be especially appealing for international students. Second, higher education in the United Kingdom has always had more affinity to the US system than with the continental European one. The UK-dummy should control for this difference in educational culture.

IV. Results

Basic results

Table II reports the regression results of a series of gravity models for international student flows at ISCED level 5A. First, as a benchmark, the results from a simple gravity model are reported with size as measured by student population, distance, a border and language dummy, and regional dummies (column (1)). All the variables have the expected signs and most are highly significant, with the exception of the language dummy. Apparently language differences are not a deterrent for international students, probably because of the widespread adoption of English in higher education. Note that several regional dummies are highly significant. This suggests that there are indeed regional characteristics that have an impact on the size and direction of student flows. All regions except the UK and the non-EU countries receive less international students than the base group constituted by northwestern Europe. The negative effect is particularly strong for the Mediterranean region and the new member states in Central Europe. Not surprisingly,

[8] Ideally we would include country dummies in the model, as these are better suited to control for unobserved host and sender characteristics. However, the limited number of observations precludes us from including country dummies.

the UK receives significantly more students than the base group. The positive coefficient of the non-EU countries is driven by Switzerland which has a high share of foreign students in its student population.

In the second column, we include the lagged 5-year average bilateral student flows. The coefficient of the average lagged student flow is large and highly significant, confirming the strong persistence through time in bilateral student flows. Due to the high persistency of student flows, past student flows absorb all the explanatory power of the model. All other variables lose significance, with the exception of host and sender student population. Therefore, in the remainder of the specifications, we no longer include past student flows.[9]

In specification (3), additional host (HC_i) and sender characteristics (SC_j) are added. Higher education expenditure in the host country has a strong and significant positive effect on the size of incoming student flows. A 1% increase in higher education expenditure per student leads to an average 2% increase in the size of incoming student flows. Although tuition fees are not always significant across specifications, the coefficient is always positive. This is in contrast with a cost-perspective prediction. It is however consistent with a signaling effect of tuition fees: high tuition fees signal quality, and therefore attract more students. Educational opportunities in the sending country are not significantly different from zero in any of the specifications. Perhaps educational opportunities are no longer a pressing issue in our sample of industrialized European countries.

Column (4) includes the 'relative impact' measure for research quality. Relative impact has a strongly positive and significant impact on student flows: a jump in this indicator from, say, 1 to 1.1 would on average lead to a 23% increase in the number of incoming students. Column (5) includes the university counts in the top 200 of the Shanghai ranking. The number of universities a host country has in the Shanghai ranking's top 200 also has a significant, positive and substantial effect: ceteris paribus, an additional institution in the top 200 increases the number of incoming students by approximately 15%. When we include 'relative impact' and the Shanghai ranking top 200 simultaneously, (column (7)), only the number of universities in the Shanghai ranking top

[9] We also included past bilateral flows of Erasmus students as extra independent variable. It had no significant effect and did not affect the other results. We therefore did not maintain the variable in further analysis.

TABLE II

Basic gravity models

	(1) *International students (ISCED level 5A) in logs*	(2) *International students (ISCED level 5A) in logs*	(3) *International students (ISCED level 5A) in logs*	(4) *International students (ISCED level 5A) in logs*	(5) *International students (ISCED level 5A) in logs*	(6) *International students (ISCED level 5A) in logs*	(7) *International students (ISCED level 5A) in logs*
student population host (ISCED 5A)	0.888	0.097	1.067	0.999	0.615	1.042	0.484
	(9.95)**	(2.66)**	(11.77)**	(10.39)**	(3.65)**	(7.33)**	(2.34)*
student population sender (ISCED 5A	0.812	0.118	0.711	0.712	0.712	0.711	0.712
	(9.08)**	(3.29)**	(7.90)**	(7.87)**	(8.02)**	(7.88)**	(8.08)**
distance	-0.812	-0.056	-0.989	-0.906	-0.838	-0.981	-0.847
	(4.72)**	(0.91)	(5.69)**	(5.36)**	(4.92)**	(5.59)**	(4.95)**
border	0.833	0.126	0.790	0.834	0.862	0.795	0.854
	(3.79)**	(1.57)	(3.69)**	(3.91)**	(3.85)**	(3.68)**	(3.74)**
shared language	0.413	-0.138	0.407	0.441	0.385	0.420	0.346
	(1.60)	(1.44)	(1.50)	(1.62)	(1.32)	(1.54)	(1.14)
average flow of international students in previous 5 years (ISCED levels 5+6)		0.896					
		(37.54)**					
higher education expenditure per student - host			2.087	1.960	1.616	2.066	1.529
			(6.02)**	(5.93)**	(5.06)**	(6.10)**	(4.70)**
tuition fees - host			0.049	0.015	0.151	0.050	0.224
			(1.63)	(0.47)	(4.08)**	(1.67)	(3.53)**
educational opportunities (ISCED level 5) - sender			0.007	0.007	0.006	0.007	0.006
			(1.80)	(1.75)	(1.70)	(1.79)	(1.70)
relative impact 1999-2001 - host				2.284			-1.998
				(2.55)*			(1.55)
SR top 200 institutions - host					0.148		0.211
					(3.74)**		(3.43)**
THES top 200 institutions - host						0.013	
						(0.29)	
scandinavia - host	-0.341	-0.005	0.467	0.090	1.250	0.499	1.909
	(2.00)*	(0.09)	(1.76)	(0.30)	(4.14)**	(1.84)	(3.69)**
meditteranean - host	-1.716	-0.049	-0.668	-0.202	0.076	-0.594	-0.018
	(7.73)**	(0.55)	(2.72)**	(0.62)	(0.22)	(1.49)	(0.05)
new EU members - host	-2.769	0.041	-1.333	-0.324	-0.547	-1.252	-1.098
	(11.57)**	(0.31)	(3.15)**	(0.52)	(1.08)	(2.19)*	(1.89)
non EU members - host	0.370	-0.009	-0.958	-0.295	-1.348	-0.936	-2.092
	(2.02)*	(0.17)	(3.14)**	(0.76)	(4.18)**	(2.95)**	(3.53)**
uk - host	0.892	-0.045	0.929	0.948	-0.611	0.727	-1.276
	(3.51)**	(0.56)	(3.54)**	(3.62)**	(1.36)	(1.07)	(1.93)
scandinavia - sender	0.351	-0.079	0.296	0.295	0.279	0.298	0.273

