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EUI Working Paper **RSCAS** 2019/49

ISSN 1028-3625

Printed in Italy, July 2019
European University Institute
Badia Fiesolana
I – 50014 San Domenico di Fiesole (FI)
Italy
www.eui.eu/RSCAS/Publications/
www.eui.eu
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Abstract

International student flows from emerging and developing countries have grown tremendously over the last decades. In this paper, we address the question of whether donors, who might care about the potential brain drain effects student emigration entails in the countries of origin, can affect the student outflows through their foreign aid activities. Employing standard gravity-type approaches of international migration, we separately analyse the impact of scholarships for students from developing countries, and of development projects in recipient countries aimed at improving the local quality of tertiary education. We find that these two types of post-secondary aid lead to opposite effects on student mobility. Investing in the quality of tertiary education in recipient countries appears to be associated with lower outflows of tertiary educated students to donor countries, which corroborates previous research showing that aid may reduce emigration from developing countries if it improves public services. The provision of in-donor scholarships obviously raises student mobility for the duration of the university education abroad, but our results suggest that the student inflows also translate into permanent immigration of highly educated people.

Keywords

Aid, International Student Mobility, Permanent Immigration

JEL: F22, F35, O15

1. Introduction*

Recent years have seen an unprecedented growth in international student flows. In 2017, 4.6 million international students were enrolled worldwide, three times the number in 1999 (OECD, 2017). This increase has been driven by students from emerging economies such as India and China predominantly moving to English-speaking OECD countries (UNESCO, 2018). For the destination countries, international students constitute a source of talent that can help spur economic growth (e.g. Docquier and Rapoport, 2012). They therefore have an incentive to attract talented students, who are likely to stay and work in the host country once they have completed their studies (Rosenzweig, 2008). In the countries of origin, a permanent outflow of students could give rise to a brain drain. Origin countries may also experience a brain gain if a significant share of international students returns with human capital that could not have been acquired at home (Beine et al., 2014).

In this paper, we depart from the assumption that OECD countries are not only interested in attracting international students but also care about the potential brain drain effects this might entail in the countries of origin. Specifically, we address the question of whether and how they affect student flows from emerging and developing countries by means of their foreign aid activities. The paper thereby links the literature on the determinants of international student mobility (e.g. Beine et al., 2014; Rosenzweig, 2008) to the literature on aid and migration (e.g. Berthelemy et al., 2009; Lanati and Thiele, 2018a).

The contribution of the paper is threefold. First, employing a standard gravity model of international migration, we separately analyse the impact of transferred vs non-transferred foreign assistance for tertiary education on international student mobility. The latter primarily includes scholarships that cover studying costs in donor countries, while the former encompasses all the development projects in recipient countries aimed at improving the quality of tertiary education locally. We find that these two different types of aid lead to opposite effects on student mobility. Investing in the quality of tertiary education in emerging economies appears to lead to lower outflows of tertiary educated students to donor countries, which is in line with previous research showing that aid may reduce migrant flows if it improves public services (Gamso and Yuldashev, 2018a; Gamso and Yuldashev, 2018b; Lanati and Thiele; 2018a; Lanati and Thiele, 2018b). Not surprisingly, the delivery of foreign assistance in the form of in-donor scholarships is associated with increasing emigration from emerging economies.

Second, while it is fairly obvious that the provision of in-donor scholarships raises student mobility at least for the duration of the studies abroad, the key question from a development policy perspective is whether it leads to a permanent transfer of talent to advanced economies. To approach this question, we build on Beine et al. (2011) and run gravity-type regressions linking past inflows of international students to the (change in the) number and skill composition of emigrants permanently residing in 18 OECD countries. We find a positive and quantitatively important association between student inflows and permanent migration for the high skilled. This finding is in line with Rosenzweig (2008) and suggests that countries of destination are at least in part driven by the motive to attract foreign talent rather than fostering development.

Third, with the exception of Moullan (2013), who considers the emigration of physicians, all previous studies on the relationship between aid and migration have focused on aggregate migrant flows. Such a macro-oriented analysis can hardly control for all the confounding factors that affect the aid-migration link. By following Moullans' general approach and regressing student flows on aid for post-secondary education, we are better able to identify the exact relationship we are interested in and at the same time obtain the specific information required for drawing policy conclusions.

* The authors are grateful to Martin Ruhs and Axel Dreher for helpful comments and suggestions. We also thank Melissa Siegel, Andrew Geddes and the participants at the 2019 MPC Annual Conference at the European University Institute.

The remainder of the paper is structured as follows. In Section 2, we briefly discuss the previous literature that is related to our study. Section 3 describes the method and data employed in the econometric analysis and provides some descriptive statistics, while Section 4 reports our regression results including a number of robustness checks. Section 5 concludes.

2. Related Literature

Our paper speaks to two different strands of literature, namely the one on the *determinants of international student mobility* and the one on the *impact of foreign assistance on migration decisions*.

To the best of our knowledge, this is the first study that focuses on origin-specific determinants of student mobility using a multi-year, multi-origin and multi-destination structural gravity model of international migration. In a similar setting, Beine et al (2014) stress the dyadic and destination-specific determinants of student emigration and find that the underlying gravity factors shaping migration in general are also important forces behind the pattern of international student mobility.[1] In particular, they find a strong network effect: the presence of country nationals at destination strongly attracts international students. Rosenzweig (2008) looks at both origin and destination specific determinants of student mobility to the US employing cross sectional data for the year 2004. His results suggest that the gap in skill prices between the US and origin countries as well as the provision of under-graduate higher education in the countries of origin trigger international student mobility. In addition, Rosenzweig (2008) argues that international students are likely to stay and work in the host country once they have completed their studies. Differences in skill prices between the origin and destination countries also turn out to be a major determinant of stay rates of students and their effect is relatively large: doubling the skill price in the origin country decreases the stay rate in the US, relative to the stock, by 32 to 41 percent. A recent contribution by Beine et al (2018) analyzes the determinants of international student mobility at the university level for Italy as one single destination. Their evidence supports the important role of destination-specific variables such as fees, quality of the education, host capacity, the expected return of education, the cost of living and the existence of education programs taught in English. Abbott and Silles (2016) obtain gravity estimates for a sample of 18 countries of destination and 38 countries of origin over the period 2005–11; their most notable finding is that time zone differences play an important role for student mobility. Based on a larger country coverage for the years 2004-2009, Perkins and Neumayer (2014) find that migration costs typically have a larger (negative) impact on emigration of students from developing countries and that a country's position in university rankings only marginally affects international student mobility.

In contrast to most of the studies that focus on the effect of foreign assistance on the migration decision, our empirical analysis considers heterogeneity not only in foreign aid (aid on post-secondary education) but also in the migration variable (international student mobility). The only existing study with a similar framework is Moullan (2013), who examines the impact of foreign assistance targeted at the health sector on the emigration rates of physicians. Using a large panel data set that covers the period 1998–2005, he shows that the relationship between the two variables is significantly negative, pointing to the ability of donors to mitigate the medical brain drain.

Moullan's finding is in accordance with the notion that non-monetary dimensions of well-being such as improved public services constitute important factors in peoples' decision to migrate (Dustmann and Okatenko, 2014). Foreign aid might therefore dampen emigration from poorer countries if it leads to improved public services (*public services channel*). In addition to the public services channel, aid may also affect migration decisions through changes in income. If aid raises incomes in recipient countries, the impact on migration is expected to exhibit a U-shaped pattern (e.g. Hatton and Williamson, 2002; Clemens, 2014). The logic of this so-called migration hump is as follows: at low levels of development,

[1] In a similar vein, using five years of student inflow data (1997-2002) in Germany, Bessey (2007) finds that many of the determinants of immigration location choices (e.g. network effects, distance) also explain international student mobility.

additional income is likely to enable a larger share of the population in the countries of origin to finance migration costs (*budgetary constraint channel*), raising the number of people who leave. At higher development levels, the fact that rising domestic incomes provide an incentive to stay at home because of lower potential income gains to be achieved abroad (*income channe*l) eventually becomes more important than budgetary constraints that prevent people from emigrating. Since the threshold at which the income-migration relationship turns negative has been estimated to be broadly in the range of 8,000-10,000 US Dollars in purchasing power parities (Clemens and Postel, 2018), rising incomes are likely to be associated with higher emigration rates in the vast majority of aid-receiving countries.

To disentangle the channels through which foreign aid affects migration, recent empirical research has accounted for the heterogeneity of foreign assistance by disaggregating it along sectoral lines while retaining aggregate migration as the dependent variable (see Lanati and Thiele, 2018a; Lanati and Thiele, 2018b; Gamso and Yuldashev, 2018a; Gamso and Yuldashev, 2018b). The main common message of all these contributions is that the impact of foreign aid on aggregate migration tends to manifest itself through improved public services that create incentives for people to stay in their home countries rather than leaving. There is no evidence of empirically relevant income-enhancing effects of foreign aid that might give rise to increased emigration by allowing would-be migrants to finance the costs of moving to destination countries. In other words, among all the different ways in which aid might affect migration, the public services channel appears to predominate.

Lanati and Thiele (2019) focus on another important dimension of heterogeneity, namely whether or not the delivery of foreign aid is actually associated with a transfer of resources to the recipient country. Running separate gravity-type regressions for transferred and non-transferred aid, Lanati and Thiele (2019) find that the (negative) impact of foreign assistance on migration is driven predominantly by its transferred component. This approach is very close to the one proposed in this paper: in the following empirical analysis we disaggregate aid for post-secondary education into in-donor scholarships that – by definition - are spent within donor borders and assistance that is transferred to the recipient country.

