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Out of sight, not out of mind. Education
networks and international trade

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# Out of sight, not out of mind. Education networks and international trade

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**Abstract**. This paper investigates the impact of international students on the UK bilateral trade with 167 partner economies during 1999-2009. The base hypothesis is that transnational social networks lower the invisible trade barriers existing between countries. University students typically develop ties of friendship and trust that can last for decades after graduation and may evolve into economic and business ties. I find robust evidence that education networks boost the bilateral trade between the UK and the home countries of graduates and students. At a more disaggregated level, the strongest effects on exports and imports derive from the networks linked to the Middle East and to the new member countries of the European Union.

*"Doing business is about building relationships, it's people betting on people, so you still want to trust the people you're dealing with. A lot of trust is developed through friendship and professional networks like school alumni relations, business associations, and industry ties".* (Saxenian, 2000)

*Good morning Exeterians! The company I work for […] is hiring project managers for large scale  mobile marketing campaigns. If anyone is interested feel free to send me an email.* Exeter Alumni Greece, Facebook 20 September 2012.


**I. Introduction**.

A know story is that the initial links between the Silicon Valley in USA and Bangalore and Hyderabad in India have been built by Indian graduates at California universities who perceived the profitability of offshoring parts of the production abroad and, above all, knew how and where to do it and with whom to establish the first, crucial, contacts. Case studies in sociology and politics published from the nineties have shed light on this and similar facts, concerning Chinese, Taiwanese and other ethnic networks of professionals graduated in the US (Zweig, 1995, Saxenian, 2000, 2005).

Since then economists have systematically explored the impact of international social networks on the economic exchanges between countries but, differently from the case studies on graduates and professional networks, have focused on the broader and somewhat different category of international migrants (Gould, 1994; Head and Ries, 1998;  Rauch 1999;  Rauch and Trindade 2002; Gao, 2003; Tong, 2005; Combes, Lafourcade and Mayer, 2005; Buch, Kleinert and Toubal, 2006; Blanes and Martin-Montaner, 2006; Herander and Saavedra, 2005; Kugler and Rapoport, 2007; Tadesse and White, 2008).

The general hypothesis is that migrants possess a specific knowledge on opportunities in foreign markets and are able to supply matching and referral services that can boost the economic exchanges between their home and residence countries (Rauch, 2001). While trade between countries is deterred by invisible barriers, built on differences in institutions, norms, cultures and languages, knowledge flows easily within networks of individuals who know each other directly or by referral (Granovetter, 1973). Hence, the knowledge of migrants is valuable because it lowers the costs of international transactions and the height of the invisible barriers.

Empirical evidence from different countries has provided support to the theoretical predictions: migrant networks appear to boost trade (a review is in Wagner, Head and Ries, 2002). In particular, the positive impact of skilled individuals is often higher than that of unskilled ones; a likely explanation is that skilled individuals are more likely to possess both the knowledge on potential opportunities abroad and the means to make them feasible (among others, Docquier and Lodigiani, 2009; Murat and Flisi, 2011). Also, a corollary of the general hypothesis is that the

impact of networks on trade should be stronger as countries are more diverse, or, in other terms, as the invisible barriers separating them are higher (Girma and Yu, 2002).

This paper focuses on the transnational links of education networks and their impact on bilateral trade. As in the case studies mentioned above, international students, alumni and graduates are the subjects of the analysis but in this paper, to my knowledge for the first time, the relation between education networks and bilateral trade is investigated systematically. Specifically, students from 167 countries registered in UK Universities during the period 1999-2009 are taken into account. Following the definition adopted by *UNESCO*, students are classified as international students if they left their country of origin and moved to another country for the purpose of study. In other terms, they are individuals that moved from their country with the purpose of investing in their human capital and skills. The UK is the second country in the world after the USA in attracting tertiary level students from abroad and, among the two, is the first in terms of international students as a proportion of the total students' population. Hence, the main question of this paper is, can international movements of tertiary level students boost bilateral trade? And, also, do the student networks of more diverse countries have a higher impact on trade?