	(1.73)	(1.12)	(1.43)	(1.44)	(1.37)	(1.44)	(1.34)
mediterranean - sender	0.463	-0.086	0.339	0.305	0.272	0.337	0.274
	(1.91)	(1.23)	(1.32)	(1.19)	(1.07)	(1.31)	(1.09)
new EU members - sender	-0.214	0.014	-0.175	-0.168	-0.175	-0.173	-0.181
	(1.30)	(0.17)	(1.21)	(1.15)	(1.21)	(1.19)	(1.26)
non EU member - sender	0.483	0.141	0.328	0.322	0.326	0.327	0.330
	(1.84)	(1.64)	(1.30)	(1.30)	(1.32)	(1.29)	(1.33)
uk - sender	-0.102	-0.075	0.463	0.446	0.409	0.464	0.401
	(0.32)	(0.86)	(1.18)	(1.18)	(1.13)	(1.18)	(1.11)
Constant	-11.106	-1.843	-31.169	-31.782	-23.410	-30.801	-19.609
	(5.79)**	(2.69)**	(8.58)**	(9.04)**	(6.04)**	(8.12)**	(4.04)**
Observations	306	306	255	255	255	255	255
R-squared	0.70	0.96	0.78	0.79	0.80	0.78	0.80

Notes: Robust t statistics in parentheses; * significant at 5%; ** significant at 1%

200 remains strongly positive and significant. This suggests that what matters more to attract international students is the availability of high quality education in the form of a large number of top-ranked institutions. When including the Shanghai ranking top 200 indicator, the UK–host dummy loses its significance, suggesting that the popularity of the UK as a host for foreign students is indeed related to its larger number of higher quality institutions.

Column (6) includes the university counts in the THES ranking, as a closer measure for teaching quality. Contrary to the research quality measures, the coefficient for number of institutions in the THES ranking is not significantly different from zero. A possible reason is the THES ranking's skew towards British universities in comparison to our other quality indicators. The UK dummy and the THES quality indicator may be absorbing each other's effect. In the appendix (table BI; 6) we report the results when omitting the UK dummy from the model, in which case the THES indicator indeed turns out positive and significant.

The results on the host and sending characteristics are not affected by the inclusion of the quality indicator measures, with the exception of the tuition fees variable which becomes significantly positive with the inclusion of the Shanghai ranking measure of quality. [10]

[10] Moreover, the results are largely robust to the inclusion of additional control variables such as Erasmus student flows, migrant stocks and unemployment. Tables are available from the authors upon request.

Robustness of the results with respect to the quality indicators

We check the robustness of our results with alternative constructions of the quality indicators. The results are reported in appendix table BI. When we substitute our relative impact factor for the more common measure of average citations per publication in a country, we still find a significantly positive coefficient, but the size of the coefficient is smaller (column (1)). When we include the number of institutes in the top 500 of the Shanghai ranking, rather than the top 200, i.e. lowering our quality benchmark, the coefficient on the top 500 turns out to be significantly negative, albeit small: an additional institution in the top 500, ceteris paribus, leads to a 2.7% decrease in the number of incoming students in the host country (column (2)). Apparently students do not perceive institutions in the bottom of the Shanghai ranking as attractive. We also include a variant of our Shanghai top 200 indicator, as constructed by Aghion et al. (2007) and used by Thissen and Ederveen (2006) in a similar context as ours (column (3)). This indicator is constructed as the weighted number of universities in the total Shanghai ranking, with universities ranked higher up receiving a larger weight, divided by the host country's population. Although our specification already includes a correction for size through S_i, this measure additionally corrects for country size in the construction of the quality indicator. The coefficient remains positive and highly significant. The same indicator constructed with the THES ranking turns out negative and significant (column (4)). Again the strong UK-effect appears to be behind this surprising result; when the UK-dummy is omitted, the THES indicator becomes insignificant (column (5)).