3. Method and Data

Our econometric specification relies on a standard gravity model of international migration (e.g. Beine and Parsons 2015), where bilateral student emigration rates from recipient *i* to donor *j* are a function of dyadic (OD_{ijt-1}) as well as origin-specific factors (O_{it-1}), which in our case includes the overall post-secondary per-capita aid received by country *i*. The baseline specification is given by:

$$\ln(\mathrm{EM}_{ijt}) = \alpha_i + \alpha_{jt} + \ln(\mathrm{O}_{it-1}) * \Delta + \ln(\mathrm{OD}_{ijt-1}) * \vartheta + e_{ijt} \qquad (1)$$

We are not including destination characteristics, as the impact of those factors will be absorbed by the inclusion of destination-time fixed effects. Among the dyadic determinants we distinguish time-varying migrant network effects, which we capture by the pre-determined stock of migrants from country *i* living in country j, from a time-invariant component of migration costs proxied by physical and linguistic distance as well as past colonial relationships. The bilateral stocks of immigrants born in country *i* and resident in country *j* are from the World Bank Bilateral Migration Dataset, which provides cross-sections for a limited number of years.[2] In order to match the information on migrant networks with student mobility we have interpolated observations to fill in missing values in intermediate years. Along the lines of Berthelemy et. al. (2009), we also add a trade intensity variable, measured by the bilateral export from the country of emigration to the country of immigration, which proxies for economic inter-connectedness between sending and receiving countries.

[2] The yearly cross-sections from the World Bank dataset are for the years 1960, 1970, 1980, 1990, 2000, 2010, 2013 and 2017. See for more information http://www.worldbank.org/en/topic/migrationremittancesdiasporaissues/brief/migration-remittances-data

In addition to the aggregate aid received by country i, we consider a standard set of origin-specific control variables. These comprise socioeconomic push factors – *GDP per capita* and the *share of unemployed* people – a set of variables that control for the quality of governance – *political stability* and *voice and accountability* – and a proxy for the quality of tertiary education, the *number of Top 500 universities* according to the Shanghai World University rankings. The latter variable is meant to capture the capacity of national universities with an international reputation to train students to the highest international standards that make them eligible for graduate training abroad. Table A1 in the appendix includes sources as well as a brief description of all the variables used in the empirical analysis.

The disaggregated analysis we pursue has potential limitations that are a consequence of the research question, i.e. the aim to explain student mobility in response to different types of foreign aid. While the share of in-donor scholarships in post-secondary education is fairly substantial (see Figure 2), the exclusion of all the volume of transferred assistance in Equation (1) may lead to biased estimates due to model mis-specification. To address this omitted variable bias, we follow Aleksynska and Peri (2014) and use the fact that the value of in-donor scholarships in tertiary education is equal to aggregate aid multiplied by the corresponding share of in-donor scholarships), i.e. In-Donor Scholarships = Aggregate Aid*In-Donor Scholarships Share. Hence, by taking logs and using log properties, we can separate the effect into two terms: ln (Aggregate Aid) + ln (In-Donor Scholarships Share).

The sample used in the subsequent empirical analysis includes 23 donor countries (student destinations) and 120 recipient countries (student origins). The period under consideration is 2008–2015. Emigration rates are calculated as the ratio of annual bilateral student inbound flows (source: UIS UNESCO) over the population of the official age for tertiary education in the country of origin. [3] [4] UNESCO defines student inbound flows as the annual number of internationally mobile students by country of origin enrolled in destination country universities. While data on student inbounds certainly has some limitations (see for instance Perkins and Neumayer, 2014), they are the best and most comprehensive measure of international student flows available.[5]

For our foreign aid variable, data are gross disbursements of foreign assistance in post-secondary education expressed in constant US dollars from the CRS OECD dataset for sectoral disaggregated flows. Non-reported values of ODA are treated as zeros. We distinguish in-donor scholarships from the resources that actually reach the recipient country by subtracting *scholarships and student costs in donor countries* from *total* ODA in post-secondary education. We take two-year averages for the total aid received to account for the volatility of annual aid flows. Foreign assistance is also pre-determined with respect to student mobility as it plausibly takes time for scholarships to be awarded and for aid projects to affect the decision to move. Specifically, total aid received at time t -1 is the 2-year average between t-1 and t-2. Including lags also at least partly addresses concerns that our aid variable may be endogenous due to reverse causality. In addition, it has to be noted that only the bilateral part of the total ODA

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[3] Bhargava and Docquier (2008) as well as Moullan (2013) compute the rate of medical brain drain *m* for country *i* in time period *t* as $[m_{it}/(P_{it} + m_{it})]$ where m_{it} denotes the stock of physicians from country i working abroad and P_{it} denotes the number of physicians working in the home country. Since we do not have a complete bilateral student mobility matrix, we are not able to compute the correspondent rate for bilateral student emigration. Hence, we prefer to normalize bilateral student flows with the population of the official age. The first stage of our two-step strategy presented in this paper includes origin*year fixed effects which completely absorb the denominator of the dependent variable, making the choice regarding the normalization irrelevant.

[4] Population of the official age in tertiary education is available until 2015 (source: UIS UNESCO) which limits the time span for our regression analysis. See http://data.un.org/Data.aspx?d=UNESCO&f=series%3ASAP_56

[5] The UNESCO definition of student inbounds relates to *stocks* rather than *inflows* of international students, and these two measures are in principle not directly comparable (see OECD 2018, p.31 for a discussion). However, data on the number of issued residence permits - which is arguably the more accurate measure of international student flows - do not exist at the bilateral level. In addition, given the large set of fixed effects used in the econometric specification (including dyadic fixed effects), identification comes mostly from the *within* dimension of the data; therefore, our empirical analysis deals mostly with the changes over time of bilateral stocks of enrolled international students, which justifies the use of the UNESCO data.

country i receives is potentially affected by migration from country i to country j, e.g. because migrants successfully lobby the government in the destination country to allocate more aid to their country of origin (Lahiri and Raimondos-Møller 2000). Reverse causality should thus not be a major issue in our estimation, but we still refrain from making strong causal claims regarding the link between aid and student mobility.[6]

To further attenuate potential estimation biases, we include origin (α_i) as well as destination-time (α_{jt}) fixed effects. In particular, the inclusion of α_{jt} absorbs the impact of migration policies, which are likely to be significant drivers of student mobility but for which data are not readily available. These policies include both measures to attract students to come and study and to encourage them to stay and enter the labour market after graduation.[7] The inclusion of the fixed effects also allows us to account for multilateral resistance to migration, i.e. the fact that the choice of a potential migrant to move to a given destination country does not only depend on the attractiveness of the country of destination relative to the country of origin, but also on how this relates to the opportunities to move to other destination. Failing to do so could lead to significant biases in the estimated coefficients of the gravity model (Bertoli and Fernandez-Huertas Moraga, 2013). The inclusion of destination-time fixed effects will completely account for multilateral resistance to migration in receiving countries, which is likely to be the most important factor in the context of international migration, given the key role that migration policies of the destination country play (Beine and Parsons, 2015).

We choose OLS as our baseline estimator for the econometric analysis. The number of zeros in the dependent variable amounts to around 9 percent of the total number of observations.[8] Hence, taking logs of emigration rates in the dependent variable is unlikely to cause a considerable loss of information that could create severely biased results due to a possible selection bias. As a robustness check, Table A2 in the Appendix compares the gravity results across different econometric techniques – Poisson PML, Gamma PML and EK Tobit – that allow for the inclusion of zeros. For this exercise we rely on the standard Anderson and Van Wincoop gravity model with origin*year and destination*year fixed effects, which directly builds on previous studies examining the bilateral determinants of international migration (see Beine et al., 2016) and constitutes the first-stage of the two-step strategy we use in one of our robustness checks below.[9] We find only minor differences in the results of alternative estimators as compared to OLS, suggesting that our baseline estimates are not severely biased by the presence of country pairs with zero flows.[10]

To estimate in a second step the extent to which the emigration of students from developing countries leads to a permanent loss of talent, we follow Beine et al. (2011) and run gravity-type cross-section regressions linking past inflows of international students to the (change in the) number and skill composition of emigrants permanently residing in 18 OECD countries. The gravity specification reduces to

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6 The standard procedure to deal with the issue of reverse causality is to use instrumental variables. However, in our baseline gravity setup, we would have to look for an instrument that has an *ijt* dimension, while our aid variable is origin-specific. As an alternative, we tried an instrumentation strategy for the second stage of our two-step approach we use for a robustness check below, in which the dependent variable varies over time and across countries of origin (see Table 6). Along the lines of Dreher et al. (2019) and Dreher and Langlotz (2019), we created an instrument by interacting donor-government fractionalization and recipient countries' probability of receiving aid for post-secondary education. Yet, as indicated by Cragg Donald F statistics of only around one, the instrument turned out to be extremely weak. Hence, we decided not to include the results in the paper, even though the estimated coefficients are in a plausible range.

7 See OECD (2018) for some examples and a discussion about the implementation of such measures in OECD countries.

8 This refers to our baseline estimates of Equation 1.

9 In Table A6 we conduct a similar analysis in which we add bilateral aid in post-secondary education as additional dyadic regressor. While this entails a considerable reduction in the sample size, the results remain similar across estimators.

10 EK Tobit is the estimator where results are closest in magnitude to OLS. Conversely, PPML is the estimator exhibiting the largest gaps in the coefficients. As Aleksinska and Peri (2014) pointed out, PPML produces consistent estimates only if the error terms satisfy the log normality and homoscedasticity conditions, which are indeed very strong assumptions.

$$\ln(\mathrm{S}_{ij(l)}) = \beta_i + \beta_j + \ln(\mathrm{OD}_{ij}) * \gamma + \epsilon_{ij(l)} \quad (2)$$

$S_{ij(l)}$ is the difference in bilateral stocks of emigrants by skill level *l* between t-5 (2005) and t (2010), which is regressed on the average of bilateral student inflows between t-10 (2000) and t-5 (2005), controlling for a standard set of dyadic variables such as bilateral migrant networks (2005), and including destination and origin fixed effects.[11] Data on bilateral stocks of high-skilled emigrants are from Brücker et al. (2013) and available only for a selected number of OECD destinations.[12] An issue that may potentially affect the estimates of Equation (2) is the presence of omitted factors that are correlated both with lagged number of enrolled students (2000-2005) and the error term $\epsilon_{ij(l)}$.[13] To check the robustness of our results, we proceed to an IV-2SLS estimation of equation (2), in which we consider two instruments that are plausibly linked to the number of enrolled students and unrelated to the change in bilateral stocks of emigrants at destination. One instrument – the observed size of diaspora in 1970 – closely resembles the one used by Beine et al. (2011).[14] In addition, we include the number of enrolled students in 1998, the earliest year available in the dataset on international student mobility provided by the OECD.[15] The rationale behind the inclusion of the latter instrument is that, on the one hand, the number of students enrolled in 1998 exerts a strong impact on the number of enrolments in the period 2000-2005. On the other hand, it is highly unlikely that those early student inflows influence the more recent changes in bilateral migrant stocks (2005-2010) over and beyond the impact exerted by the size of the student diaspora itself. Our set of instruments clearly passes the F-test for the relevance of instruments, and the Hansen J-test of orthogonality with the residuals points to instrument validity in particular for the stocks of high-skilled immigrants.

