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The determinants of student mobility in Europe: the quality dimension

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The Bologna Process in Europe aims to increase student mobility, with the purpose of increasing average university quality through fiercer competition for students in a larger, more unified market. However, this beneficial effect of increased student mobility will only occur if student mobility is guided by quality considerations. We examine whether the quality of a country's higher education system helps explain macro-flows of foreign tertiary students in Europe. Using various measures for 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 31 European countries. At the graduate level, however, the driving force for student mobility appears to be the lack of educational opportunities in the home country.

Keywords: school choice; higher education; student mobility; economies of scale; human capital

1. Introduction

In European policy documents, research and higher education are identified as central to help turn the EU into the most competitive economy and knowledge-based society of the twenty-first century.[1] But in a European higher education and research area that still remains too fragmented, European universities currently do not seem to be in a position to achieve their full potential. Whereas the United States experienced a rapid geographic integration in the second half of the twentieth century (Hoxby 2002), Europe's higher education market has remained largely segmented into national or regional markets (Musselin 2004). Operating in segmented local markets, European universities do not have sufficient incentives to develop their strengths. As a result, compared with their counterparts in the US and perhaps soon also China, they run the risk of falling behind in the increased international competition for talented academics and students.

Redressing this fragmentation has been high on the European policy agenda, with mobility of students and researchers a main policy target. The EU's research policy revolves around the building of a European integrated Research and Higher Education Area. The '2020 vision of ERA' (European Research Area), with its 'fifth freedom' concept, or free circulation of knowledge, explicitly targets the integration into a single market for research by improving the mobility of scientific talents. Also the Bologna process, which currently covers 47 European countries, tries to improve

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the comparability and compatibility of Europe's diverse higher education systems, thus facilitating the mobility of students, graduates and higher education staff.

In an integrated market, increased mobility should lead universities to offer a more open and challenging environment to be attractive. Through fiercer competition between a larger number of institutions for the best students and researchers, the overall quality of European universities should increase (Eurydice 2010). However, for this beneficial effect to occur, two conditions must be satisfied: talents should not only be internationally mobile, but they should also be guided by quality in their choice of university.

The purpose of this article is to examine whether the quality of the higher education system indeed 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. As there are yet no standard, commonly accepted measures to assess the quality of universities, we use three different regularly used measures as quality indicators: the relative impact of a country's scientific publications, the number of universities a country has in the top 200 of the Shanghai ranking and 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 article 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.

2. Literature review

To factor in quality of education as a driver of student mobility, we will mostly rely on neo-classical economic theories, using a push-pull, cost-benefit framework and/or a human capital model. In the human capital perspective on education, individuals consider education as an investment decision where education directly increases their human capital (e.g. Becker 1964; Freeman 1987). Students will bear the costs of higher education in order to increase their future earnings and employment opportunities. Within this perspective, students will prefer to attend a high-quality institution if its higher costs are compensated by higher returns. Empirically, the quality of the institution indeed seems to increase returns: a degree from a renowned university is likely to enhance students' salary prospects and open doors to more interesting jobs (Brewer, Eide, and Ehrenberg 1999) on top of the existing higher education wage premium (Krueger and Lindahl 2001).

A student that considers attending a higher education programme in a different location than the home country must incorporate extra costs of international mobility into her investment decision. All else equal, internationally mobile students should be more sensitive to the quality dimension, as higher expected returns to education must compensate for the higher costs they incur.

Other strands in the social sciences literature such as social capital theory, stress that migrants are attracted to locations where similar social networks of the same ethnic group or country are located. This strand shows that once initiated, migration flows tend to persist in a cumulative causation process (Massey 1999). Another

strand in the social sciences literature see migration flows from poor dependent countries (periphery) to dominant wealthy countries (centres). Countries at the centre ensure their dominant position by policies to attract talent, draining the peripheral countries and perpetuating/exacerbating inequalities. These theories have been mostly applied to flows between developing and developed countries, particularly on colonial ties. But as Docquier and Rapoport (2012) show, highly skilled migration need not lead to more inequality, as it generates positive network externalities. Who gains and who loses depends to a large extent on the public policies adopted in the sending and the receiving countries.

Few empirical migration studies have explicitly factored in quality differentials as a driver of international student flows. Most econometric studies of international student mobility have been concerned with the determinants and effects of flows of students from developing countries to industrialized countries (Cummings 1984; Lee and Tan 1984; Agarwal and Winkler 1985; McMahon 1992; Naidoo 2007; Docquier and Rapoport 2012). 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.

A few studies based on survey data discuss the motivations of students to go abroad as well as the factors that encourage or inhibit this mobility. These studies generally confirm the importance of quality dimensions: differences in quality between a foreign degree and a domestic one are found to be one of the main motivations for students from developing countries to go abroad (Gordon and Jallade 1996; Aslanbeigui and Montecinos 1998; Kemp, Madden, and Simpson 1998; Bourke 2000; Mazzarol and Soutar 2000; Szelényi 2006).