In conclusion, our hypothesis that university quality helps explain the size and direction of student flows at ISCED level 5A seems fairly robust to variation in construction of the indicators, at least for our bibliometric indicators and for the quality indicators based on the Shanghai ranking. The insignificant results on the Times Higher Education Ranking is mainly attributable to the skew in this indicator in favor of the UK.

In appendix table BII we check whether quality operates mainly as a pull factor at the host country level, or whether sending country quality also has an effect as a push factor. More specifically, we hypothesize that sending country quality will have a negative effect: students have less incentive to seek higher education abroad when their home country offers a sufficiently qualitative option. This hypothesis is only confirmed for the relative impact indicator (column (1)). Neither the Shanghai ranking (column (2)) nor the THES ranking indicator (column (3)) is significant for the sending country,

suggesting that quality is indeed more of a pull factor at the host country level than a push factor from the sending countries in the sample.

Relative versus absolute quality

A related question is whether it is host country quality that drives international student flows, or host country quality **relative to** sending country quality. In table III, we estimate three gravity models with all country characteristics, including our three measures of quality, in relative terms, i.e. host versus sender level. The results seem to suggest that specific host and sender characteristics matter in an absolute way and not relatively between host and sender. The relative quality indicators lose a lot of significance, although both the relative impact and the Shanghai ranking indicator remain significant at the 10% level. Though the coefficients are positive, they are small in size. For example, if the number of top 200 institutions in the host country doubles with respect to the number in the sending country (a jump in the relative quality indicator from 1 to 2), then the student flow from sender to host would increase by approximately 0.6%. Of the characteristics of hosts relative to senders, only higher education expenditure is significant and positive.

Non-linear quality effects

Perhaps the poor performance of the relative quality models indicates that the gap in quality has a non-linear impact on student flows. While on average a higher quality level in the host country should attract more students, sending countries with very low higher education quality may lag so far behind high quality host countries that few students have the required abilities to obtain higher education in that host country, i.e. they lack the necessary absorptive capacity to gain from higher education in a high-quality country. When the gap in quality between host and sender is too wide, student flows between these countries may therefore not be affected positively by the higher quality of the host country. Conversely, if the sending country has a quality level comparable to the host country, then the quality differential may not be sufficient to offset the costs of moving. To test these hypotheses, we create two dummy variables for sender quality: a dummy

TABLE III

Relative gravity models

	(1) *international students (ISCED level 5A) in logs*	(2) *international students (ISCED level 5A) in logs*	(3) *international students (ISCED level 5A) in logs*
student population host (ISCED 5A)	0.872	0.865	0.892
	(9.10)**	(8.84)**	(9.29)**
student population sender (ISCED 5A	0.767	0.761	0.741
	(7.51)**	(7.46)**	(7.27)**
distance	-0.874	-0.905	-0.895
	(4.60)**	(4.71)**	(4.60)**
border	0.811	0.748	0.772
	(3.35)**	(3.10)**	(3.21)**
shared language	0.459	0.482	0.457
	(1.37)	(1.42)	(1.35)
relative higher education expenditure	1.289	1.428	1.471
	(4.15)**	(4.83)**	(4.96)**
relative tuition	0.006	0.016	0.014
	(0.28)	(0.73)	(0.62)
relative educational opportunities	-0.197	-0.229	-0.252
	(1.07)	(1.23)	(1.35)
relative relative impact 1999-2001	0.895		
	(1.68)		
relative SR top 200		0.006	
		(1.83)	
relative THES top 200			0.003
			(0.97)
scandinavia - host	0.071	0.251	0.228
	(0.28)	(1.04)	(0.94)
meditteranean - host	-0.280	-0.351	-0.361
	(0.92)	(1.22)	(1.23)
new EU members - host	-1.167	-1.418	-1.435
	(2.96)**	(4.21)**	(4.26)**
non EU members - host	-0.278	-0.547	-0.539
	(0.73)	(1.63)	(1.58)
uk - host	1.086	0.948	0.953
	(3.81)**	(3.52)**	(3.71)**
scandinavia - sender	0.429	0.345	0.342
	(1.63)	(1.38)	(1.35)
mediterranean - sender	-0.604	-0.489	-0.484
	(2.06)*	(1.75)	(1.73)
new EU members - sender	-1.989	-1.666	-1.595
	(4.28)**	(5.03)**	(4.82)**
non EU member - sender	0.652	0.858	0.839
	(1.35)	(1.80)	(1.75)
uk - sender	0.240	0.258	0.307
	(0.51)	(0.55)	(0.65)
Constant	-10.728	-9.415	-9.530
	(5.01)**	(4.50)**	(4.57)**
Observations	242	242	242
R-squared	0.74	0.74	0.74

Notes: Robust t statistics in parentheses; * significant at 5%; ** significant at 1%