Descriptive Analysis

Our analysis focuses on ODA in post-secondary education, which encompasses *aid for higher education* – i.e. degree and diploma programmes at universities, colleges and polytechnics as well as scholarships – and *advanced technical and managerial training* – i.e. professional-level vocational training programmes and in-service training.[16] Donors seem to prioritize foreign assistance in post-secondary education compared to other levels of education (see Figure 1). Even aid spent on basic education, which has played a key role in supporting the Millennium Development Goal of achieving uniform primary school enrolment, has become slightly greater in volume only in very recent years. Most of the foreign assistance in post-secondary education is not transferred to recipient countries but is spent within donor

[11] The dependent variable in Equation (2) inevitably leads to negative migration flows when the difference in stocks declines over time. As Beine and Parsons (2015) pointed out, negative values might be a result of migrants returning home, moving on to a third-party country, or dying. We plausibly assume that both deaths and return migration are small relative to net flows. To the best of our knowledge, given the existing data on bilateral stocks of emigrants, this assumption is impossible to test. Nevertheless, in our sample negative values are only 8% of total observations, which makes us confident that our proxy accurately reflects actual bilateral flows.

[12] The selected OECD countries are: Australia, Austria, Canada, Chile, Denmark, Finland, France, Germany, Greece, Ireland, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.

[13] In principle, the size of diaspora could also be endogenous. However, Beine et al. (2011) found that there are no major differences between OLS and IV estimates of the coefficients for the diaspora variable. Hence, the focus of our instrumental variable strategy will be on our main variable of interest, the lagged student inflows.

[14] A description of the instruments and the corresponding data sources is included in Table A1.

[15] The OECD provides data on the number of international students from various origins enrolled in OECD countries. This data source is available from 1998 to 2012. Given that for this instrumental variable there are no data available on tertiary educated students enrolled in Chile, Greece, the Netherlands and Portugal, the sample size of our IV analysis is smaller than the one of the baseline estimate.

[16] Table A3 reports the DAC sectoral classification of aid for education.

borders in the form of scholarships and student costs (see Figure 2).[17] In the period 2006-2016 the share of transferred aid resources in post-secondary education was in the range of 30-40%. However, this portion varies considerably across recipients. In Table A4 we list the top 30 recipients of aid in post-secondary education and the correspondent shares of foreign assistance that translate into development projects in the students' countries of origin. While for most recipients in-donor scholarships are predominant, in some countries - like Pakistan, Nigeria, Tanzania, Afghanistan, Jordan and Bangladesh – the portion of transferred resources exceeds 50%.

Some of the main recipients of ODA for post-secondary education are also among the top sending countries of tertiary educated students. In particular, China and India have been the top two sending countries over the period 2006-2016, while other emerging economies - such as Viet Nam, Malaysia, Pakistan, Bangladesh and Nigeria – featured among the top 20 in each year of the period under consideration. As previous research has already highlighted, students tend to move predominantly to OECD countries where the quality of universities as well as the skill price are relatively higher (see Beine et al., 2014).[18] Figure 3 shows that this pattern holds for students from both OECD and non-OECD origins.

4. Regression Results

In presenting the regression results, we start with a base specification of the determinants of student mobility along the lines of Equation (1), then consider the extent to which student mobility translates into permanent immigration based on estimates of Equation (2), and finally add a number of robustness checks.

Baseline results for student mobility

Table 1 reports the baseline estimates for student movements to OECD destinations using a Pooled OLS approach.[19] Column (1) shows that the aggregate volume of foreign assistance in post-secondary education is positively associated with student mobility from emerging economies. Not surprisingly, the disaggregated analysis that distinguishes between in-donor scholarships from transferred assistance (Columns 2-3) shows that the aggregate results presented in Column (1) are completely driven by the provision of funds for tertiary educated students to study in donor countries. The volume of transferred assistance in post-secondary education seems to have no effect on student emigration. However, the specification in Column (3) does not include the volume of scholarships that accounted for between 60% and 70% of total ODA in post-secondary education in the period 2006-2016 (see Figure 2) and whose exclusion may bias the transferred aid coefficient upwards. In Columns 4-5 we present the estimates of our preferred specification, in which the effect of the shares of in-donor vs transferred assistance are estimated controlling for the total volume of ODA in post-secondary education. The results suggest that – while the share of in-donor scholarships has the predicted positive effect – the

[17] Other types of foreign assistance can also be counted as "*non-transferred*" (see Qian 2015 and Lanati Thiele 2019), including *Administrative Costs* and *Donor Country Personnel*, but their volume is negligible in the post-secondary education sector.

[18] The OECD sample includes the following (destination) countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.

[19] In the regression analysis we follow Beine and Parsons (2015) and estimate Equation (1) with heteroscedasticity robust standard errors. Head and Mayer (2014) argue that in a one-step gravity equation setup, the error term is likely to be correlated across destinations for a given origin, leading to downward-biased standard errors. To address this issue, they suggest clustering standard errors by country of origin. Accordingly, we re-estimate the baseline specification with standard errors clustered by country of origin in a robustness test (Table A5). The t statistics of the origin-specific coefficients – including those of our variables of interest – are only marginally affected, which we find reassuring.

portion of ODA transferred to recipient countries is negatively associated with student emigration. In other words, investing in the quality of tertiary education in emerging economies through the provision of foreign assistance leads to lower outflows of tertiary-educated students to donor countries. This finding is in line with Rosenzweig (2008) and the predictions of the human capital mobility theory: The better the quality of tertiary education in the country of origin, the lower the skill-price ratio between donor and recipient country, and the lower in turn the incentives for students to get a university degree in advanced economies. Our findings also provide additional support for the importance of the public services channel through which foreign aid has previously been shown to affect the decision to migrate (see Section 2 above).

Among the control variables, all dyadic determinants of student mobility have the expected sign and are statistically significant. A larger diaspora, a common language, a colonial relationship, and bilateral trade relations all spur the emigration of students. Conversely, the larger the distance between origin and destination (i.e., the greater the migration costs), the lower, on average, is student mobility. The number of top-500 universities is the only statistically significant origin-specific variable; its positive sign confirms our hypothesis that this variable proxies the ability of national university systems to prepare students to enter international universities. With the exception of unemployment, which has previously been shown to be a push factor for would-be migrants, the insignificance of economic and institutional characteristics at origin is in accordance with parts of the existing literature (e.g. Beine and Parsons, 2015; Lanati and Thiele, 2018a).

The model outlined in Equation (1) is suitable for estimating the impact of total aid received by countries of origin on bilateral student emigration rates. Hence, the bilateral outflows of tertiary educated students, say from Nigeria to the United Kingdom, may be influenced by bilateral aid flows from donors other than the United Kingdom if the aid is transferred to Nigeria rather than being used for scholarships. In order to isolate the effect of bilateral aid for post-secondary education on student mobility, we estimate a standard structural gravity model a la Anderson and Van Wincoop (2003) with origin*year and destination*year fixed effects. Bilateral aid and the correspondent shares of in-donor and transferred foreign assistance are included in the model along with the other standard gravity variables that control for geographic and cultural proximity. As can be seen from columns 2 and 3 of Table 2, the baseline results hold when not accounting for spillover effects in the regression analysis.[20] This is to be expected for scholarships where spillovers do not play a role, but is remarkable for aid spent in recipient countries. Previous research (Berthelemy et al., 2009; Lanati and Thiele, 2018a) has revealed that bilateral aid relationships are characterised by substantial network effects: more bilateral contacts through the implementation of aid projects increase the information on the donor country and thereby lower transaction costs for would-be migrants. The negative effect of transferred aid on student mobility we obtain therefore implies that incentives to stay provided by improvements in local education systems are strong enough to more than offset any positive network effects.

Student mobility and permanent immigration

While scholarships only provide for temporary residence, many students stay beyond their university education. According to estimates by the OECD (Figure 4), the stay rates in 2008/2009 were between 20 and 30 percent in most of the countries for which data were available. Table 3 shows the extent to which students who emigrate add to the stock of permanent immigrants in countries of destination. We find that past inflows of international students have a positive effect on the (change in the) number of

[20] The difference in the sample size when we do (Table 1) or do not (Table 2) account for spillover effects, is due to the relatively high share of non-reported (zero) values of bilateral aid flows in post-secondary education. Since the Anderson and Van Wincoop model only has a dyadic dimension, when taking the log of bilateral aid all the zeros drop out automatically from the specification. On the contrary, when accounting for spillover effects, we are summing up all ODA inflows received by a given recipient from all donors, making the sample size less dependent on the number of dyads with zero aid flows.

emigrants residing in advanced economies.[21] The positive association between student inflows and permanent migration turns out to be particularly strong for the high skilled. As concerns the magnitude of the impact, doubling the number of international student inbounds raises the (difference in the) stock of high skilled emigrants by around 10 percent. This fairly large effect points to considerable success of destination countries in attracting foreign talent. Our results are in line with Rosenzweig (2008), who found for the case of the United States that student stayers constituted about 6 percent of a sample drawn from the over 18-year olds admitted as permanent residents within a seven-month period in 2003, and that these student stayers were highly educated. As a robustness check, Columns 3-4 present the IV-2SLS estimates of Equation 2. The results for total and high-skilled migrants are close to the OLS counterparts and confirm the positive causal impact of student inflows on the (difference in the) stock of emigrants in the countries of destination. Hence, we can conclude that any effective policy – including in-donor scholarships - to attract international students is likely to translate into a permanent loss of talent for developing countries (brain drain).