As higher education quality differentials are likely to be smaller among industrialized countries than between developing and industrialized countries, it remains to be seen whether the importance of the quality dimension remains valid for flows within Europe. Few econometric studies on student flows within developed countries include the quality dimension explicitly. Nevertheless, they do find evidence on the importance of 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). A few studies factor in the quality dimension more explicitly. Although it is not the focus of their analysis, Thissen and Ederveen (2008) include a measure of quality among their list of determining factors in their study of intra-EU student mobility. They find that a positive quality differential significantly increases the enrolment of foreign students. Similarly, Rodríguez González, Bustillo Mesanza, and Mariel (2011) study the determinants of Erasmus student flows within Europe, and find that the number of top-ranked universities in a host country is a significant pull factor in the destination choice of Erasmus students. However, we believe that regular student mobility (i.e. students who enrol for a full programme abroad, as opposed to the Erasmus programme where students spend one or two semesters abroad but remain enrolled in their home university) is driven to a greater extent by university quality, as

the prestige of the foreign institution will be reflected in these students' final diploma. Erasmus mobility is arguably driven more by consumption motives, as illustrated by the significant attraction of countries with a warmer climate (Rodríguez González et al. 2011).

In conclusion, although the theoretical human capital literature and the qualitative 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, especially for more developed countries such as those in the European Higher Education Area.

3. Methodology and data

3.1. Level of analysis

To test whether university quality is one of the reasons for tertiary students to go abroad, ideally we should compare the quality of the institution the student attends abroad to the alternative options available to the student. This requires a large set of data covering a sufficient number of institutions in several countries. Lacking individual choice data, we take an alternative approach using macro-level data. The use of data at the national level has the substantial drawback that we no longer observe the individual institutions that foreign students attend, and therefore do not know whether a particular foreign student attends a high-quality or a low-quality institution. We only observe whether countries with better university systems *on average* attract significantly larger flows of incoming foreign students, *ceteris paribus*. However, a macro-level analysis remains interesting as it informs policy makers at the European level of the likely impact on the average quality of its higher education system should the ERA and Bologna process substantially increase aggregate student mobility in the future.

3.2. The model

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

$$F_{ij} = \frac{S_i^{\alpha} \times S_j^{\beta}}{D_{ij}^{\gamma}} e^{s_{ij}} \tag{1}$$

with F_{ij} the flow of people from country j to country i, S_i and S_j the respective sizes of countries i and j, D_{ij} the distance between these countries and $e^{s_{ij}}$ the error term. For flows of people, the most often used measure of size is the relevant population, in casu the relevant student population. Big sending countries have more students to send out, whereas big host countries with more students have more infrastructure to absorb a larger number of incoming students. Distance is usually measured by the distance between both countries' capital cities, assuming that capital cities are often large centres of economic and intellectual life within a country. 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 smaller, thus lowering the adjustment costs for the student.

Gravity equations are often loglinearized in empirical applications, so the coefficients are interpreted as elasticities, and extended to include other determining factors. Adding a quality measure of the host country's university system ($QUAL_i$) as well as other characteristics of the host country (HC_i), the sending country (SC_j), and characteristics on the relationship between the host and sender (R_{ij}), yields our final model[2]:

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

Our main variable of interest is the quality of the higher education system of the *host* country as a pull factor ($QUAL_i$).[3] So far, debates are still going on what good indicators are for assessing the quality of the higher education system. No standard empirical measure to capture quality of the higher education system has emerged yet. To measure the quality of the higher education system we will use various indicators, which are detailed in the next sections.

3.3. 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, to which countries supply yearly data on the basis of commonly agreed definitions.

Our dataset contains 31 European countries[4] that all belong to the European Higher Education Area. We use a cross-section of the bilateral flows between these 31 countries for the year 2007 (the most recent year for which complete data are available), which leaves a maximum number of 931 observations.[5]

Students whose nationality differs from that of the country in which they enrol, are counted as foreign students.[6] For the analysis, we are interested in foreign students in tertiary education. The largest number of students is exchanged at the level of tertiary programmes with an academic orientation that gives access to advanced research programmes (International Standard Classification of Education (ISCED) level 5A). This group will be the focus of our analysis. But we also analyse students in the second stage of tertiary education, the PhD level (ISCED level 6). We compare the determinants of international mobility patterns across these two groups of tertiary students and expect the quality dimension to be stronger for the latter group.[7]

Data for the comparable population of tertiary students from the host country (S_i) and the sender country (S_j) are taken from Eurostat as well. A country's student population includes native students enrolled for a full academic year.