TABLE IV

Gravity models with absorptive capacity

	(1) *international students (ISCED level 5A) in logs*	(2) *international students (ISCED level 5A) in logs*	(3) *international students (ISCED level 5A) in logs*
student population host (ISCED 5A)	1.007	0.631	1.054
	(10.61)**	(3.71)**	(7.33)**
student population sender (ISCED 5A	0.820	0.764	0.754
	(8.49)**	(8.32)**	(8.00)**
distance	-0.960	-0.901	-1.053
	(5.66)**	(5.23)**	(5.78)**
border	0.801	0.842	0.757
	(3.68)**	(3.76)**	(3.46)**
shared language	0.485	0.402	0.397
	(1.80)	(1.37)	(1.44)
higher education expenditure per student - host	1.971	1.638	2.087
	(5.86)**	(5.21)**	(6.24)**
tuition fees - host	0.015	0.148	0.049
	(0.47)	(4.08)**	(1.65)
educational opportunities (ISCED level 5) - sender	0.005	0.006	0.007
	(1.30)	(1.62)	(1.77)
relative impact 1999-2001 - host	2.026		
	(2.28)*		
relative impact interacted with high sender quality	-0.089		
	(0.50)		
relative impact interacted with low sender quality	0.655		
	(2.18)*		
SR top 200 institutions - host		0.135	
		(3.29)**	
SR top 200 interacted with high sender quality		-0.018	
		(1.05)	
SR top 200 interacted with low sender quality		0.047	
		(1.96)	
THES top 200 institutions - host			0.004
			(0.10)
THES top 200 interacted with high sender quality			-0.020
			(1.11)
THES top 200 interacted with low sender quality			0.031
			(1.37)
scandinavia - host	0.117	1.249	0.497
	(0.39)	(4.22)**	(1.86)
meditteranean - host	-0.199	0.092	-0.582
	(0.63)	(0.26)	(1.45)
new EU members - host	-0.373	-0.571	-1.284
	(0.61)	(1.11)	(2.19)*
non EU members - host	-0.304	-1.333	-0.936

	(0.79)	(4.30)**	(3.04)**
uk - host	0.953	-0.569	0.787
	(3.77)**	(1.27)	(1.15)
scandinavia - sender	0.413	0.273	0.268
	(1.89)	(1.26)	(1.23)
mediterranean - sender	0.055	0.157	0.240
	(0.19)	(0.59)	(0.88)
new EU members - sender	-0.798	-0.455	-0.395
	(2.47)*	(2.50)*	(2.18)*
non EU member - sender	0.413	0.398	0.394
	(1.69)	(1.58)	(1.51)
uk - sender	0.298	0.354	0.416
	(0.77)	(0.99)	(1.07)
Constant	-32.631	-23.912	-31.090
	(9.19)**	(6.28)**	(8.32)**
Observations	255	255	255
R-squared	0.79	0.80	0.79

Notes: Robust t statistics in parentheses; * significant at 5%; ** significant at 1%

variable for a sender in the low end of the quality range and a dummy for a sender in the high end of the quality range.[11] These dummies are then interacted with host country quality. We expect both coefficients of these interacted quality indicators to be negative. Table IV contains the regression results.

The coefficient on host quality interacted with high sender quality is, as expected, negative, though insignificant. The coefficients on host quality interacted with low sender quality are, contrary to expectations, positive. For the relative impact indicator and the Shanghai ranking count the coefficients are positive at the 5% level (although only borderline for the Shanghai ranking). As before, the THES count remains insignificant. The results suggests that, at least for the European countries considered in this sample, the gaps in quality are not so strong that they pose absorptive capacity problems. European countries with lower educational quality are not absorptive capacity constrained to send students to higher quality host countries; on the contrary, student flows originating in countries with low educational quality seem to be even more strongly guided by quality considerations.

[11] High and low sending country dummies are created for relative impact and for Shanghai and THES ranking top 200. The low quality dummy is 1 for countries with relative impact < 0.8 and for countries with no universities in the rankings' top 200. The high quality dummy is 1 for countries with relative impact > 1 and for countries with more than 5 universities in the rankings' top 200. Our results are robust to variations in these criteria.

Advanced research students

Lastly, we check whether the effect of quality is the same for students in advanced research studies, such as doctoral students (ISCED level 6). Students enrolled in advanced research programmes are typically older than ISCED level 5A and may have different preferences**.** Particularly, we would expect these students to be more sensitive to the research quality of their host institutions. Table V compares results for both types of students. The first three columns display the regression results for student flows at ISCED level 6, the last three show the same results for ISCED level 5A. As not all the countries in our sample report incoming foreign students at ISCED level 6, the comparable sample for these specifications is smaller than in the previous analyses. More specifically Germany, Greece and the Netherlands have missing data for ISCED level 6, and therefore have to be excluded from the comparable sample. As a consequence of the sample restriction, the relative impact indicator loses significance for ISCED level 5A students. The Shanghai indicator, and this time the THES indicator also, are significant at the 5% level.