Accounting for Statistical Problems

One statistical issue is the potential omission of unobserved factors that may be correlated both with the error term and the included time-varying bilateral determinants of student mobility, i.e. migrant networks and bilateral trade relationships. For example, political or cultural proximity – which does not vary much over time and is often difficult, if not impossible, to measure with quantitative data – between countries is likely to be positively correlated with migration and trade flows (see Beine and Parsons, 2015). Along the lines of Lanati and Thiele (2018b) and Faye and Niehaus (2012), we empirically address this issue by including asymmetric destination–origin fixed effects (α_{ij}). The results reported in Table 4 indicate that the time variation of bilateral trade relationships is not a statistically significant determinant of student mobility, while diaspora maintains a positive impact although its magnitude significantly decreases. The estimated impacts of our variables of interest are substantially unchanged, leaving the conclusion of opposite effects of in-donor scholarships vs transferred resources on student mobility intact.

In Table 5, we present a specification with three additional origin-specific controls, the omission of which could in principle and bias our estimates. First, we include aid in secondary education that may also affect university student outflows, because better high schools provide quality training to students who are then more likely to be admitted to post-secondary education programmes, both locally as well as internationally. Our negative and significant estimate suggests that aid-induced improvements in secondary education tend to help students enter the domestic university system rather than preparing them for studying abroad. Yet, the effect is quantitatively small. Second, we follow previous studies (e.g. Lanati and Thiele, 2018a) and consider the presence of conflict as an additional push factor at origin, which is however not significantly associated with student mobility. Finally, we include the pupil-teacher ratio in tertiary education as a proxy for the quality of domestic universities and colleges. The positive and statistically significant coefficient indicates that better prepared students in countries of origin are more likely to pursue their university career in OECD countries. Our estimates for the impact of aid for post-secondary education are robust to the inclusion of all additional control variables.

The second statistical concern relates to the multilateral resistance to migration. While Equation (1) accounts for multilateral resistance at destination through the inclusion of destination*year fixed effects, the condition of cross-sectional dependence or autocorrelation of the error term in Equation (1) may still not be satisfied (see Bertoli and Fernandez-Huertas Moraga, 2013, for a discussion). If we define b (i)

[21] Similarly to Ortega and Peri (2013) we address the presence of zeros (around 20% of total observations) in the dependent variable of Equation (2) by taking the log of one plus our proxy for migration flows. Following Santos Silva and Tenreyro (2006), in a robustness test we check the potential inconsistencies due to the log linearization of gravity models by estimating Equation (2) with Poisson PML. These estimates - available upon request - provide very similar results to the OLS counterparts.

as a nest of countries i characterized by similar characteristics with j, a bilateral shock between j and i may introduce a correlation in the stochastic component of Equation (1). In other words, if the unobserved components that create interdependencies across cross-sections within nests are correlated with the included regressors, the OLS estimator will be biased and inconsistent. To address this issue we propose a two-step strategy where the first stage is a structural gravity model that includes (i) origin-time and then (ii) country-pair dummies.[22] With the fully specified model (ii), in particular, we generate a nest for each country-pair through (α_{ij}), alleviating potential estimation problems deriving from an incorrect gravity specification. The estimated origin time fixed effects (α_{it}) are then regressed on origin specific determinants, including our variables of interest. Table 6 reports the second stage results that are very close to the baseline results presented in Table 1 for our main variable of interest.[23]

Accounting for non-linearities

The analysis conducted so far has identified contrasting effects on student mobility between in-donor scholarships and aid resources transferred to recipient countries. One may expect both effects to differ between richer and poorer countries of origin. The opportunity to study abroad thanks to scholarships or exchange programmes may be particularly attractive for students in poorer contexts characterized by low skill prices and low quality of education, but there may also be fewer students with the skills required for studying abroad. By the same token, improvements in the quality of tertiary education induced by aid projects (new and better universities, opening of new undergraduate and graduate programmes, courses taught in English etc.) would create greater incentives for students to stay particularly in poor areas where those services are most sorely lacking, whereas low quality at primary and secondary levels of education may prevent them from actually capturing the benefits of improved tertiary education. To test for the existence of such non-linearities, we split the sample according to the sample median of income per capita at the origin. As shown in Table 7, there is evidence of a non-linearity in the impact of post-secondary aid on student mobility for non-transferred assistance in particular. As predicted by the human capital approach, scholarships have a larger impact in more deprived areas. By contrast, the share of transferred assistance has a stronger association with student mobility in richer countries, which points to the relevance of minimum conditions in primary and secondary education for post-secondary aid to be effective. Among the control variables, the number of top500 universities is only significant for the richer part of the sample, which simply reflects the absence of such universities in poor countries.

Another dimension along which effects of aid on student mobility may differ is the development level of destination countries. The UNESCO dataset on student mobility includes numerous destinations and thus allows us to compare the impact of different types of post-secondary aid between OECD and non-OECD destinations. Given that non-OECD destinations offer at the same time lower quality in tertiary education and lower skill prices, one may expect to see larger (negative) effects of transferred assistance than on student emigration to advanced economies. This is indeed borne out by our results for transferred aid that helps improve local conditions (Table 8). For in-donor scholarships, the aid coefficients of OECD and non-OECD destinations are fairly similar across destinations but slightly higher for non-OECD countries, which may be due to (a) easier access and lower entry costs and (b) the fact that the largest recipients of in-donor scholarships (e. g. India and China) are those countries that also exhibit the highest student propensity to move internationally. The most notable difference between the two country groups is that the number of top-500 universities is positively related to student mobility only in OECD countries where entry into universities arguably is more competitive and pre-qualifications of students therefore matter.

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[22] A detailed discussion of the two-step approach applied to gravity models is included in Head and Mayer (2014).

[23] First stage estimates are available in Table A2.

5. Concluding Remarks

In this paper, we have analyzed whether donors can affect the migration decision of students from developing countries, distinguishing in-donor scholarships and foreign aid spent within recipient countries on tertiary education. Our empirical analysis suggests that these two types of post-secondary aid lead to opposite effects on student mobility. Investing in the quality of tertiary education in recipient countries appears to be associated with lower outflows of tertiary educated students to donor countries, which corroborates previous research showing that aid may reduce emigration from developing countries if it improves public services. The provision of in-donor scholarships obviously raises student mobility for the duration of the university education abroad, but our results suggest that the student inflows also translate into a sizeable permanent immigration of highly educated people, which points to a transfer of talent from recipient to donor countries.

As concerns development policy, donors then have two basic options if their objective is to mitigate any brain drain effects that might occur in recipient countries: They can re-orient their aid allocations towards improving local systems of higher education in (low-income) recipient countries, or they can provide additional incentives for students to return to their home countries after having finished their university education abroad. To what extent such incentives work and how they should be designed has not yet been investigated in a systematic way, which suggests a promising avenue for future research.

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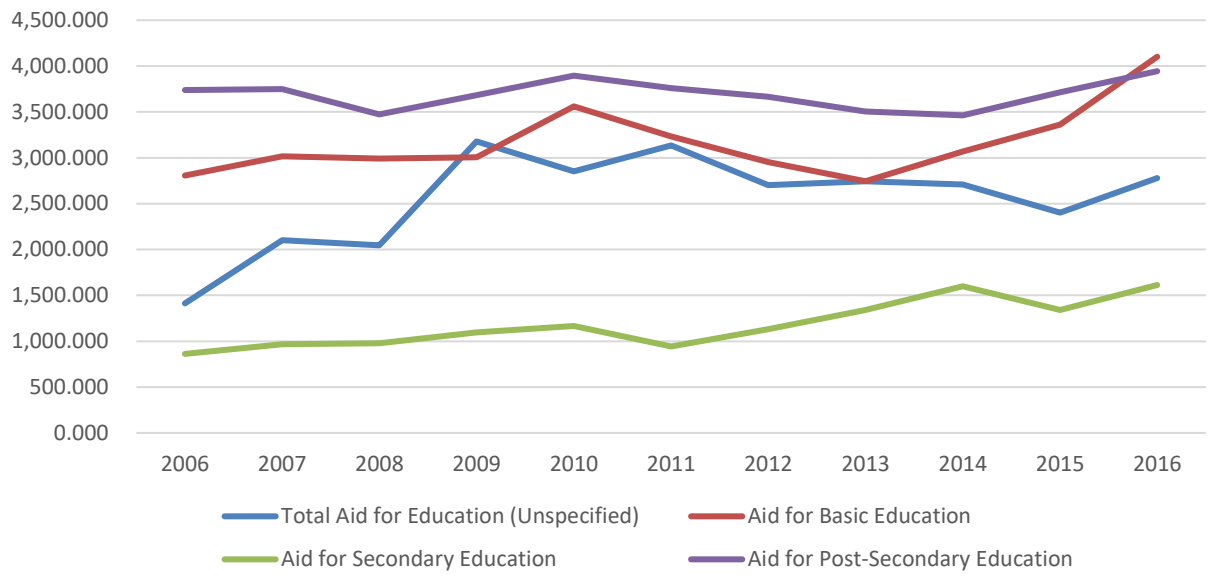
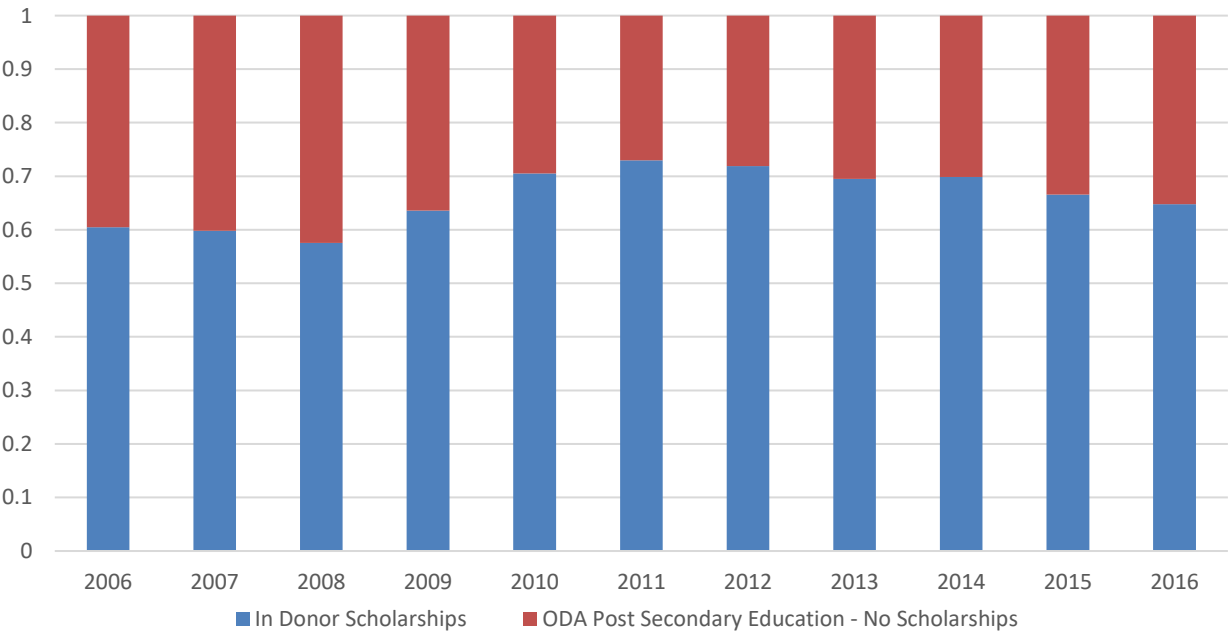
Figure 1: Aid for Education - Trend Over Time