Figure 1 shows the major source and destination countries for international flows of tertiary students (ISCED 5A) within our sample. The UK is the largest net importer of European students, sending out only 8400 students to the other countries in our sample but receiving 118,000 in return. Germany is also a major destination for European students, with almost 85,000 foreign students. However, as Germany also sends out a large number of students to other European countries, it is a

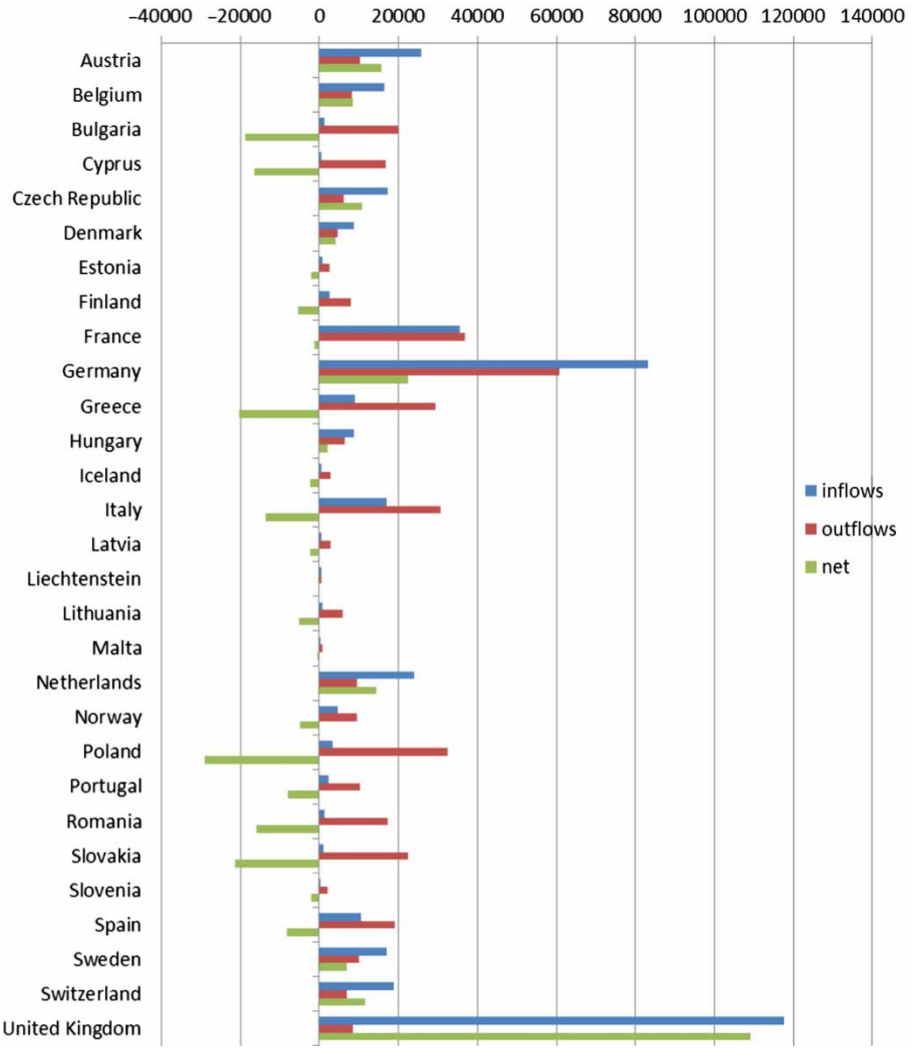

Figure 1. Inflows, outflows and net inflows of foreign students (ISCED level 5A).

considerably smaller 'net importer' of students compared to the UK. Austria, Belgium, Denmark, the Netherlands, Sweden and Switzerland are also net receiving countries. The major net exporters of students are Greece, Poland and Slovakia. While most eastern European countries are net senders, the Czech Republic and Hungary are net importers of students, mostly from other eastern European countries. They appear to serve as regional hubs of higher education in Eastern Europe (Kondakci 2010).

The picture is slightly different for graduate students (ISCED level 6). The number of observations for graduate students is slightly lower, as not all the countries in our sample report incoming foreign students at ISCED level 6. Germany, the Netherlands and Greece, for example, do not report incoming foreign students at this

level. Inflows, outflows and net inflows are displayed in Figure 2. Graduate students appear to be much more oriented towards the UK than undergraduates.[8]

3.4. Measuring the quality of countries' higher education

Which indicators to use to measure and/or rank the quality of universities is still highly debated, particularly in Europe.[9] No standard, commonly accepted (set of) indicators has yet emerged from this debate. To measure the aggregated quality of a country's higher education system, we will use several different indicators, each of which has its problems, but which each been used regularly to assess the quality of universities.

First, we measure the quality of a country's research through citations received to its scientific publications, as citations are widely regarded as an indicator of the