Surprisingly, none of the quality indicators are even remotely close to significance at ISCED level 6. For ISCED level 6 students, again a clear 'UK-effect' can be discerned. The UK attracts significantly more ISCED level 6 students than the base group, whereas this effect is not so strongly present for ISCED level 5A students. We checked whether the presence of this 'UK-effect' is what makes the quality indicators insignificant (results reported in table BIII in appendix). Omitting the UK dummy indeed makes all three quality indicators highly significant for ISCED 6, while the results remain largely unaffected for ISCED level 5A. This may suggest that the quality of PhD programs in the UK is high relative to equivalent programs in other countries of our sample. Students who continue their studies into ISCED level 6 programmes may view a degree from a UK university as particularly more valuable than a similar degree from another country.

Also contrary to ISCED 5A students, lack of educational opportunities at home seems to significantly drive ISCED 6 student flows: an increase in available places in the sending country of 1 percentage point would on average lead to a decrease of the number of outgoing students of almost 13%. No significant effects are found for educational

TABLE V

Comparison ISCED level 6 and ISCED level 5A

	(1) *International students (ISCED level 6) in logs*	(2) *international students (ISCED level 6) in logs*	(3) *international students (ISCED level 6) in logs*	(4) *international students (ISCED level 5A) in logs*	(5) *international students (ISCED level 5A) in logs*	(6) *international students (ISCED level 5A) in logs*
student population host (ISCED 6)	0.973	0.998	0.972	1.041	0.624	0.532
	(7.95)***	(8.47)***	(7.03)***	(7.32)***	(3.23)***	(2.15)**
student population sender (ISCED 6)	0.666	0.665	0.665	0.749	0.747	0.750
	(8.46)***	(8.54)***	(8.54)***	(6.10)***	(6.15)***	(6.07)***
distance	-1.064	-1.037	-1.034	-0.962	-0.955	-0.959
	(5.66)***	(5.38)***	(5.32)***	(5.07)***	(5.01)***	(5.11)***
border	0.678	0.686	0.684	0.840	0.864	0.825
	(2.95)***	(2.87)***	(2.87)***	(3.23)***	(3.30)***	(3.19)***
shared language	-0.100	-0.102	-0.097	0.178	0.148	0.204
	(0.42)	(0.42)	(0.40)	(0.50)	(0.41)	(0.58)
higher education expenditure per student - host	-0.003	0.154	0.170	1.900	1.431	1.280
	(0.01)	(0.51)	(0.56)	(3.49)***	(3.68)***	(3.36)***
tuition fees - host	-1.467	-1.411	-1.428	-0.584	0.060	0.054
	(3.82)***	(3.69)***	(3.76)***	(0.90)	(0.10)	(0.09)
educational opportunities - sender	-0.126	-0.127	-0.127	0.001	0.001	0.001
	(5.13)***	(5.14)***	(5.13)***	(0.13)	(0.12)	(0.12)
relative impact 1999-2001 - host	-1.810			5.448		
	(0.73)			(1.60)		
SR top 200 institutions - host		0.017			0.107	
		(0.51)			(1.91)*	
THES top 200 institutions - host			0.027			0.144
			(0.58)			(1.71)*
scandinavia - host	-8.915	-8.709	-8.812	-4.316	0.534	0.562
	(3.56)***	(3.42)***	(3.48)***	(0.97)	(0.13)	(0.14)
meditteranean - host	-0.240	-0.031	0.070	0.142	-0.057	0.379
	(0.85)	(0.13)	(0.23)	(0.29)	(0.16)	(0.63)
new EU members - host	-4.722	-3.716	-3.649	0.211	-1.048	-0.852
	(3.50)***	(5.79)***	(5.26)***	(0.13)	(1.11)	(0.80)
non EU members - host	9.551	9.553	9.661	4.294	-0.743	-0.573
	(3.84)***	(3.72)***	(3.78)***	(0.94)	(0.19)	(0.15)
uk - host	2.582	2.059	1.849	0.830	-0.175	-1.199
	(4.40)***	(3.43)***	(2.12)**	(1.49)	(0.20)	(0.83)
scandinavia - sender	0.022	0.018	0.018	0.572	0.568	0.576
	(0.15)	(0.12)	(0.13)	(2.27)**	(2.26)**	(2.29)**
mediterranean - sender	1.195	1.178	1.177	0.465	0.460	0.466
	(5.78)***	(5.54)***	(5.49)***	(1.43)	(1.43)	(1.43)
new EU members - sender	0.249	0.249	0.249	-0.084	-0.087	-0.080
	(1.50)	(1.50)	(1.50)	(0.45)	(0.47)	(0.42)
non EU member - sender	0.189	0.189	0.188	0.483	0.484	0.483
	(1.09)	(1.08)	(1.08)	(1.55)	(1.55)	(1.55)
uk - sender	-0.225	-0.228	-0.228	0.324	0.323	0.322
	(0.83)	(0.85)	(0.85)	(0.70)	(0.70)	(0.70)

Constant	5.869	1.832	1.968	-30.403	-20.273	-17.924
	(0.85)	(0.41)	(0.45)	(3.43)***	(3.18)***	(2.75)***
Observations	169	169	169	169	169	169
R-squared	0.87	0.87	0.87	0.74	0.74	0.74

Notes: Robust t statistics in parentheses; * significant at 5%; ** significant at 1%

opportunities at the host country. Educational opportunities for PhD students therefore seem to operate mostly as a push factor at the level of the sending country, less as a pull factor.[12]

Conclusion

Although the existing literature on international student flows mentions the importance of quality differentials in the decision to study abroad, few empirical studies explicitly include a measure of university quality. We use an extended gravity model to assess to what extent quality of higher education helps explain flows of international students between countries.