In old as in modern times the young attending college and university tend to develop ties of friendship and sentiments of fidelity toward their educational institution. This is so especially in countries where higher education takes place in campuses where students live for some years and participate in study groups, sport teams, associations, unions, societies and fraternities. (Mayer and Puller, 2008; Marmaros and Sacerdote, 2006, Baker, Mayer and Puller, 2011, Arcidiacono, Khan and Vigdor, 2011). Some of these friendship ties survive after university, partly maintained by the graduates themselves and partly by the educational institutions, which often hold officially recognized nets of alumni associations worldwide. In recent years, communication has been facilitated and improved by the use of the Internet, and especially by social media like Facebook, LinkedIn, Twitter, which convey and expand the links among people; Facebook, in particular, was initially conceived exactly as a virtual platform for the social interactions of college students. In the past as in present time, graduates and alumni are keen to maintain college and university links out of sentimental but also of practical reasons. As the citations at the beginning of this paper read, relationships between university mates are based on friendship and trust, and over time can evolve into professional and business interactions (Cohen, Frazzini and Malloy, 2008).

This paper's main findings are that education networks positively and significantly affect the bilateral trade between the UK and the home countries of students and graduates. Results are robust to different specifications. Moreover, the disaggregated picture provides only a partial support to the corollary on diversity, other forces appear to be also at work. Specifically, the larger impact on

bilateral trade is that of Middle East students, which supports the assumption of higher network effects between less similar countries, but effects are also significantly positive for students from the European Union (EU) and especially from the new member countries, which cannot be considered more dissimilar to the UK than other regions of the world. While the first result sheds light on the potentially positive impact of a country's policy of attraction of foreign students on its economic exchanges, the second can be influenced by the common measures on higher education pursued by European countries during the last fifteen years. The paper is organized as follows. Section II presents the data and some descriptive statistics, Section III makes clear the empirical strategy, Section IV discusses the main findings and Section V concludes.

**II. Data and descriptive statistics**.

There were 288,588 international students on average each year in the UK from 1999 to 2009 (Table 1). During this period, both the overall size of the students' population and its international component have increased, but the latter has grown more than proportionately: the proportion of international students on the total number of students was 11% in 1999 and 15% in 2009.

| Table 1. Summary statistics. All countries | | | | | |
|---|---|---|---|---|---|
| | Total. Average year 1999-2009 | mean | standard deviation | within standard deviation | between standard deviation |
| *International students* | 288,587.82 | 1680.3 | 4376.1 | 1904.2 | 3992.4 |
| *Imports* | 462,223.35 | 2642.1 | 8083.4 | 2338.1 | 7777.2 |
| *Exports* | 350,024.67 | 2067 | 6699 | 1424.6 | 6567.3 |

*International students: total numbers. Imports and exports: current US$, milions.*

International students registered in UK universities originate from all world areas. Table 2 shows that the main flows originate from the European Union of 15 countries (EU members in 1999) and North America (Canada, USA and Mexico), then follow those from Asia and the new members countries of the EU (members of EU27 after 1999) and, finally, those from the other areas. The third column for each group in Table 2 reports the changes of these flows through time. The correlation coefficients between the variable *International students* and a time trend show a significant variability in time patterns. The presence of students from the new EU countries and from the Middle East has increased fastest than that of any other group, numbers from Asia and

North America have grown at a slower pace, and the time-path of the more conspicuous group, concerning students from the EU15, is rather stationary if not slightly negative.

**Table 2. Summary statistics. World areas**

| | mean | standard deviation | correlation with time trend* | mean | standard deviation | correlation with time trend | mean | standard deviation | correlation with time trend |
|---|---|---|---|---|---|---|---|---|---|
| | EU15 | | | EU new countries | | | Europe no EU | | |
| *International students* | 6,535 | 6,439.79 | -0.07 | 1,335 | 2,071.45 | 0.30 | 707 | 980.29 | 0.04 |
| *Imports* | 16,382.20 | 17,330.00 | 0.19 | 2,407.41 | 5,449.16 | 0.23 | 2,273.82 | 5,367.13 | 0.16 |
| *Exports* | 13,917.40 | 13,072.50 | 0.16 | 1,031.33 | 1,281.59 | 0.22 | 1,181.33 | 1,957.58 | 0.15 |
| | North America | | | Central America and Caribbean | | | South America | | |
| *International students* | 6,304 | 5,280.40 | 0.13 | 140 | 219.51 | 0.09 | 260 | 313.92 | 0.06 |
| *Imports* | 17,894.50 | 20,050.70 | 0.09 | 92.18 | 184.19 | 0.07 | 511.30 | 863.15 | 0.20 |
| *Exports* | 19,536.10 | 23,727.60 | 0.11 | 53.93 | 55.44 | 0.10 | 278.18 | 492.07 | 0.15 |
| | Middle East | | | Asia | | | Oceania and Australia | | |
| *International students* | 987 | 1,381.41 | 0.26 | 3,749 | 8,251.89 | 0.15 | 512 | 604.51 | 0.07 |
| *Imports* | 603.33 | 1,242.00 | 0.16 | 2,942.12 | 6,602.47 | 0.11 | 1,083.71 | 1,300.37 | 0.14 |
| *Exports* | 723.02 | 992.45 | 0.17 | 1,251.43 | 1,999.79 | 0.14 | 1,203.45 | 1,801.26 | 0.08 |
| | Sub Saharan Africa | | | | | | | | |
| *International students* | 537 | 1,346.97 | 0.11 | | | | | | |
| *Imports* | 239.08 | 923.36 | 0.06 | | | | | | |
| *Exports* | 174.54 | 553.85 | 0.09 | | | | | | |