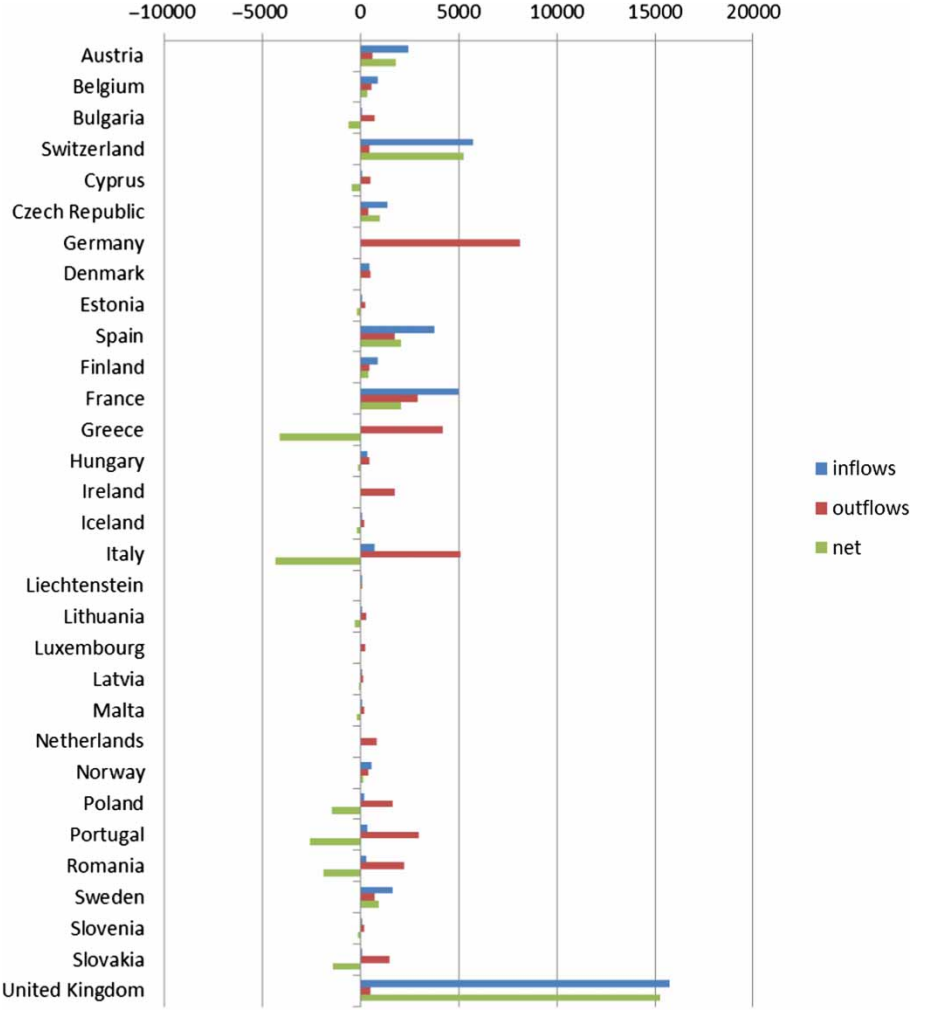

Figure 2. Inflows, outflows and net inflows of foreign graduate students (ISCED level 6).

quality of a publication. Most scientific publications are authored by researchers affiliated to universities. The quality of a country's scientific output should therefore closely reflect the quality of its university faculty more generally.

Students that have the opportunity to witness top quality research may have an advantage over their peers that do not. As excellence in research contributes to a strong academic reputation, a degree from a country with a strong research reputation can be expected to have a higher market value than a degree from a less reputed country. Furthermore, it is not unlikely that excellence in research correlates with quality in tertiary education.

We use publication and citation data 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. The quality measure is constructed as 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*.

The indicator *relative impact* has a number of drawbacks. For countries where a sizable part of academic research is done at research institutions, such as in France or Germany, this measure is probably less adequate. Moreover, the use of citations reflects a specific perspective on research quality, namely through its visibility in the scientific community. It may therefore be too specific for prospective students who are 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 is based on 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. 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 use when they decide which university in which country to apply for. Also Rodriguez Gonzalez et al. (2011) and Thissen and Ederveen (2008) use this indicator to measure the quality of a country's higher education system.

To construct the *Shanghai Ranking* indicator, we count the number of universities a country has in the top 200 of this ranking. 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. Both measures, *relative impact* and *Shanghai ranking*, measure research quality, whereas undergraduate students arguably care more about 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.[10] As a third indicator, we therefore use the number of universities a country has in the THES ranking.

The Shanghai and THES ranking differ somewhat, but not much. In Europe, the UK clearly dominates both rankings, with 23 institutions in the Shanghai ranking and 32 in the THES ranking. Both rankings produce similar results with regard to the lowest scoring countries. The picture provided by the relative impact indicator is more nuanced. Denmark, Finland, Germany, the Netherlands, Sweden, Switzerland and the UK all have scores above 1. All three quality indicators are positively correlated, especially both ranking indicators which have a correlation of 0.98 (cf. Table 1). As in the econometric analysis only the relative values matter rather than the absolute ones, the high correlation between the various indicators suggest that the results will not be sensitive to the specific indicator used.

3.5. Other variables influencing international student mobility

The distance between two countries (D_{ij}) is measured as the bird's eye distance between their capitals. Two variables control for the relationship between the host country i and the sending country j (R_{ij}). 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 her official language is spoken. We therefore 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. Students from border regions may have to travel less far to attend a university across the border than within their home country. Moreover, neighbouring countries often share a certain cultural and linguistic affinity that further lowers migration costs. Both dummies are taken from CEPII's distances database.

The vector SC_j controls for sending country characteristics. We control 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 (Cummings 1984; Lee and Tan 1984; Agarwal and Winkler 1985; McMahon 1992; Naidoo 2007). Educational opportunities are 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 5A. 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. There is little variation in the average educational opportunities of incoming foreign students' sending countries at the undergraduate level: in all countries in our sample, incoming students come from sending countries where on average 75% of students in upper secondary education are likely to pursue an undergraduate degree at the tertiary level (cf. Table 2).