We find that quality of the host country, measured by the relative impact of a country's publications and especially the number of universities a country has in the top 200 of the Shanghai ranking, is indeed a factor that determines the size and direction of student flows in a sample of 18 European countries. Quality of the destination is especially important for students from countries with a low score on quality indicators. Using the number of institutes in the Times Higher Education Ranking as an indicator for quality yields no significant results. This is mainly attributable to its skew in favor of the UK. For the mobility patterns of students in advanced research studies (e.g. doctoral students), once the 'UK-effect' is accounted for, quality does not seem to be a significant explanatory factor. Educational opportunities (or lack thereof) are important factors driving outward flows of PhD students.

From a European policy perspective, our findings imply that removing barriers to student mobility in Europe could indeed have a positive effect on university quality in the mid to long run, as international flows of tertiary students seem to be guided – amongst other things - by quality considerations. Or vice versa, if the aim is to stimulate intra-EU mobility of students, promoting excellence in research quality is perhaps the most efficient instrument to motivate students to move around in the EU.

[12] Regression results are available from the authors upon request.

This research suffers from the drawbacks of conducting a macro-level analysis of a multi-faceted phenomenon. Heterogeneity among institutions, fields and regions is concealed by the use of national data. Our findings should therefore be seen as a part of bigger research agenda. Much as we would like to conclude that student mobility is guided by quality considerations, we can only conclude that at the macro-level, several different quality indicators appear to help explain the size and direction of student flows. To confirm the former, bolder conclusion, additional research at the micro- and meso-level should be done. For this, comparable data for European universities of quality indicators as well as student in-and out-flows would be most welcome.

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Appendix A – International Standard Classification of Education (ISCED 1997)

The International Standard Classification of Education (ISCED) was designed by UNESCO in the early 1970's to serve 'as an instrument suitable for assembling, compiling and presenting statistics of education both within individual countries and internationally'. It was approved by the International Conference on Education (Geneva, 1975), and was subsequently endorsed by UNESCO's General Conference when it adopted the Revised Recommendation concerning the International Standardization of Educational Statistics at its twentieth session (Paris, 1978). The present classification, now known as ISCED 1997, was approved by the UNESCO General Conference at its 29th session in November 1997.

Level 5: First stage of tertiary education (not leading directly to an advanced research qualification)

This level consists of tertiary programmes having an educational content more advanced than those offered at levels 3 (upper secondary education) and 4 (post-secondary non-tertiary education). Entry to these programmes normally requires the successful completion of ISCED level 3A or 3B or a similar qualification at ISCED level 4A.

For the definition of this level, the following criteria are relevant:

(i) normally the minimum entrance requirement to this level is the successful completion of ISCED level 3A or 3B or ISCED level 4A;

(ii) level 5 programmes do not lead directly to the award of an advanced research qualification (level 6); and

(iii) these programmes must have a cumulative theoretical duration of at least 2 years from the beginning of level 5.

There is a distinction between the programmes which are theoretically based/research preparatory (history, philosophy, mathematics, etc.) or giving access to professions with high skills requirements (e.g. medicine, dentistry, architecture, etc.) (level 5A), and those programmes which are practical/technical/occupationally specific (level 5B).

ISCED level 5A programmes are tertiary programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements. They must satisfy a sufficient number of the following criteria:

(i) they have a minimum cumulative theoretical duration (at tertiary) of three years' full-time equivalent, although typically they are of 4 or more years. If a degree

has 3 years' full-time equivalent duration, it is usually preceded by at least 13 years of previous schooling (see paragraph 35). For systems in which degrees are awarded by credit accumulation, a comparable amount of time and intensity would be required;

(ii) they typically require that the faculty have advanced research credentials;

(iii) they may involve completion of a research project or thesis;

(iv) they provide the level of education required for entry into a profession with high skills requirements or an advanced research programme.

Qualifications in category 5B are typically shorter than those in 5A and focus on occupationally specific skills geared for entry into the labour market, although some theoretical foundations may be covered in the respective programme.

The content of ISCED level 5B programmes is practically oriented/occupationally specific and is mainly designed for participants to acquire the practical skills, and know-how needed for employment in a particular occupation or trade or class of occupations or trades - the successful completion of which usually provides the participants with a labour-market relevant qualification.

A programme should be considered as belonging to level 5B if it meets the following criteria:

(i) it is more practically oriented and occupationally specific than programmes at ISCED 5A, and does not provide direct access to advanced research programmes;

(ii) it has a minimum of two years' full-time equivalent duration but generally is of 2 or 3 years. For systems in which qualifications are awarded by credit accumulation, a comparable amount of time and intensity would be required;

(iii) the entry requirement may require the mastery of specific subject areas at ISCED 3B or 4A; and

(iv) it provides access to an occupation.