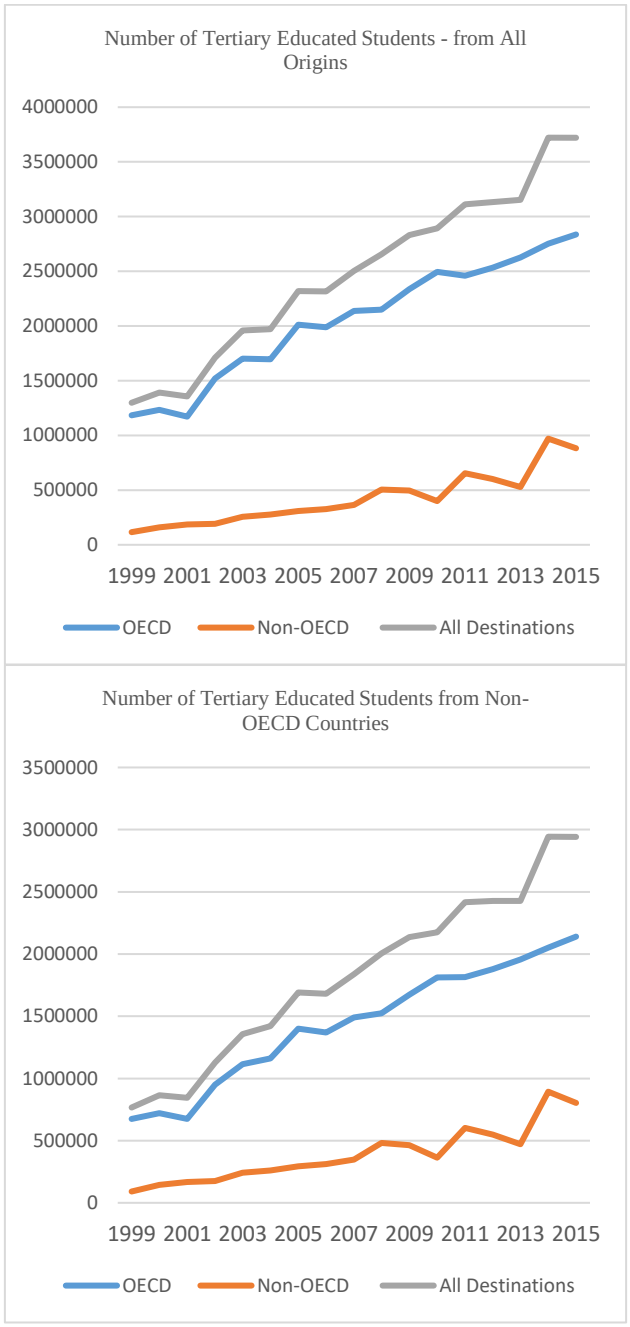
Notes: Aid for *basic*, *secondary* and *post-secondary* education are defined according to the OECD-DAC definitions outlined in Table A3. Values of ODA are expressed in Constant Million 2016 US Dollars. Source: OECD-CRS dataset.

Figure 2: ODA Post-Secondary Education - Share of In-Donor Scholarships



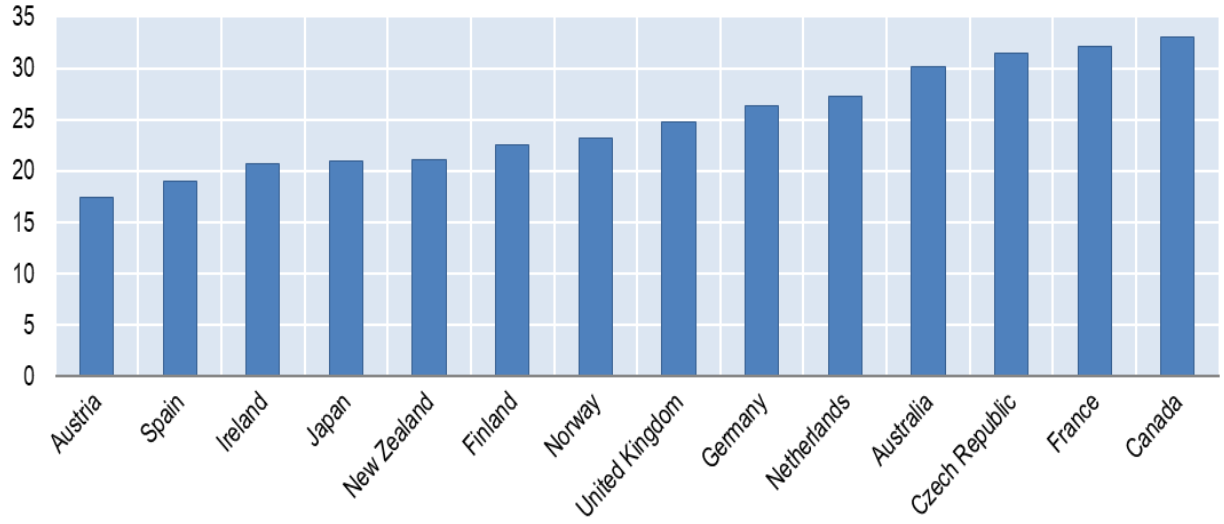
Notes. In-donor Scholarships include (a) *Indirect ("imputed") costs of tuition in donor countries* as well as (b) *Financial aid awards for individual students and contributions to trainees*. Source: OECD-CRS dataset.

Figure 3: Tertiary Educated Students Abroad



Notes: The sample includes 209 countries of origin. The list of OECD countries of origin includes: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Czech Republic, Ireland, Italy, Japan, Luxembourg, Poland, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, South Korea, Portugal, United Kingdom and United States. Source UIS UNESCO

Figure 4: International students staying on in selected OECD countries, 2008 or 2009



Notes: The figure reports the share of International students changing status and staying on in selected OECD countries, in 2008 or 2009.
Source: OECD (2014)

Table 1: Benchmark Estimates – OECD Destinations

	(1)	(2)	(3)	(4)	(5)
Dep. Var.	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$
Estimator	OLS	OLS	OLS	OLS	OLS
ODA Type	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av
Log Diaspora (o to d)	0.356***	0.356***	0.356***	0.356***	0.356***
	(48.29)	(48.27)	(48.31)	(48.27)	(48.29)
Log Bilateral Trade (o to d)	0.0123***	0.0125***	0.0122***	0.0125***	0.0125***
	(4.45)	(4.52)	(4.41)	(4.52)	(4.51)
Log Distance (o d)	-0.799***	-0.800***	-0.799***	-0.800***	-0.799***
	(-28.81)	(-28.82)	(-28.80)	(-28.82)	(-28.81)
Common Language (o d)	0.826***	0.826***	0.826***	0.826***	0.826***
	(25.16)	(25.17)	(25.15)	(25.17)	(25.16)
Colonial Relationship (o d)	1.300***	1.300***	1.299***	1.300***	1.300***
	(26.68)	(26.70)	(26.67)	(26.70)	(26.69)
Log GDP (o)	0.129	0.0901	0.143	0.0918	0.139
	(0.89)	(0.62)	(0.98)	(0.63)	(0.95)
Log Total Post-Sec. ODA (o)	0.0818**			0.122***	0.0977***
	(2.87)			(3.80)	(3.33)
Log ODA type (o)		0.107***	0.00696		
		(3.87)	(0.46)		
Log Share ODA type (o)				0.0920**	-0.0474*
				(2.81)	(-2.21)
Unemployment (o)	0.00636	0.00629	0.00778	0.00590	0.00738
	(0.77)	(0.76)	(0.94)	(0.72)	(0.89)
Voice and Accountability (o)	0.0863	0.0865	0.0899	0.0853	0.0926
	(1.22)	(1.22)	(1.27)	(1.20)	(1.31)
Political Stability (o)	-0.0521	-0.0543	-0.0480	-0.0549	-0.0540
	(-1.51)	(-1.57)	(-1.39)	(-1.59)	(-1.56)
Number of Top 500 Univ. (o)	0.0359*	0.0356*	0.0345*	0.0361*	0.0334*
	(2.52)	(2.51)	(2.42)	(2.54)	(2.34)
N	16325	16325	16325	16325	16325
*Dest*Year Fes*	X	X	X	X	X
Origin Fes	X	X	X	X	X
Origin Countries	120	120	120	120	120
Destination Countries	23	23	23	23	23

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are robust in specifications.