Two control variables account for the host country characteristics HC_i. First, we control for 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 annual higher education expenditure per tertiary student (measured in full-time equivalents for ISCED levels 5 and 6) are taken from Eurostat for the year 2007, and are purchasing power standard-corrected. The difference between western and eastern European countries in terms of spending is stark: whereas most western

Table 1. Average student flows and quality indicators by country.

Country	Average flow of international students	Relative impact	Shanghai ranking count	THES ranking count
Switzerland	624.7	1.37	6	5
Netherlands	822.41	1.15	9	11
Denmark	306.48	1.1	3	3
Sweden	584.76	1.07	4	4
UK	4,045.21	1.06	23	32
Finland	88.24	1.05	1	2
Germany	2,787.07	1.03	14	11
Belgium	546.34	0.96	4	5
France	1,176.62	0.96	7	5
Austria	877.28	0.93	1	2
Italy	585.79	0.92	5	2
Iceland	18.79	0.9	0	0
Ireland	n/a	0.89	0	2
Norway	162.72	0.84	1	1
Spain	368.9	0.79	1	1
Estonia	23.55	0.66	0	0
Hungary	290.77	0.63	0	0
Portugal	80.1	0.63	0	0
Slovenia	4.47	0.58	0	0
Greece	302.6	0.55	0	0
Czech Republic	592.21	0.52	0	0
Cyprus	14.86	0.51	0	0
Poland	116.41	0.49	0	0
Lithuania	27.72	0.46	0	0
Latvia	22.2	0.43	0	0
Bulgaria	46.1	0.37	0	0
Slovakia	39.1	0.36	0	0
Romania	43.82	0.32	0	0
Liechtenstein	15.2	n/a	0	0
Luxembourg	n/a	n/a	0	0
Malta	5.67	n/a	0	0
Correlation with Shanghai ranking		0.50		
Correlation with THES ranking		0.46	0.98	

European countries spend between €10,000 and €15,000 per student in 2007, most eastern European countries spent around €3,000–€5,000 (cf. Table 2). Replacing higher education expenditure per student with a higher education expenditure compared to GDP per capita yields similar results. Second, we include the average amount of tuition in the host country as a measure for the cost of education. Standard economic theory assumes that 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 (Naidoo 2007). In many European countries tuition fees are determined through public intervention and therefore do not necessarily reflect the full cost of providing higher education. The total cost of education for a student also

Table 2. Control variables by country.

Country	Student population	Average distance	Higher education expenditure	Tuition fee	Educational opportunities
Austria	219,691	1,080.34	13,133.40	824.79	0.75
Belgium	185,363	1,207.52	11,208.90	546.50	0.76
Bulgaria	226,923	1,509.57	2,827.30	n/a	0.74
Cyprus	4,989	2,534.52	8,922.50	n/a	0.76
Czech Republic	308,376	1,051.28	6,825.10	0.00	0.74
Denmark	198,052	1,204.14	13,689.30	0.00	0.74
Spain	1,468,942	1,975.90	10,300.60	844.00	0.72
Estonia	42,966	1,590.10	4,339.10	n/a	0.74
Finland	287,216	1,647.76	11,278.60	0.00	0.74
France	1,567,977	1,298.48	10,618.80	1,671.50	0.74
Germany	1,950,468	1,082.31	11,448.40	n/a	0.74
Greece	367,439	1,804.84	n/a	n/a	0.74
Hungary	397,722	1,111.68	n/a	n/a	0.74
Iceland	15,320	2,778.93	7,912.30	1,815.35	0.74
Ireland	130,260	1,631.68	10,501.40	0.10	0.74
Italy	1,983,005	1,385.07	7,210.90	1,342.44	0.74
Liechtenstein	655	1,070.81	8,295.40	n/a	0.74
Lithuania	140,644	1,393.93	4,652.30	n/a	0.72
Latvia	108,458	1,432.76	4,543.90	n/a	0.73
Luxembourg	n/a	1,087.29	n/a	n/a	0.74
Malta	8,336	1,814.71	n/a	n/a	0.74
Netherlands	582,613	1,208.48	13,276.00	1,707.00	0.73
Norway	207,776	1,492.90	14,249.50	614.88	0.73
Poland	2,092,162	1,192.17	3,811.80	n/a	0.73
Portugal	345,120	2,384.65	7,939.80	2,114.44	0.73
Romania	887,526	1,536.55	4,239.30	n/a	0.74
Sweden	371,307	1,452.14	15,265.00	0.00	0.74
Switzerland	157,403	1,115.84	n/a	n/a	0.74
Slovenia	65,757	1,138.00	5,955.10	668.00	0.74
Slovakia	204,645	1,092.52	4,768.00	n/a	0.74
UK	1,747,199	1,387.10	13,015.50	4,694.00	0.75

includes, besides the tuition fees, the cost of books and materials and the cost of living, for which we have no information. As tuition fees nevertheless make up a 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. The data on tuition fees are taken from the OECD's Education at a Glance 2009 and reflect the tuition fees for the academic year 2006/2007. Average tuition fees vary strongly, with the UK charging the highest fee of almost $4,700 and several countries, including Sweden, Denmark and the Czech Republic charging none. Unfortunately, for many countries information on tuition fees is not available, which leads to a significant loss of observations for host countries: 15 out of 31 countries do not report tuition fees.[11]