*International students: total numbers. Imports and exports: current US dollars, milions.*Correlation between variable and time trend*

The fastest growth in the inflows of students from the *EU new countries* is likely to have been influenced by the students' acquisition of the EU citizenship during the period considered. By becoming EU citizens, they have gained not only the possibility to move freely within the Union, as any other EU citizen, but also to register at the universities of EU countries without the need of visas and residence permits. Moreover, and very importantly, the fees they have to pay to UK universities are substantially lower. The UK has a policy of differentiation of university fees for EU (including, of course, UK) and non-EU citizens. During 1999-2009, the fees paid by EU citizens have been about 70% lower of those paid by overseas students.[1] Furthermore, the Lisbon Convention of 1977 (*Convention on the Recognition of Qualifications concerning Higher Education in the European Region*)**,** initially signed by European countries and reaching in 2012 the number of 47 partners, stipulates that degrees and periods of study abroad must be recognized unless *substantial differences* can be proved by the institution that is charged with recognition. This represents a further incentive for young Europeans to study in a foreign European country; the university degree obtained in one country can turn to be useful in any economy of the wide European market.

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[1] The UK has the highest university fees in Europe and is the preferred destination of students for tertiary education.

The world patterns of trade flows partially differ from those of students. Table 2 shows that the UK bilateral trade takes place, in descending order, with Asian countries, EU new countries, European countries outside the EU and, in a lesser extent, with North America and the European countries of the EU 15 group. Also in this case, however, the more rapid growth in imports and exports concerns the *EU new countries* (and, also in this case, growth can be the result of the new EU membership), followed by the economic exchanges with South America, the EU15 and the Middle East (figures are in the third column for each group in the Table).

## III. Empirical strategy

Following Bergstrand (1985) and Gould (1994), I use a gravity equation of trade augmented by international students' variables to assess the link between education networks and the bilateral trade between the United Kingdom and students' home countries. The general specification is $Y_{it} = f(International\ students_{it};\ X_{it})$, where $Y_{it}$ is the volume of UK exports or imports, *International students$_{it}$* is a measure of students in the UK from country $i$ at time $t$, and $X_{it}$ is a vector of variables that influence bilateral trade between the UK and country $i$ at time $t$. The gravity model predicts that the volume of trade is positively related to the pair countries' economic masses (as measured by domestic products) and negatively related to the trade costs between them. Per capita GDP is also used to account for the wealth and productivity effects of the partner countries. Wealthier and more productive countries are hypothesised to be more open to trade while geographic distance is supposed to increase the costs of trade. Regressors include also other factors that the empirical literature have found to be significantly correlated to trade. These are the level of development of countries' institutions, a common language and trade and institutional agreements among countries (Dunlevy, 2006; Hutchinson, 2005; White, 2007). The base functional form used in this paper is:

$$Y_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 PcGDP_{it} + \beta_3 DIST_i + \beta_4 Governance\_quality_{it} + \beta_5 Language_i +$$

$$\beta_6 Interantional\_Students_{it} + \beta_7 D_{EU15} + \beta_8 D_{EUnew} + \beta_9 D_{CMW} + \lambda_t + u_{it} \qquad (1)$$

where $i = 1,\ldots, 167$ (countries) and $t = 1999,\ldots,2009$. All variables, except dummies, are in natural logs. Specifically, *GDPit* and *PcGDPit* are partner countries' *GDP* and per capita *GDP;* despite the general gravity model concerns pairs of trading countries, the UK *GDP* and per capita *GDP* are not included into the model because time dummies are used in all specifications; $DIST_i$ is the great circle distance between the foreign country capital city and London (km); $GOV_{it}$ is an index of quality of partner country's institutions; *Language$_i$* is the percentage of population speaking English in country $i$; $D_{EU15}$ is an European Union dummy that takes the value of one if country $i$ is in the EU

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in 1999; $D_{EUnew}$ is a dummy that takes the value of one if country $i$ is in the EU after 1999; $D_{CMW}$ is a Commonwealth dummy, equal to one if country $i$ is in the Commonwealth during the period 1999-2009; $\lambda_t$ is a time dummy, meant to capture a host of macroeconomic and trade policy factors that affect UK's aggregate trade. *International students$_{it}$*, the variable of interest, is measured in flows. The panel is unbalanced; there are no missing values concerning international students and about 3% missing data overall, distributed among the other variables. Variables and sources are listed in Table A2 in the Appendix.