The table shows the estimates of Eq. (1) for OECD destinations. For foreign aid in post-secondary education we take the 2-year average for total ODA received. So total ODA received at time t-1 is the 2-years average between t-1 and t-2. Column (1) reports the estimates of total aid received by countries of origin, while Columns (2-3) separately estimate the impact of non-transferred and transferred assistance, respectively. Columns (4-5) show the results of the preferred specification, in which we separate the effect of non-transferred assistance into two terms: ln (Aggregate Aid) + ln (In-Donor Scholarships Share).

Table 2: Anderson Van Wincoop Model – No Spillover Effects

	(1)	(2)	(3)
Dep. Var.	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$
Estimator	OLS	OLS	OLS
Type of ODA	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av
Log Diaspora (o to d)	0.266***	0.250***	0.263***
	(9.17)	(8.95)	(9.09)
Log Bilateral Trade (o to d)	0.00319	0.00412	0.00290
	(0.52)	(0.69)	(0.48)
Log Total Post-Sec. ODA (d to o)	0.397***	0.433***	0.397***
	(16.78)	(18.24)	(16.86)
Log Share ODA type (d to o)		0.188***	-0.0418*
		(5.82)	(-2.19)
Log Distance (o d)	-0.468***	-0.469***	-0.469***
	(-4.20)	(-4.37)	(-4.25)
Common Language (o d)	0.607***	0.525***	0.591***
	(4.77)	(4.20)	(4.69)
Colonial Relationship (o d)	0.571***	0.519***	0.574***
	(4.26)	(3.99)	(4.29)
N	3060	3060	3060
*Dest*Year Fes*	X	X	X
*Ori*Year Fes*	X	X	X
Destination Countries	21	21	21
Origin Countries	116	116	116

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard Errors are clustered by country-pair

The estimated model is $\boldsymbol{ln(EM_{ijt}) = \alpha_{it} + \alpha_{jt} + OD_{ijt-1} * \vartheta + e_{ijt}}$ where $\boldsymbol{\alpha_{it}}$ stands for origin*year fixed effects. For bilateral foreign aid we take the 2-year average for bilateral volumes of ODA. So bilateral ODA at time t - 1 is the 2-years average between t -1 and t -2.

Table 3: Effect of Student Inbounds on the Change in Migrant Stocks

	(1)	(2)	(3)	(4)
Dependent Variable	$\ln(S_{ij(l)})$	$\ln(S_{ij(l)})$	$\ln(S_{ij(l)})$	$\ln(S_{ij(l)})$
Estimator	OLS	OLS	IV-2SLS	IV-2SLS
Skill Level	Total	High Skill	Total	High Skill
Log Student Inflows (o to d)	0.0450***	0.110***	0.0585*	0.135***
	(3.49)	(8.61)	(2.45)	(5.62)
Log Diaspora (o to d)	0.816***	0.695***	0.804***	0.702***
	(87.53)	(73.46)	(53.57)	(44.80)
Common Language (o d)	0.299***	0.328***	0.291***	0.262***
	(6.06)	(6.63)	(4.50)	(4.33)
Log Distance (o d)	-0.0296	0.0245	-0.103*	-0.00348
	(-0.90)	(0.84)	(-2.23)	(-0.09)
Colonial Relationship (o d)	0.122	0.154*	0.220*	0.209*
	(1.53)	(2.06)	(2.43)	(2.56)
N	2887	2887	2149	2149
Dest FEs	X	X	X	X
Origin FEs	X	X	X	X
Dest Countries	18	18	14	14
Origin Countries	183	183	180	180
F-test First Stage			358.21	358.21
Hansen J Stat (p-value)			0.3841	0.1763

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard Errors are clustered by country-pair

The table shows the cross-section estimates of Eq. (2) obtained with OLS (Columns 1-2) and IV-2SLS (Columns 3-4). Instrument sets for Log Student Inflows include the size of diaspora in 1970 and the bilateral number of enrolled international students in 1998. $S_{ij(l)}$ is the difference in bilateral stocks of emigrants by skill level *l* between t-5 (2005) and t (2010); *Student Inflows* is the average of bilateral student inflows between t-10 (2000) and t-5 (2005).

Table 4: Adding Asymmetric Dyadic Fixed Effects

	(1)	(2)	(3)
Dep. Var.	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$
Estimator	OLS	OLS	OLS
ODA Type	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av
Log Diaspora (o to d)	0.0395*	0.0386*	0.0399*
	(2.40)	(2.35)	(2.43)
Log Bilateral Trade (o to d)	0.00143	0.00159	0.00163
	(0.91)	(1.02)	(1.04)
Log GDP (o)	0.193**	0.159*	0.202**
	(2.97)	(2.43)	(3.11)
Log Total Post-Sec. ODA (o)	0.0963***	0.134***	0.113***
	(6.43)	(8.23)	(7.43)
Log Share ODA type (o)		0.0857***	-0.0486***
		(5.13)	(-4.30)
Unemployment (o)	-0.000752	-0.00118	0.000298
	(-0.20)	(-0.31)	(0.08)
Voice and Accountability (o)	0.0505	0.0491	0.0564
	(1.61)	(1.57)	(1.80)
Political Stability (o)	-0.0422**	-0.0449**	-0.0441**
	(-2.68)	(-2.86)	(-2.80)
Number of Top 500 Univ. (o)	0.0329***	0.0331***	0.0303***
	(6.69)	(6.75)	(6.14)
N	16249	16249	16249
*Dest*Year Fes*	X	X	X
Country Pair Fes	X	X	X
Origin Countries	119	119	119
Destination Countries	23	23	23

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are robust in specifications.

The estimated model is $\boldsymbol{ln(EM_{ijt}) = \alpha_{ij} + \alpha_{jt} + O_{it-1} * \gamma + OD_{ijt-1} * \vartheta + e_{ijt}}$ where $\boldsymbol{\alpha_{ij}}$ stands for asymmetric dyadic fixed effects. For foreign aid in post-secondary education we take the 2-year average for total ODA received. So total ODA received at time t-1 is the 2-years average between t -1 and t -2.

Table 5: Adding Origin Specific Controls

	(1)	(2)	(3)
Dep. Var.	$\ln(\mathrm{EM}_{ijt})$	$\ln(\mathrm{EM}_{ijt})$	$\ln(\mathrm{EM}_{ijt})$
Estimator	OLS	OLS	OLS
ODA Type	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av
Log Diaspora (o to d)	0.0398*	0.0380	0.0405*
	(1.97)	(1.88)	(2.00)
Log Bilateral Trade (o to d)	0.000754	0.00132	0.00115
	(0.32)	(0.57)	(0.50)
Log GDP (o)	0.340***	0.125	0.285**
	(3.33)	(1.18)	(2.78)
Log Total Post-Sec. ODA (o)	0.132***	0.217***	0.159***
	(6.88)	(10.07)	(8.11)
Log Share ODA type (o)		0.194***	-0.0639***
		(6.92)	(-4.33)
Log Total Sec. ODA (o)	-0.0322**	-0.0334***	-0.0305**
	(-3.20)	(-3.39)	(-3.05)
Unemployment (o)	0.00414	0.00543	0.00777
	(0.79)	(1.04)	(1.45)
Voice and Accountability (o)	-0.0381	-0.0591	-0.0515
	(-1.00)	(-1.55)	(-1.35)
Political Stability (o)	-0.0563**	-0.0603**	-0.0604**
	(-2.72)	(-2.95)	(-2.92)
Conflict (o)	-0.00595	-0.0141	-0.00933
	(-0.26)	(-0.63)	(-0.41)
Number of Top 500 Univ. (o)	0.0839***	0.0796***	0.0740***
	(4.68)	(4.44)	(4.11)
Pupil Teacher Ratio (o)	0.00501***	0.00484**	0.00451**
	(3.34)	(3.24)	(3.01)
N	10651	10651	10651
*Dest*Year Fes*	X	X	X
Country Pair Fes	X	X	X
Origin Countries	87	87	87
Destination Countries	23	23	23

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are robust in specifications.

The estimated model is $\boldsymbol{ln(EM_{ijt}) = \alpha_{ij} + \alpha_{jt} + O_{it-1} * \gamma + OD_{ijt-1} * \vartheta + e_{ijt}}$ where $\boldsymbol{\alpha_{ij}}$ stands for asymmetric dyadic fixed effects. For foreign aid in post-secondary education we take the 2-year average for total ODA received. So total ODA received at time t-1 is the 2-years average between t - 1 and t - 2.

Table 6: Second Stage of Two-Step Strategy

	(1)	(2)	(3)	(4)
Dep. Var.	$\widehat{\alpha_{it}}$	$\widehat{\alpha_{it}}$	$\widehat{\alpha_{it}}$	$\widehat{\alpha_{it}}$
Estimator	OLS	OLS	OLS	OLS
	In-Donor Scholarship	Transferred Aid	In-Donor Scholarship	Transferred Aid
Log GDP (o)	0.182	0.218*	0.297**	0.325**
	(1.86)	(2.20)	(2.93)	(3.21)
Log Total Post-Sec. ODA (o)	0.0962***	0.0804**	0.0931***	0.0840***
	(3.69)	(3.27)	(3.68)	(3.59)
Log Share ODA type (o)	0.0684**	-0.0381*	0.0492*	-0.0336*
	(2.77)	(-2.44)	(1.97)	(-2.30)
Unemployment (o)	0.00245	0.00359	-0.00443	-0.00352
	(0.33)	(0.47)	(-0.68)	(-0.53)
Voice and Accountability (o)	0.105*	0.109*	0.0757	0.0798
	(2.16)	(2.23)	(1.78)	(1.86)
Political Stability (o)	-0.0602*	-0.0603*	-0.0484	-0.0491
	(-2.10)	(-2.08)	(-1.76)	(-1.76)
Number of Top 500 Univ. (o)	0.0359***	0.0337***	0.0325***	0.0306***
	(4.71)	(4.34)	(7.70)	(7.20)
N	889	889	887	887
Origin FEs	X	X	X	X
Year Fes	X	X	X	X

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are robust in specifications.
The dependent variables of the second stage are the estimated origin-year fixed effects $\widehat{\alpha_{it}}$ obtained through the OLS regressions $ln(EM_{ijt}) = \alpha_{jt} + \alpha_{it} + OD_{ijt-1} * \vartheta + e_{ijt}$ for Columns 1 and 2 and $ln(EM_{ijt}) = \alpha_{ij} + \alpha_{jt} + \alpha_{it} + OD_{ijt-1} * \vartheta + e_{ijt}$ for columns 3-4, respectively. First stage results are presented in Table A2. For foreign aid in post-secondary education we take the 2-year average for total ODA received. So total ODA received at time t - 1 is the 2-years average between t - 1 and t - 2.