Level 6 – Second stage of tertiary education (leading to an advanced research qualification)

This level is reserved for tertiary programmes which lead to the award of an advanced research qualification. The programmes are therefore devoted to advanced study and original research and are not based on course-work only.

It typically requires the submission of a thesis or dissertation of publishable quality which is the product of original research and represents a significant contribution to knowledge. It prepares graduates for faculty posts in institutions offering ISCED 5A programmes, as well as research posts in government, industry, etc.

Appendix B – Robustness checks

Table BI

Robustness checks – alternative quality indicators

	(1) *international students (ISCED level 5A) in logs*	(2) *international students (ISCED level 5A) in logs*	(3) *international students (ISCED level 5A) in logs*	(4) *international students (ISCED level 5A) in logs*	(5) *international students (ISCED level 5A) in logs*	(6) *international students (ISCED level 5A) in logs*
student population host (ISCED 5A)	1.008	1.229	1.166	0.764	1.056	1.004
	(10.50)**	(10.89)**	(13.47)**	(6.68)**	(9.74)**	(9.15)**
student population sender (ISCED 5A	0.732	0.730	0.732	0.773	0.776	0.732
	(8.29)**	(8.43)**	(8.40)**	(9.23)**	(8.97)**	(8.26)**
distance	-0.704	-0.768	-0.690	-0.926	-0.846	-0.776
	(3.88)**	(4.54)**	(3.73)**	(5.12)**	(4.31)**	(4.36)**
shared border	0.852	0.817	0.862	0.679	0.750	0.814
	(3.62)**	(3.61)**	(3.58)**	(2.77)**	(2.95)**	(3.42)**
shared language	0.622	0.564	0.577	0.360	0.295	0.613
	(2.27)*	(2.06)*	(2.09)*	(1.28)	(1.08)	(2.25)*
higher education expenditure per student - host	2.004	1.955	1.836	0.934	0.950	2.052
	(6.22)**	(5.56)**	(5.37)**	(2.48)*	(2.38)*	(6.10)**
tuition fees - host	0.014	0.111	0.040	-0.018	0.041	0.054
	(0.43)	(2.95)**	(1.33)	(0.43)	(0.91)	(1.79)
educational opportunities (ISCED level 5) - sender	0.006	0.007	0.006	0.006	0.005	0.007
	(1.70)	(1.78)	(1.66)	(1.47)	(1.34)	(1.73)
citations per publication 1999-2001	1.056					
	(2.62)**					
SR top 500 institutions - host		-0.027				
		(3.13)**				
SR quality indicator (population)			0.554			
			(2.94)**			
THES quality indicator (population)				-0.342	-0.170	
				(2.52)*	(1.20)	
THES top 200 institutions - host						0.043
						(2.41)*
uk - host	0.748	1.128	0.442	1.272		
	(2.71)**	(3.95)**	(1.54)	(4.26)**		
scandinavia - host	0.024	0.816	0.069	-0.300	0.101	0.529
	(0.08)	(2.84)**	(0.24)	(0.96)	(0.32)	(2.09)*
meditteranean - host	-0.281	-0.971	-0.395	-1.648	-1.650	-0.540

	(0.89)	(3.59)**	(1.43)	(2.96)**	(2.71)**	(1.78)
new EU members - host	-0.195	-1.760	-0.310			-1.013
	(0.31)	(3.58)**	(0.57)			(2.12)*
non EU members - host	-0.228	-1.461	-0.614	-0.476	-0.683	-0.858
	(0.58)	(4.16)**	(1.87)	(1.26)	(1.75)	(2.67)**
uk - sender	0.226	0.247	0.208	-0.212	-0.314	0.248
	(0.56)	(0.59)	(0.51)	(0.54)	(0.75)	(0.59)
scandinavia - sender	0.250	0.244	0.242	0.130	0.100	0.256
	(1.25)	(1.25)	(1.21)	(0.67)	(0.48)	(1.27)
mediterranean - sender	0.170	0.188	0.165	0.279	0.221	0.202
	(0.64)	(0.74)	(0.62)	(1.19)	(0.89)	(0.76)
new EU members - sender	-0.103	-0.116	-0.107	-0.327	-0.343	-0.109
	(0.69)	(0.81)	(0.74)	(2.23)*	(2.35)*	(0.73)
non EU member - sender	0.362	0.365	0.367	0.237	0.244	0.363
	(1.52)	(1.55)	(1.54)	(1.15)	(1.10)	(1.50)
Constant	-34.038	-33.806	-34.819	-15.453	-21.036	-32.038
	(10.26)**	(10.56)**	(10.34)**	(3.16)**	(4.27)**	(9.40)**
Observations	255	255	255	204	204	255
R-squared	0.79	0.79	0.79	0.77	0.74	0.78

Notes: Robust t statistics in parentheses; * significant at 5%; ** significant at 1%