As already mentioned, the coefficients of *GDP* and *PcGDP* are expected to be positive. As transport costs and cultural and institutional dissimilarities between countries - which enhance the costs of transactions - are supposed to increase with distance (*DIST*), its coefficient is expected to be negative. Better institutions and a common language should instead lower transaction costs, so the coefficients of *Governance quality* and *Language* are expected to be positive. Regarding the latter, the matching and referral services of international students and graduates in the UK can be reinforced by their speaking English. Hence, in principle, the 'common language' factor can be correlated with trade both directly, through the *Language* variable, and indirectly, through *International students*. The coefficients of the three dummies, *EU15*, *EU new countries* and *CMW*, meant to capture the effects of economic and institutional agreements between countries, are expected to be positive. The variable of interest, *International students*, should positively affect trade because, as mentioned above, international students, graduates and alumni are skilled individuals with specific knowledge on economic opportunities in foreign markets.

As network effects are likely to depend mainly on older students and graduates, the regressions are also run by substituting the time-varying variable *International students* with a time-invariant regressor, *International students$_{-1999}$*, which concerns the number of students registered in 1999, the initial year of the panel time-span. Reasonably, all students registered in 1999 will have completed their studies within the next few years and will be graduates and alumni when the imports and exports considered take place. Hence, the coefficient of this variable can be interpreted as the influence of graduate and alumni networks on bilateral trade.

The use of initial values is also useful as a preliminary test for potential reverse causality, but its reliability remains limited, as problems of this type could still affect coefficients. For example, international students might more easily choose to move to countries that already have important trade exchanges with the home economy because information on these countries is more easily available. Hence, to further control for this possibility as well as for that of omitted variables bias in coefficients, I utilize instrumental variables.

Following Javorcik et al. (2006), I consider two potential instruments are taken into account: the number of international students in Western European countries and the number of international students in Canada and USA, during the period considered.[2] After testing the appropriateness of each instrument, regressions are re-run by using the TSLS approach. In a further specification, as trade can be highly auto-correlated over time, the endogenous variable lagged one period is added to the base OLS model.

The dummies and time-invariant variables (*Distance, Language, EU15, EU new countries and CMW*) utilised in equation (1) and subsequent modifications should capture the effects of time-constant factors affecting each country, but there could still be other factors with these characteristics that are omitted from the regressions, To check for this possibility and, more generally, to test the robustness of results, countries fixed-effects are added to the base regression model.

Finally, a corollary to the main networks hypothesis is that the impact of transnational links should be higher as countries are more diverse. In this case, coefficients should be higher for networks related to the areas less culturally and institutionally similar to the UK, which, in Table 2, can be considered to be Sub-Saharan Africa, the Middle East and Asia, while they should instead be lower for the more similar ones: North America, Europe and Australia and Oceania. To test the impact of education networks across these different groups of countries and world areas, the *International students* variable is interacted with a dummy corresponding to each of the world regions considered in Table 2, and regressions are re-run accordingly.

## IV. Regression analysis

Table 3 presents the results of the regressions based on equation (1) and subsequent modifications. It shows that, and as expected, the coefficients of the variable *International students* are always positive; also, they are significant in all the export regressions and in all the import ones, except Model 5.

More specifically, Model 1 shows that a 10% increase in the number of international students in the UK leads to higher exports to and imports from the students' home countries of more than 3%. Significance levels are in both cases at 1%.

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[2] The two instruments are the flow of students from country *j* registered in Western European (WE) countries (except UK) at time *t* and the flow from country *j* registered in North America at time *t*. Given that the UK, North America and WE are major destinations for international students' flows, the flows in the UK and in the other two destinations should be positively correlated. However, there is less reason to expect that the flows in WE or in North America are correlated with the error term in the regression.