Table 7: Splitting of sample according to GDP per capita at origin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$
GDP - Centile	50^{th}-100^{th}	0-50^{th}	50^{th}-100^{th}	0-50^{th}	50^{th}-100^{th}	0-50^{th}	50^{th}-100^{th}	0-50^{th}
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
	In-Donor	In-Donor	Transf.	Transf.	In-Donor	In-Donor	Transf.	Transf.
Log Diaspora (o to d)	0.378***	0.328***	0.378***	0.328***	0.0526*	0.0133	0.0533*	0.0157
	(38.05)	(29.48)	(38.08)	(29.49)	(2.07)	(0.87)	(2.10)	(1.03)
Log Bilateral Trade (o to d)	0.0399***	0.00327	0.0400***	0.00317	-0.00411	0.00190	-0.00396	0.00187
	(7.32)	(1.10)	(7.33)	(1.07)	(-0.94)	(1.20)	(-0.91)	(1.17)
Log Distance (o d)	-0.707***	-1.042***	-0.707***	-1.041***				
	(-20.96)	(-20.32)	(-20.95)	(-20.30)				
Common Language (o d)	0.578***	1.006***	0.578***	1.005***				
	(10.92)	(23.51)	(10.92)	(23.50)				
Colonial Relationship (o d)	1.384***	1.376***	1.385***	1.375***				
	(18.59)	(20.71)	(18.59)	(20.71)				
Log GDP (o)	0.157	0.202	0.161	0.302	0.245**	0.296**	0.246**	0.393***
	(0.78)	(0.97)	(0.81)	(1.45)	(2.98)	(2.59)	(3.00)	(3.49)
Log Total Post-Sec. ODA (o)	0.101*	0.117**	0.0976*	0.0743	0.101***	0.131***	0.104***	0.0923***
	(2.03)	(2.69)	(2.11)	(1.87)	(4.04)	(5.89)	(4.50)	(4.44)
Log Share ODA type (o)	0.0388	0.118**	-0.0466	-0.0302	0.00972	0.112***	-0.0258	-0.0374*
	(0.76)	(2.66)	(-1.44)	(-1.05)	(0.41)	(4.68)	(-1.53)	(-2.43)
Unemployment (o)	0.0115	-0.00307	0.0130	-0.00271	-0.000844	0.00191	-0.000108	0.00225
	(1.17)	(-0.21)	(1.32)	(-0.19)	(-0.18)	(0.30)	(-0.02)	(0.35)
Voice and Accountability (o)	0.101	0.0396	0.109	0.0620	0.0292	0.0447	0.0363	0.0629
	(1.04)	(0.37)	(1.12)	(0.58)	(0.69)	(0.88)	(0.85)	(1.24)
Political Stability (o)	-0.0823	0.00958	-0.0844	0.0129	-0.0834***	0.0170	-0.0846***	0.0203
	(-1.79)	(0.17)	(-1.83)	(0.23)	(-4.30)	(0.64)	(-4.36)	(0.76)
Number of Top 500 Univ. (o)	0.0272	-0.206	0.0252	-0.223	0.0233***	-0.141*	0.0221***	-0.151*
	(1.90)	(-1.32)	(1.76)	(-1.42)	(4.72)	(-2.11)	(4.44)	(-2.25)
N	8152	8173	8152	8173	8066	8088	8066	8088
*Dest*Year Fes*	X	X	X	X	X	X	X	X
Origin Fes	X	X	X	X				
Country Pair Fes					X	X	X	X

t statistics in parentheses* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are robust in specifications.

The table shows the estimates of Eq. (1) separately for relatively poor (0-50^{th}) and relatively rich 50^{th}-100^{th} countries of origin. The sample median of GDP per capita at the origin is 6114.061 constant US dollars. Columns (5-8) add asymmetric country pair fixed effects to the baseline specification. For foreign aid in post-secondary education we take the 2-year average for total ODA received. So total ODA received at time t-1 is the 2-years average between t-1 and t-2.

Table 8: OECD vs Non-OECD Destinations

Destination	***OECD***			***Non-OECD***		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$
Estimator	OLS	OLS	OLS	OLS	OLS	OLS
ODA Type	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av
Log Diaspora (o to d)	0.356***	0.356***	0.356***	0.176***	0.176***	0.176***
	(48.29)	(48.27)	(48.29)	(36.18)	(36.20)	(36.22)
Log Bilateral Trade (o to d)	0.0123***	0.0125***	0.0125***	0.0127***	0.0128***	0.0128***
	(4.45)	(4.52)	(4.51)	(5.53)	(5.57)	(5.54)
Log Distance (o d)	-0.799***	-0.800***	-0.799***	-1.004***	-1.004***	-1.004***
	(-28.81)	(-28.82)	(-28.81)	(-44.15)	(-44.14)	(-44.15)
Common Language (o d)	0.826***	0.826***	0.826***	0.908***	0.909***	0.909***
	(25.16)	(25.17)	(25.16)	(23.07)	(23.09)	(23.10)
Colonial Relationship (o d)	1.300***	1.300***	1.300***	0.542***	0.543***	0.543***
	(26.68)	(26.70)	(26.69)	(3.64)	(3.65)	(3.65)
Log GDP (o)	0.129	0.0918	0.139	-0.155	-0.202	-0.146
	(0.89)	(0.63)	(0.95)	(-0.75)	(-0.97)	(-0.70)
Log Total Post-Sec. ODA (o)	0.0818**	0.122***	0.0977***	0.0916*	0.138**	0.118**
	(2.87)	(3.80)	(3.33)	(2.24)	(2.92)	(2.79)
Log Share ODA type (o)		0.0920**	-0.0474*		0.104*	-0.0694*
		(2.81)	(-2.21)		(2.09)	(-2.30)
Unemployment (o)	0.00636	0.00590	0.00738	0.00520	0.00497	0.00732
	(0.77)	(0.72)	(0.89)	(0.45)	(0.43)	(0.63)
Voice and Accountability (o)	0.0863	0.0853	0.0926	-0.0257	-0.0218	-0.0120
	(1.22)	(1.20)	(1.31)	(-0.28)	(-0.24)	(-0.13)
Political Stability (o)	-0.0521	-0.0549	-0.0540	-0.0912*	-0.0940*	-0.0926*
	(-1.51)	(-1.59)	(-1.56)	(-2.03)	(-2.10)	(-2.06)
Number of Top 500 Univ. (o)	0.0359*	0.0356*	0.0345*	-0.00325	-0.00274	-0.00636
	(2.52)	(2.51)	(2.42)	(-0.25)	(-0.21)	(-0.49)
N	16325	16325	16325	17382	17382	17382
*Dest*Year Fes*	X	X	X	X	X	X
Origin Fes	X	X	X	X	X	X
Origin Countries	120	120	120	120	120	120
Destination Countries	23	23	23	90	90	90

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are robust in specifications.
The table compares the estimates of Eq. (1) for OECD destinations (Columns 1-3) with the ones for non-OECD destinations (Columns 4-6). For foreign aid in post-secondary education we take the 2-year average for total ODA received. So total ODA received at time t - 1 is the 2-years average between t - 1 and t - 2.

Table A1: Variables Used and Related Sources

Variable	Short description	Source
Dependent variable		
Student Emigration Rates	Bilateral Inbound Internationally Mobile Students divided by the Population of the official age for Tertiary Education.	UIS UNESCO Institute for Statistics
Explanatory variables		
ODA Post-Secondary Education	Total ODA received by country i from all donors normalized by the population of the official age for tertiary education, gross disbursements in Constant US dollars (2 years average)	CRS-OECD DAC
ODA Secondary Education	Total ODA received by country i from all donors normalized by the population of the official age for secondary education, gross disbursements in Constant US dollars (2 years average)	CRS-OECD DAC
GDP Per Capita	GDP per capita, expressed in PPP constant US$ (2011 prices)	World Bank
Unemployment Rate	Number of unemployed workers at the origin, calculated as the share of unemployed as % of the labour force	ILO
Colony	Dummy =1 if country pair ever in a colonial relationship, 0 otherwise (var: *colony*)	CEPII
Stocks Birth	Stock of migrants born in country n and resident in country i at time t-3	World Bank
Comlang Ethno	=1 if common language is spoken by at least 9% of population	CEPII
Distance	Weighted Distance, pop-wt, km (var: *distw*)	CEPII
Political Stability	Index ranging from -2.5 to 2.5 with higher value indicating more political stability.	World Development Indicators, World Bank
Voice and Accountability	Index ranging from -2.5 to 2.5 with higher value indicating better voice and accountability.	World Development Indicators, World Bank
Trade Flows	Aggregate Bilateral Trade in Current US dollars	BACI, CEPII

Top 500 Universities	The number of universities ranked among the Top500 universities in the world by the Shanghai Ranking	Shanghai Ranking of World Universities
Pupil Teacher Ratio	Average number of pupils per teacher at a given level of education, based on headcounts of both pupils and teachers.	UIS UNESCO Institute for Statistics
Instrumental Variables		
Stocks Birth (1970)	Stock of migrants born in country n and resident in country i in the 1970	World Bank
Past Student Enrolments (1998)	Bilateral Number of Students Enrolled in OECD countries in 1998	OECD – Education at a Glance