Last, regional dummies control for regional characteristics of the destination and source countries. The base group is constituted by continental Western Europe

(France, Germany, Belgium, Luxembourg, the Netherlands and Austria). Additionally, we define four regions: Scandinavia, the Mediterranean, the New Member States and non-EU (Norway, Iceland, Switzerland and Liechtenstein). In addition to these regional dummies, we include a dummy for the English-speaking countries in the sample (Ireland and the United Kingdom). As English has acquired the status of *lingua franca* in science over the past century, these countries may be especially appealing for international students.

4. Results

4.1. Basic results

Table 3 reports the regression results of a series of basic gravity models for international student flows at ISCED level 5A. Robust t-statistics are reported between brackets. As a first benchmark, the results from a simple gravity model are reported with size, 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. The Mediterranean countries and the new EU member states receive less international students than the base group, northwestern Europe. By contrast, the English speaking countries receive significantly more students than the base group.

In the second specification (column 2), additional host and sender characteristics are added. Higher education expenditure in the host country has a positive effect on the size of incoming student flows, although the coefficient is only significant at the 10% level. The coefficient for tuition fees is negative and highly significant. Educational opportunities in the sending country have no significant impact, which can probably be explained by the lack of variation in this variable.

We now turn to our main focus of interest, namely the impact of quality on international student flows. Column 3 includes the 'relative impact' measure for research quality of the host country. 'Relative impact' has a strongly positive and significant impact on student flows: a 10% increase in this indicator would on average lead to a 26% increase in the number of incoming students. Column 4 includes the university counts in the top 200 of the Shanghai ranking. The Shanghai ranking indicator also has a positive and significant effect: ceteris paribus, an additional institution in the top 200 increases the number of incoming students by approximately 11%. When the Shanghai ranking top 200 indicator is included, the English speaking host country dummy loses its significance, suggesting that the popularity of the Anglo-Saxon countries among foreign students is explain to a large extent by their high number of high quality institutions (especially in the case of the UK). Finally, column 5 includes the university counts in the THES ranking, as a closer measure for teaching quality. Contrary to the previous two quality measures, the coefficient for the THES ranking is not significantly different from zero. As the THES ranking is more skewed towards British and Irish universities than the Shanghai ranking, we expect this variable to be more affected by multicollinearity

Table 3. Basic gravity models.

Variables	(1) lintstud5a	(2) lintstud5a	(3) lintstud5a	(4) lintstud5a	(5) lintstud5a
Student population – host	0.949***	0.766***	0.675***	0.561***	0.746***
	(0.0797)	(0.0807)	(0.0867)	(0.109)	(0.0868)
Student population – sender	0.680***	0.710***	0.710***	0.709***	0.710***
	(0.0469)	(0.0452)	(0.0449)	(0.0451)	(0.0453)
Distance	−0.733***	−0.726***	−0.687***	−0.712***	−0.726***
	(0.136)	(0.134)	(0.135)	(0.136)	(0.134)
Shared border	1.002***	0.881***	0.946***	0.935***	0.892***
	(0.344)	(0.321)	(0.323)	(0.324)	(0.325)
Shared language	0.496	0.589	0.593	0.615	0.597
	(0.442)	(0.426)	(0.429)	(0.434)	(0.426)
Higher education expenditure		0.776*	1.013**	1.125***	0.749*
		(0.424)	(0.414)	(0.420)	(0.430)
Tuition fee		−0.167***	−0.195***	−0.203***	−0.172***
		(0.0493)	(0.0506)	(0.0519)	(0.0506)
Educational opportunities		−0.425	−0.419	−0.423	−0.423
		(0.304)	(0.301)	(0.301)	(0.304)
Relative impact			2.425***		
			(0.785)		
Shanghai ranking count				0.110***	
				(0.0357)	
THES ranking count					0.0228
					(0.0274)
Host – Scandinavia	−0.142	−1.844***	−2.344***	−2.010***	−1.837***
	(0.177)	(0.495)	(0.522)	(0.502)	(0.495)
Host – Mediterranean	−1.256***	−0.774***	−0.0758	−0.0949	−0.653**
	(0.187)	(0.244)	(0.315)	(0.329)	(0.282)
Host – new member state	−2.526***	−3.035***	−2.013***	−2.620***	−2.968***
	(0.294)	(0.434)	(0.522)	(0.440)	(0.432)
Host – non EU	0.365	1.793***	2.445***	2.116***	1.864***
	(0.250)	(0.489)	(0.540)	(0.505)	(0.504)
Host – English speaking	1.366***	1.784***	1.782***	0.129	1.223*
	(0.261)	(0.278)	(0.280)	(0.572)	(0.683)
Sender – Scandinavia	0.311	0.410*	0.397*	0.411*	0.412*
	(0.209)	(0.215)	(0.213)	(0.212)	(0.215)
Sender – Mediterranean	0.353	0.540*	0.514*	0.537*	0.541*
	(0.248)	(0.281)	(0.281)	(0.280)	(0.281)
Sender – new member state	0.274	0.404**	0.396**	0.408**	0.406**
	(0.169)	(0.197)	(0.196)	(0.195)	(0.197)
Sender – non EU	0.339	0.378	0.378	0.377	0.378
	(0.253)	(0.243)	(0.239)	(0.238)	(0.243)
Sender – English speaking	−0.00297	0.0505	0.0494	0.0565	0.0526
	(0.238)	(0.210)	(0.211)	(0.208)	(0.210)
Constant	−10.62***	−14.61***	−18.18***	−15.67***	−14.19***
	(1.604)	(4.369)	(4.276)	(4.262)	(4.457)
Observations	435	435	435	435	435
R-squared	0.759	0.773	0.776	0.776	0.773