**Table 3. International students and trade between countries**

| Dependent variable: | Exports | | | | | Imports | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
| | OLS | OLS | IV var. | LDV | FE | OLS | OLS | IV var. | LDV | FE |
| *International students* | 0.329 *** | | 0.526 *** | 0.019 ** | 0.061 ** | 0.327 *** | | 0.491 ** | 0.027 ** | 0.026 |
| | (0.058) | | (0.129) | (0.008) | (0.031) | (0.087) | | (0.202) | (0.013) | (0.067) |
| *International students_ 1999* | | 0.326 *** | | | | | 0.328 *** | | | |
| | | (0.061) | | | | | (0.090) | | | |
| *GDP partner country* | 0.562 *** | 0.576 *** | 0.412 *** | 0.050 *** | 0.213 | 0.723 *** | 0.734 *** | 0.596 *** | 0.083 *** | -0.096 |
| | (0.055) | (0.055) | (0.104) | (0.012) | (0.247) | (0.089) | (0.090) | (0.166) | (0.018) | (0.663) |
| *PC GDP partner country* | 0.177 *** | 0.173 *** | 0.158 *** | 0.000 | 0.386 | 0.040 | 0.034 | 0.017 | 0.014 | 0.938 |
| | (0.047) | (0.050) | (0.041) | (0.007) | (0.246) | (0.080) | (0.082) | (0.064) | (0.013) | (0.648) |
| *Distance* | -0.384 *** | -0.406 *** | -0.328 *** | -0.050 *** | ___ | 0.089 | 0.059 | 0.126 | -0.017 | ___ |
| | (0.095) | (0.093) | (0.084) | (0.013) | | (0.161) | (0.156) | (0.133) | (0.018) | |
| *Governance quality* | 0.171 ** | 0.118 | 0.214 | 0.016 | 0.115 | 0.592 *** | 0.538 *** | 0.629 *** | -0.009 | 0.087 |
| | (0.087) | (0.091) | (0.078) | (0.014) | (0.091) | (0.133) | (0.138) | (0.112) | (0.021) | (0.154) |
| *Language* | 0.003 * | 0.003 | 0.002 * | 0.000 * | ___ | -0.001 | -0.002 | -0.002 | 0.000 | ___ |
| | (0.002) | (0.002) | (0.001) | (0.000) | | (0.003) | (0.003) | (0.003) | (0.000) | |
| *EU15* | -0.004 | -0.108 | -0.138 | -0.045 * | ___ | 0.499 | 0.392 | 0.391 | 0.022 | ___ |
| | (0.220) | (0.231) | (0.221) | (0.025) | | (0.397) | (0.384) | (0.346) | (0.049) | |
| *EU new countries* | 0.134 | 0.317 * | 0.023 | 0.028 | ___ | 0.642 ** | 0.825 *** | 0.548 ** | 0.104 ** | ___ |
| | (0.161) | (0.162) | (0.163) | (0.019) | | (0.303) | (0.318) | (0.264) | (0.050) | |
| *Commonwealth* | -0.128 | -0.133 | -0.491 | -0.020 | ___ | 0.435 | 0.426 | 0.133 | 0.070 * | ___ |
| | (0.192) | (0.195) | (0.298) | (0.020) | | (0.316) | (0.314) | (0.449) | (0.043) | |
| *Exports (Imports) t-1* | | | | 0.927 *** | | | | | 0.910 | |
| | | | | (0.016) | | | | | (0.017) | |
| *Constant* | 3.444 *** | 3.717 *** | 2.600 *** | 0.535 *** | 1.079 | -0.047 | 0.215 | -0.911 | -0.356 | -2.184 |
| | (0.998) | (0.998) | (0.964) | (0.134) | (1.235) | (1.654) | (1.626) | (1.556) | (0.221) | (3.269) |
| *Adjusted $R^2$* | 0.90 | 0.90 | 0.89 | 0.98 | 0.98 | 0.83 | 0.83 | 0.82 | 0.97 | 0.96 |
| *N. of observations* | 1774 | 1774 | 1774 | 1617 | 1788 | 1773 | 1773 | 1773 | 1615 | 1787 |

*All variables, except dummies, are in logs. Time-dummies used in all regressions. Robust standard errors in parentheses - * significant at 10%; ** significant at 5%; *** significant at 1%. Model 3, instrumental variables: international students in USA and Canada. First stage F-Statistic (1, 1761) = 230.3*

The professional and business ties of graduates and alumni are tested in Model 2, where the time-constant variable concerning the students registered the initial year, *International students$_{1999}$*, is used instead of *International students*. The resulting coefficients are high, significant and very similar to those of *International students* in Model 1. This provides support to the prior expectation that the education networks of graduates and alumni have a strong effect on the UK bilateral exports and imports.