Table A2 - Accounting for Zeros: Alternative Estimators

Estimator	(1) OLS	(2) PPML	(3) EK Tobit	(4) GPML
Log Diaspora (o to d)	0.350***	0.446***	0.383***	0.382***
	(20.56)	(18.45)	(25.31)	(22.69)
Log Bilateral Trade (o to d)	0.0140*	0.0594**	0.0225***	0.0317***
	(2.30)	(3.27)	(4.58)	(6.44)
Log Distance (o d)	-0.781***	-0.744***	-0.832***	-1.031***
	(-11.48)	(-8.00)	(-31.89)	(-14.03)
Common Language (o d)	0.817***	0.627***	0.889***	0.963***
	(10.15)	(4.66)	(11.20)	(11.22)
Colonial Relationship (o d)	1.193***	0.836***	1.133***	1.093***
	(10.29)	(5.57)	(9.99)	(8.85)
N	17213	20640	20469	20469
*Dest*Year Fes*	X	X	X	X
*Origin*Year Fes*	X	X	X	X

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard Errors are clustered by country pair

Table A3: ODA Education Sectors

DAC 5 Code	CRS Code	Voluntary Code	DESCRIPTION	Clarifications / Additional notes on coverage
110			**EDUCATION**	
111			**Education, level unspecified**	
	11110		Education policy and administrative management.	Education sector policy, planning and programmes; aid to education ministries, administration and management systems; institution capacity building and advice; school management and governance; curriculum and materials development; unspecified education activities.
	11120		Education facilities and training	Educational buildings, equipment, materials; subsidiary services to education (boarding facilities, staff housing); language training; colloquia, seminars, lectures, etc.
	11130		Teacher training	Teacher education (where the level of education is unspecified); in-service and pre-service training; materials development.
	11182		Educational research	Research and studies on education effectiveness, relevance and quality; systematic evaluation and monitoring.
112			**Basic education**	
	11220		Primary education	Formal and non-formal primary education for children; all elementary and first cycle systematic instruction; provision of learning materials.
	11230		Basic life skills for youth and adults	Formal and non-formal education for basic life skills for young people and adults (adults education); literacy and numeracy training.
		11231	Basic life skills for youth	Formal and non-formal education for basic life skills for young people.
		11232	Primary education equivalent for adults	Formal primary education for adults.
	11240		Early childhood education	Formal and non-formal pre-school education.
113			**Secondary education**	
	11320		Secondary education	Second cycle systematic instruction at both junior and senior levels.
		11321	Lower secondary education	Second cycle systematic instruction at junior level.
		11322	Upper secondary education	Second cycle systematic instruction at senior level.
	11330		Vocational training	Elementary vocational training and secondary level technical education; on-the job training; apprenticeships; including informal vocational training.
114			**Post-secondary education**	
	11420		Higher education	Degree and diploma programmes at universities, colleges and polytechnics; scholarships.
	11430		Advanced technical and managerial training	Professional-level vocational training programmes and in-service training.

Source: OECD, *http://www.oecd.org/dac/stats/type-aid.htm*

Table A4: ODA Post-Secondary Education -Top 30 Recipients (mean 2006-2016)

Recipient	Mean ODA Post-Secondary Education	Mean In Donor Scholarships	Mean ODA No Scholarships	Share ODA Post-Secondary No Scholarships
China (People's Republic of)	533.5855	396.2407	137.3448	0.257399798
Morocco	160.2094	152.7128	7.496676	0.046792985
India	118.2723	73.43267	44.83959	0.379121654
Algeria	113.9096	105.5156	8.394044	0.0736904
Viet Nam	108.0828	67.03693	41.04588	0.379763293
Tunisia	94.38589	80.91603	13.46986	0.142710526
Turkey	90.88998	84.00116	6.888813	0.075792876
Cameroon	79.03164	76.00648	3.025158	0.038277809
Pakistan	73.44519	26.16727	47.27792	0.643717036
Indonesia	68.28189	46.26693	22.01497	0.322413015
Ukraine	66.04398	58.26436	7.779625	0.117794612
Iran	59.89363	58.0955	1.79813	0.030022057
Brazil	57.1399	48.56211	8.577793	0.150119146
Senegal	55.74773	45.6463	10.10144	0.181199127
Syrian Arab Republic	54.09499	50.42976	3.665233	0.067755498
Egypt	49.9883	29.90327	20.08503	0.40179462
Lebanon	46.01738	33.67841	12.33897	0.268137169
Afghanistan	45.35811	7.250615	38.1075	0.84014744
Mexico	33.77774	27.99929	5.778448	0.171072665
Bangladesh	33.57019	15.4259	18.14429	0.540488153
Colombia	32.20768	28.71602	3.491652	0.108410541
Albania	30.89289	28.45222	2.44067	0.079004263
Jordan	30.64903	14.76151	15.88752	0.518369423
Serbia	30.46071	19.31123	11.14948	0.366028238
Nigeria	28.43155	10.05872	18.37283	0.646212746
Thailand	27.36309	19.07017	8.292923	0.303069683
Malaysia	26.88891	15.07698	11.81192	0.439285936
Bosnia and Herzegovina	25.55266	22.2928	3.259856	0.127574037
Tanzania	24.79702	3.718424	21.0786	0.850045691
Georgia	22.81136	17.39435	5.417012	0.237469927

Notes. Source: OECD-CRS dataset.

Table A5: Baseline with Standard Errors Clustered by Country of Origin

	(1)	(2)	(3)	(4)	(5)
Dep. Var.	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$	$\ln(EM_{ijt})$
Estimator	OLS	OLS	OLS	OLS	OLS
ODA Type	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av
Log Diaspora (o to d)	0.356***	0.356***	0.356***	0.356***	0.356***
	(14.48)	(14.47)	(14.49)	(14.46)	(14.48)
Log Bilateral Trade (o to d)	0.0123*	0.0125*	0.0122*	0.0125*	0.0125*
	(2.07)	(2.09)	(2.05)	(2.09)	(2.08)
Log Distance (o d)	-0.799***	-0.800***	-0.799***	-0.800***	-0.799***
	(-7.75)	(-7.75)	(-7.75)	(-7.75)	(-7.75)
Common Language (o d)	0.826***	0.826***	0.826***	0.826***	0.826***
	(7.54)	(7.54)	(7.54)	(7.54)	(7.54)
Colonial Relationship (o d)	1.300***	1.300***	1.299***	1.300***	1.300***
	(11.32)	(11.32)	(11.32)	(11.32)	(11.32)
Log GDP (o)	0.129	0.0901	0.143	0.0918	0.139
	(0.88)	(0.62)	(0.97)	(0.63)	(0.97)
Log Total Post-Sec. ODA (o)	0.0818*			0.122**	0.0977**
	(2.17)			(3.25)	(2.68)
Log ODA type (o)		0.107***	0.00696		
		(3.44)	(0.44)		
Log Share ODA type (o)				0.0920**	-0.0474*
				(2.73)	(-2.49)
Unemployment (o)	0.00636	0.00629	0.00778	0.00590	0.00738
	(0.66)	(0.67)	(0.81)	(0.63)	(0.77)
Voice and Accountability (o)	0.0863	0.0865	0.0899	0.0853	0.0926
	(1.28)	(1.27)	(1.30)	(1.26)	(1.39)
Political Stability (o)	-0.0521	-0.0543	-0.0480	-0.0549	-0.0540
	(-1.35)	(-1.44)	(-1.16)	(-1.47)	(-1.41)
Number of Top 500 Univ. (o)	0.0359***	0.0356***	0.0345***	0.0361***	0.0334***
	(6.52)	(6.64)	(6.07)	(6.66)	(6.30)
N	16325	16325	16325	16325	16325
*Dest*Year Fes*	X	X	X	X	X
Origin Fes	X	X	X	X	X
Origin Countries	120	120	120	120	120
Destination Countries	23	23	23	23	23

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are clustered by country of origin.

Table A6: Anderson Van Wincoop Model – Alternative Estimators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimator	**PPML**	**PPML**	**PPML**	**EK Tobit**	**EK Tobit**	**EK Tobit**	**GPML**	**GPML**	**GPML**
Type of ODA	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av	Total Post-Sec. 2 Yrs. Av	In-Donor Scholarship 2 Yrs. Av	Transferred Aid 2 Yrs. Av
Log Diaspora (o to d)	0.340***	0.329***	0.341***	0.266***	0.250***	0.263***	0.258***	0.244***	0.254***
	(7.00)	(6.63)	(6.82)	(16.34)	(10.93)	(9.44)	(17.72)	(10.69)	(10.73)
Log Bilateral Trade (o to d)	0.113*	0.115**	0.119**	0.000844	0.00193	0.000530	0.00455	0.00543	0.00439
	(2.54)	(2.67)	(2.60)	(1.72)	(1.80)	(1.65)	(0.82)	(0.96)	(0.80)
Log Total Post-Sec. ODA (d to o)	0.380***	0.422***	0.383***	0.395***	0.432***	0.395***	0.395***	0.426***	0.395***
	(9.32)	(9.41)	(9.72)	(32.31)	(31.08)	(29.10)	(30.21)	(22.11)	(20.30)
Log Share ODA type (d to o)		0.235***	-0.0741**		0.188***	-0.0405***		0.176***	-0.0440**
		(4.65)	(-2.61)		(6.88)	(-3.42)		(6.61)	(-2.69)
Log Distance (o d)	-0.534**	-0.573***	-0.520**	-0.473***	-0.475***	-0.477***	-0.533***	-0.533***	-0.529***
	(-3.09)	(-3.34)	(-3.00)	(-9.01)	(-9.19)	(-4.68)	(-10.36)	(-6.14)	(-5.89)
Common Language (o d)	0.197	0.0978	0.159	0.627***	0.544***	0.611***	0.570***	0.478***	0.551***
	(0.89)	(0.44)	(0.72)	(8.18)	(6.59)	(6.02)	(8.45)	(4.47)	(5.18)
Colonial Relationship (o d)	0.424*	0.309	0.401*	0.556***	0.504***	0.560***	0.631***	0.585***	0.635***
	(2.21)	(1.68)	(2.08)	(6.03)	(5.91)	(5.31)	(9.14)	(5.16)	(5.45)
N	3085	3085	3085	3085	3085	3085	3085	3085	3085
*Dest*Year Fes*	X	X	X	X	X	X	X	X	X
*Ori*Year Fes*	X	X	X	X	X	X	X	X	X
Destination Countries	21	21	21	21	21	21	21	21	21
Origin Countries	117	117	117	117	117	117	117	117	117

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard Errors are clustered by country pair