TABLE BII

Robustness checks – sending country quality

	(1) *international students (ISCED level 5A) in logs*	(2) *international students (ISCED level 5A) in logs*	(3) *international students (ISCED level 5A) in logs*
student population host (ISCED 5A)	1.007	0.608	1.049
	(10.84)**	(3.60)**	(7.37)**
student population sender (ISCED 5A	0.746	0.620	0.783
	(8.30)**	(5.21)**	(6.94)**
distance	-0.955	-0.825	-0.997
	(5.65)**	(4.82)**	(5.64)**
border	0.778	0.848	0.785
	(3.57)**	(3.85)**	(3.60)**
shared language	0.497	0.385	0.397
	(1.80)	(1.32)	(1.42)
higher education expenditure per student - host	1.979	1.613	2.071
	(6.10)**	(5.01)**	(6.13)**
tuition fees - host	0.015	0.152	0.050
	(0.48)	(4.12)**	(1.66)
educational opportunities (ISCED level 5) - sender	0.004	0.007	0.007
	(1.13)	(1.84)	(1.73)
relative impact 1999-2001 - host	2.133		
	(2.43)*		
relative impact 1999-2001 - sender	-1.697		
	(2.58)*		
SR top 200 institutions - host		0.151	
		(3.79)**	
SR top 200 - sender		0.033	
		(1.24)	
THES top 200 institutions - host			0.009
			(0.21)
THES top 200 - sender			-0.045
			(1.16)
scandinavia - host	0.109	1.253	0.486
	(0.37)	(4.14)**	(1.79)
meditteranean - host	-0.209	0.082	-0.612
	(0.67)	(0.23)	(1.53)
new EU members - host	-0.378	-0.530	-1.280
	(0.63)	(1.05)	(2.23)*
non EU members - host	-0.299	-1.351	-0.935
	(0.76)	(4.20)**	(2.93)**
uk - host	0.949	-0.643	0.783
	(3.79)**	(1.44)	(1.15)
scandinavia - sender	0.274	0.362	0.154
	(1.37)	(1.72)	(0.66)
mediterranean - sender	-0.078	0.445	0.057
	(0.27)	(1.59)	(0.16)
new EU members - sender	-0.971	0.068	-0.498
	(2.91)**	(0.30)	(1.65)
non EU member - sender	0.489	0.294	0.350
	(1.74)	(1.14)	(1.34)
uk - sender	0.332	0.146	1.131
	(0.88)	(0.36)	(1.61)

Constant	-30.060 (8.26)**	-22.468 (5.70)**	-31.399 (8.20)**
Observations	255	255	255
R-squared	0.80	0.80	0.78

Notes: Robust t statistics in parentheses; * significant at 5%; ** significant at 1%

Table BIII

Robustness checks – additional ISCED level 6 regressions (excluding UK dummy)

	(1) international students (ISCED level 6) in logs	(2) international students (ISCED level 6) in logs	(3) international students (ISCED level 6) in logs
student population host (ISCED 6)	1.257	0.889	0.815
	(11.42)**	(7.90)**	(7.24)**
student population sender (ISCED 6)	0.667	0.668	0.664
	(8.64)**	(9.10)**	(9.04)**
distance	-0.884	-0.886	-0.881
	(4.02)**	(4.19)**	(4.33)**
shared border	0.544	0.553	0.556
	(2.16)*	(2.22)*	(2.31)*
shared language	-0.040	-0.083	-0.006
	(0.14)	(0.33)	(0.02)
higher education expenditure per student - host	0.697	0.678	0.532
	(2.37)*	(2.35)*	(1.90)
tuition fees - host	-0.515	-0.871	-1.348
	(1.65)	(2.65)**	(3.89)**
educational opportunities (ISCED level 6) - sender	-0.132	-0.133	-0.132
	(5.31)**	(5.55)**	(5.59)**
relative impact 1999-2001 - host	6.671		
	(4.13)**		
SR top 200 institutions - host		0.113	
		(5.38)**	
THES top 200 institutions - host			0.123
			(6.00)**
scandinavia - host	-3.627	-5.265	-8.373
	(1.68)	(2.37)*	(3.60)**
meditteranean - host	0.159	-0.002	0.448
	(0.53)	(0.01)	(1.56)
new EU members - host	0.077	-2.461	-2.868
	(0.09)	(4.41)**	(5.26)**
non EU members - host	4.972	5.867	9.002
	(2.18)*	(2.62)**	(3.84)**
uk - sender	-0.465	-0.462	-0.436
	(1.48)	(1.45)	(1.43)
scandinavia - sender	-0.117	-0.122	-0.110
	(0.79)	(0.87)	(0.80)
mediterranean - sender	1.019	1.016	1.028
	(4.93)**	(5.19)**	(5.46)**
new EU members - sender	0.211	0.207	0.220
	(1.37)	(1.35)	(1.42)
non EU member - sender	0.188	0.197	0.186
	(1.03)	(1.10)	(1.09)
Constant	-18.769	-6.706	-1.629
	(4.31)**	(1.72)	(0.43)
Observations	192	192	192
R-squared	0.83	0.84	0.85

Notes: Robust t statistics in parentheses; * significant at 5%; ** significant at 1%

Figure 1. Inflow – outflow – net inflow of international students (ISCED level 5A)