The presence of students at the beginning of the period considered is less likely to have been determined by the international trade of the ensuing decade than vice versa, but coefficients might still be affected by endogeneity. To further check for this possibility, the instrumental variables approach is followed. A regression run with the two instruments already mentioned, international students in Western Europe, and in the North American countries of USA and Canada, in fact signals a potential problem of endogeneity in the OLS base specification. However, while both instruments appear to be uncorrelated with bilateral trade in the UK (more specifically, with the $u_{it}$ of equation 1), from first stage regressions (in Table A1 in the Appendix), only *International students in North America* is significantly correlated with *International students* in the UK. Hence, the regressions of Model 3 in Table 3 are run by using this latter instrumental variable, the validity of which is supported by an *F*-statistics value of 230.3. Results show that the coefficients of the TSLS regressions are higher than the OLS ones of Models 1-2, both in the import and export regressions: values in Model 3 are 0.53 for exports and 0.49 for imports, and significance levels are at 1% and 5% respectively.

Model 4 includes the lagged dependent variable among regressors to obviate for potential correlation of trade between countries over time. Results show that, conditional on past exports and imports, the impact of international students on bilateral trade persists: a 10% increase in the numbers of registered international students has the long run effect of increasing exports of 2.7% and that of increasing imports of 3% (significance level at 5% in both cases).[3] The values of these coefficients are similar to those of the OLS Models 1 and 2.

To control for factors that can affect countries each year, all regressions of Table 2 include time-dummies. Also, in Models 1-4, *Distance, Language*, *EU15,* and *CMW, EU new countries* should control for factors that vary across countries but not over time. As other time constant variables could still be omitted, Model 5 includes countries' fixed effects (FE). As a result, the explanatory power of the equations substantially decreases, which is not surprising, given that, as Table 1 shows, most of the variation in the data is due to between rather than to within country differences. Moreover, the FE model is based on the assumption of time-invariance of the omitted

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[3] From $y-ay_{t-1}= \gamma + \beta x$, the long run value of coefficient $\beta$ is $\beta/(1-\alpha)$.

variables, but in this case at least one important factor indeed changes during the period considered, the already mentioned EU membership status, which is subsumed in countries' fixed effects. Despite this, Model 5 provides further evidence of the link between international students and trade, particularly in the exports equation, where the coefficient of *International students* is higher than that of Model 4 (significance level at 5%), while in the imports regression the two coefficients are equal, but the result of Model 5 is non-significant.[4]

In fact, the *EU new countries* variable is treated as a fixed factor also in Models 1-4, while it captures the impact of institutional and economic agreements that have changed during the period considered. These changes may have affected the trade flows between the UK and the EU new member countries and, through trade-diversion mechanisms, also those with other world areas. Moreover, they may have influenced the flows of students from these countries to the UK. Hence, to test the robustness of coefficients to the above specifications, the regressions of Models 1-5 have been re-run by using dynamic time-dummies, obtained by interacting *EU new countries* with a time (year) dummy. The results concerning the OLS model are Table A1 in the Appendix; they show that the coefficients of the variable of interest do not vary significantly with respect to those of Model 1 in Table 3. The same applies to the coefficients concerning the other specifications (Models 2-5). Regressions are available from the author upon request.

In sum, across the different specifications, the transnational links of education networks appear to robustly and substantially affect the UK's bilateral trade with the home countries of international students.

Given this aggregate result, it is now of interest to see whether international students of different countries and areas of the world have a different effect on bilateral trade; in particular, if students from more dissimilar areas have a stronger impact on bilateral trade. Table 4 presents the results of splitting the data concerning students into different world areas of origin. More precisely, the variable *International students* is interacted with a dummy corresponding, in each case, to *EU15* countries, *EU new countries*, European countries outside the EU, countries of North, Central and South America, of Asia, Sub-Saharan Africa, the Middle East and of Oceania. Disaggregated effects are tested with the use of the dependent variable lagged one period and with countries' fixed effects (Table 4, Models 6 and 7). As in the former regressions, time-dummies are used in all regressions.

The coefficients of the interacted variable in Table 4 vary markedly across the world areas. More precisely, the effects of education networks is positive and significant in all regressions

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[4] The two specifications lead to non-comparable coefficients; however, for a discussion about lagged dependent variables versus fixed effects, see Angrist and Pischke (2009).

concerning bilateral trade with the Middle East; they are also positive and significant on the exports to the *EU new countries,* and, in Model 6, on imports from this region. In particular, the long run effect of an increase of 10% in students from the Middle East on exports to this area is of 2.8%, while the effect of a parallel increase in students from the EU new member countries on exports to these countries is of 2.3%. Turning to imports, a 10% increase in students from Middle East countries boosts imports from this area by 2.9%. The coefficient concerning the EU new countries is positive in both specifications, but significant only in Model 6. In sum, both in the exports and in the imports regression, the more robust results concern the education networks linked to the Middle East and to the new member countries of the EU. Also in this case, regressions have been re-run with the time-dummies replaced by varying time-dummies (as above, *EU new countries* is interacted with a time effect) without finding significant variations in coefficients.