Notes: Robust t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

with the English speaking host country dummy. Omitting the English speaking host dummy indeed makes the THES ranking country positive and significant (cf. appendix Table A1, column 6).

Overall, the results confirm a significant and sizeable impact of the quality of the destination country's higher education and research system on flows of incoming tertiary students.

4.2. Robustness of the results with respect to the quality indicators

We check the robustness of our results with alternative constructions of the quality indicators.[12] 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. Including 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 is still positive and significant but smaller. Top quality therefore seems a stronger attractor than average quality. Although our specification already includes a correction for size through S_i, we also include a size-corrected measure for the Shanghai ranking as constructed by Aghion et al. (2007). The coefficient remains positive and significant. The same indicator constructed with the THES ranking turns out negative and significant, but again the strong UK-effect appears to be behind this result.

Overall, our result that the quality of a host country's higher education system helps explain the size and direction of student flows at ISCED level 5A seems fairly robust to variation in construction of the quality indicators.[13]

4.3. Advanced research students

Lastly, we check the effect of quality for students in advanced research studies (ISCED level 6). We expect these students to be more sensitive to the research quality of their host institution. Table 4 displays the results for the basic gravity models at ISCED level 6 in the first three columns. Surprisingly, the quality indicators are a lot less significant at ISCED level 6: only the ranking indicators are significant at the 10% level. In the first specification, with the relative impact indicator, there is a strong and highly significant English-speaking host country effect. In the last three columns we check whether the presence of this English-speaking host dummy is what makes the quality indicators insignificant. Omitting this dummy indeed makes all three quality indicators highly significant for ISCED 6. This high correlation between the quality effect and the UK/English-speaking host dummy effect is reminiscent of the observation that the flow of students at ISCED 6 is heavily concentrated on the UK as destination and that the quality of PhD programmes in the UK is high relative to equivalent programmes in other countries of our sample.

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 by almost 16%. Availability of educational opportunities for PhD students therefore seem to be a significant push factor for explaining international mobility of PhD students in Europe.

Table 4. ISCED level 6.

Variables	(1) lintstud6	(2) lintstud6	(3) lintstud6	(4) lintstud6	(5) lintstud6	(6) lintstud6
Student population (graduate) – host	0.859***	0.807***	0.835***	0.977***	0.798***	0.845***
	(0.0799)	(0.0854)	(0.0806)	(0.0751)	(0.0838)	(0.0802)
Student population (graduate) – sender	0.545***	0.546***	0.545***	0.551***	0.546***	0.545***
	(0.0393)	(0.0394)	(0.0395)	(0.0400)	(0.0393)	(0.0393)
Distance	−0.539***	−0.529***	−0.537***	−0.453***	−0.521***	−0.547***
	(0.133)	(0.134)	(0.133)	(0.138)	(0.131)	(0.129)
Shared border	1.078***	1.098***	1.101***	1.092***	1.106***	1.083***
	(0.297)	(0.301)	(0.302)	(0.312)	(0.301)	(0.297)
Shared language	0.119	0.119	0.103	0.0922	0.116	0.114
	(0.297)	(0.302)	(0.307)	(0.308)	(0.303)	(0.299)
Higher education expenditure	0.665	0.825*	0.626	0.906*	0.889**	0.606
	(0.470)	(0.464)	(0.444)	(0.468)	(0.441)	(0.443)
Tuition fee	0.0744	0.0628	0.0710	0.137***	0.0618	0.0720
	(0.0519)	(0.0526)	(0.0518)	(0.0485)	(0.0525)	(0.0518)
Educational opportunities (graduate)	−15.88***	−15.99***	−15.96***	−16.16***	−16.04***	−15.88***
	(2.949)	(2.938)	(2.939)	(2.976)	(2.927)	(2.937)
Relative impact	0.657			2.328**		
	(1.008)			(0.980)		
Shanghai ranking count		0.0594*			0.0751***	
		(0.0351)			(0.0146)	
THES ranking count			0.105*			0.0516***
			(0.0630)			(0.0102)
Host – Scandinavia	0.588	0.601	0.739	0.733	0.592	0.709
	(0.523)	(0.496)	(0.497)	(0.524)	(0.497)	(0.494)
Host – Mediterranean	−0.713**	−0.614**	−0.506	−0.724**	−0.567**	−0.668**
	(0.333)	(0.281)	(0.316)	(0.333)	(0.274)	(0.274)
Host – new member state	−0.794	−0.836*	−0.705	0.240	−0.757*	−0.909**
	(0.649)	(0.466)	(0.504)	(0.605)	(0.431)	(0.434)

Table 4 (*Continued*)

Variables	(1) lintstud6	(2) lintstud6	(3) lintstud6	(4) lintstud6	(5) lintstud6	(6) lintstud6
Host – non EU	−0.0854	−0.0811	0.00515	−0.0103	−0.0513	−0.112
	(0.513)	(0.462)	(0.472)	(0.521)	(0.467)	(0.467)
Host – English speaking	1.320***	0.329	−1.499			
	(0.309)	(0.690)	(1.774)			
Sender – Scandinavia	−0.204	−0.207	−0.205	−0.253	−0.212	−0.200
	(0.208)	(0.206)	(0.207)	(0.215)	(0.206)	(0.207)
Sender – Mediterranean	0.695***	0.689***	0.693***	0.617***	0.682***	0.702***
	(0.226)	(0.226)	(0.224)	(0.226)	(0.224)	(0.224)
Sender – new member state	0.0264	0.0240	0.0256	−0.0172	0.0206	0.0296
	(0.167)	(0.167)	(0.167)	(0.170)	(0.167)	(0.166)
Sender – non EU	0.0307	0.0297	0.0299	0.0268	0.0292	0.0306
	(0.239)	(0.237)	(0.238)	(0.249)	(0.237)	(0.238)
Sender – English speaking	−0.297	−0.298	−0.296	−0.358*	−0.302	−0.293
	(0.185)	(0.183)	(0.183)	(0.202)	(0.184)	(0.184)
Constant	−13.37***	−13.96***	−12.55***	−19.15***	−14.57***	−12.19***
	(4.998)	(4.513)	(4.349)	(4.826)	(4.245)	(4.279)
Observations	392	392	392	392	392	392
R-squared	0.766	0.767	0.767	0.757	0.767	0.767

Notes: Robust t statistics in parentheses; *significant at 10%, **significant at 5%, ***significant at 1%.

5. 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 significantly determines the size and direction of student flows in a sample of 31 European countries. 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 favour of the UK. For the mobility patterns of students in advanced research studies, the quality effect is heavily correlated with the 'UK-effect,' as the UK is the dominant destination country. Educational opportunities (or lack thereof) are an important factor 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 improving university quality in the medium-to-long term as international flows of tertiary students are significantly guided by quality considerations.

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, better, comparable data for European universities of quality indicators as well as student in-and out-flows would be most welcome.

Notes

1. See, for example, the EU's Communication on the EU2020 strategy (http://ec.europa.eu/europe2020/index_en.htm).
2. All independent variables expressed as ratios are not converted to logarithms.
3. We have tested the relevance of quality as a push factor from the sending country, as well as relative quality measures, but none were significant.
4. Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Liechtenstein, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden, Switzerland, and the United Kingdom. Neither Ireland nor Luxembourg report data on incoming foreign students, but will nevertheless be included in the sample as sending countries.
5. Although the data are also available for an, albeit limited, range of years (2004–2007), the variation over time in this range is very limited. This strong persistency in the short run prohibits a useful panel data analysis.
6. There are two issues with respect to this type of measurement. First, children of immigrants who were born and educated in a country but who retain their parents' foreign

nationality are counted as foreign students. Second, students who spend time abroad as part of an exchange program (e.g. ERASMUS) are not counted in this database.

7. We exclude tertiary students at ISCED level 5B from the population, as these students are enrolled in more practically oriented courses and have a very different in profile from other tertiary students. They are less likely to become internationally mobile, as reflected by the small volume of international students exchanged at this level.
8. A Herfindahl index for comparable samples at the undergraduate and graduate level confirms that the graduate market is much more concentrated in the UK than the undergraduate market (a Herfindahl index of 0.39 versus 0.29, respectively).
9. See e.g. http://www.euractiv.com/innovation-enterprise/new-eu-university-rankings-chall-news-505851.
10. Although the inclusion of international staff and students may introduce endogeneity with incoming student flows, its weight in the total ranking score is small (5%) and thus contributes relatively little to a university's final ranking.
11. An alternative is to use the comparative price level index. The advantage of the comparative price level index is that it is available for almost all countries in our sample, but we consider it too broad for the purpose of our study. Using the comparative price level index instead of tuition fees generates very similar results, but in our basic models we choose to retain tuition fees as it is a more precise measure to capture (part of) the cost at the tertiary level.
12. Tables are available from the authors upon request.
13. A more detailed discussion and additional robustness checks are available from the authors upon request. Additional robustness checks include sender quality effects, relative quality effects, and non-linear quality effects. All robustness checks leave our basic findings unchanged.

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