# Table 4. International students and world regions

| Dependent variable: | Exports | | Imports | |
|---|---|---|---|---|
| | Model 6 | Model 7 | Model 6 | Model 7 |
| | LDV | FE | LDV | FE |
| *students x EU15* | 0.01 | 0.11 ** | 0.02 | 0.51 |
| | (0.01) | (0.05) | (0.01) | (0.41) |
| *students xnew EU countries* | 0.02 ** | 0.10 *** | 0.04 ** | 0.10 |
| | (0.01) | (0.04) | (0.02) | (0.12) |
| *students x Europe no27* | 0.01 | 0.02 | 0.03 * | -0.13 |
| | (0.01) | (0.10) | (0.01) | (0.18) |
| *students x Sub Saharan Africa* | 0.02 * | 0.04 | 0.03 ** | -0.08 |
| | (0.01) | (0.08) | (0.02) | (0.13) |
| *students x North America* | 0.01 | 0.01 | 0.01 | 0.24 |
| | (0.01) | (0.13) | (0.02) | (0.18) |
| *students x C. America and Caribbean* | 0.00 | -0.09 | 0.03 | -0.25 |
| | (0.01) | (0.11) | (0.02) | (0.21) |
| *students x South America* | 0.02 ** | 0.01 | 0.05 ** | -0.23 |
| | (0.01) | (0.11) | (0.02) | (0.19) |
| *students x Middle East* | 0.02 ** | 0.30 ** | 0.03 * | 0.57 *** |
| | (0.01) | (0.12) | (0.01) | (0.20) |
| *students x Asia* | 0.01 | 0.00 | 0.03 ** | -0.07 |
| | (0.01) | (0.06) | (0.01) | (0.13) |
| *students x Oceania* | 0.01 | -0.06 | 0.04 | -0.08 |
| | (0.01) | (0.08) | (0.03) | (0.14) |
| *GDP partner country* | 0.06 *** | 0.10 | 0.09 *** | -0.34 |
| | (0.01) | (0.22) | (0.02) | (0.61) |
| *PcGDP partner country* | 0.01 * | 0.48 | 0.03 * | 1.16 * |
| | (0.01) | (0.23) | (0.02) | (0.63) |
| *Distance* | -0.05 ** | ___ | -0.04 * | ___ |
| | (0.01) | | (0.03) | |
| *Governance quality* | 0.01 | 0.10 | 0.01 | 0.06 |
| | (0.01) | (0.09) | (0.02) | (0.13) |
| *Language* | 0.00 | ___ | 0.00 | ___ |
| | (0.00) | | (0.00) | |
| *Commonwealth* | -0.01 | ___ | 0.08 | ___ |
| | (0.02) | | (0.04) | |
| *Exports (Imports) $_{t-1}$* | 0.92 *** | ___ | 0.91 | ___ |
| | (0.02) | | (0.02) | |
| *Constant* | 0.24 * | 0.61 | -0.06 | -3.57 |
| | (0.14) | (1.23) | (0.24) | (3.30) |
| *Adjusted $R^2$* | 0.98 | 0.98 | 0.97 | 0.96 |
| *N. of observations* | 1617 | 1788 | 1615 | 1787 |

*All variables, except dummies, are in logs. Robust standard errors in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. Time dummies in all regressions.*

How can these results be interpreted? On the one hand, the high and significant coefficients of the education networks linked to the Middle East countries appear to confirm the expectation of strong effects with more dissimilar countries and areas. The cultures, religions, languages, institutions of the countries of the Middle East tend to differ markedly from those of the UK. Also, with the exception of Pakistan, none of them belongs to the Commonwealth.[5] On the other hand, network links with EU countries also have positive and significant coefficients, and these countries cannot be considered more dissimilar to the UK than other world regions.

In this latter case, geographic and institutional factors may have some influence on the formation and endurance of students' networks. For example, the formation of social ties among European students can be made easier by the geographical vicinity of the UK with the countries of origin and the freedom of circulation within the EU. Moreover, as already mentioned, the *Convention on the Recognition of Qualifications concerning Higher Education in the European Region*, together with the more general agreements concerning the *European Higher Education Area* increasingly allow EU graduates to work in any country of the European Union without substantial bureaucratic impediments. This adds to the incentives for European students to create long-lasting network ties (a study on the economic interactions between graduates from the same university is in Cohen, Frazzini and Malloy, 2008).

The coefficients of the other variables of the gravity model are mostly as expected. The coefficients of *GDP* and of *PcGDP* are positive in all specifications and, especially for the exports equation, are also significant. The distance variable (*DIST*) is always negative and significant in the exports equation, while it is not correlated with imports. This is consistent with the geographical composition of trade flows from and to the UK (Table 1): imports originate from faraway markets, among them Asia, while exports are more directed to Western, richer and nearby countries. A similar pattern follows the *Government Quality* variable: coefficient values are positive in the export regressions, while for imports results are not robust (coefficients are positive in Models 1-3 and negative in Model 4).

The coefficient of the *Language* variable (proportion of people speaking English in each partner country) has a low value, but a positive sign, as expected, in the exports equation (significance at the 10% level in Models 1, 3 and 4 of Table 3). As already mentioned, some of the trade-enhancing effect of a common language can also be channelled by the *International students*

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[5] During the last decade, there has been a surge of interest of UK multinationals in Middle East economies, especially of the Gulf area. Bilateral trade flows with these countries include goods and, growingly, also services (among which, education, exported by UK universities). According to this paper's findings, education networks may have supported this increase in trade flows.

variable. Table A1 in the Appendix shows that the coefficient of *International students* slightly increases if the OLS regressions are run without the *Language* variable, suggesting that the common language factor also works through the international links of education networks. The dummies concerning the *EU15* and Commonwealth, *CMW*, are scarcely significant, while *EU new countries* is always positive and significant in the import regressions (Models 1-4), and, concerning exports, in Model 2.

The robustness of the results of education networks of Table 3 are further tested by taking into account other factors that can potentially affect trade and the impact of international students. For example, individuals having to decide where to study abroad may prefer countries where a community of nationals is already present. In this case, the impact on trade might in fact depend on the immigrant community, rather than on international students. To test for this possibility, I have re-run the regressions of equation (1) by adding the stocks of immigrants from the sending countries among the regressors. Results, in Table A1 in the Appendix, are not comparable with those of Table 2 because a very substantial number of data on immigrants are missing (more than 80%). It can be observed, however, that the coefficient of the immigrant variable is non-significant in both the export and import regressions, while that of *International students* is positive and significant in both.

Other factors that have been tested are religion, as a proxy of cultural similarity (measured as the proportion of people of Christian religion living in each partner country), a dummy with value one for the UK ex-colonies, as a proxy for similarity in institutions, the level of literacy in countries, as a measure of human capital in countries, an index of inflation in countries as a measure of exchange rate volatility. In none of these cases, the coefficients of these variable turned out to be significant or robust.

## V. Conclusion

To my knowledge, this paper is the first systematic analysis of the link between education networks and bilateral trade. To date, the few economic studies on international students have focused on brain-drain and innovation activity in sending or receiving countries, or on the determinants of studying abroad. This paper makes clear the existence of a nexus between transnational education networks and the economic exchanges between the home countries and the country of higher study of students and graduates. It can therefore represent a contribution towards the understanding of the possible overall effects of international students on economy as a whole.

The splitting of the data into world areas shows that the networks linked to the Middle East and to countries of the European Union, especially the new member economies, have the strongest effects on trade. Hence, network effects are vary across countries, but the picture that emerges does provides a clear support to previous findings in the literature on international networks (Girma and Yu, 2002): in this case the effects on trade do not unambiguously increase with the degree of diversity between the partner countries

On the one hand, the influence on bilateral trade of Middle East education networks appears to be consistent with the diversity assumption; on the other, the effect of networks linked to countries of the European Union does not provide support for it, these countries cannot be considered more dissimilar to the UK than other world areas. This latter result, instead, might be driven by other forces, concerning more directly the formation and endurance of student ties. For example, the geographical vicinity between countries and the freedom of movement within the EU can enhance and strengthen the interactions among students and graduates. A positive influence can also derive from the measures pursued during the last fifteen years by European and neighbouring countries, leading to a convergence in higher education standards and to the reciprocal acceptance of university degrees. For graduates and alumni, the practical usefulness of the ties born while at university increases with the possibility of freely seeking job positions in the whole wide European market. Both these elements can favour the robustness of the network ties and the circulation of valuable economic information.

While the UK has a long tradition of attracting students from abroad, despite some policy restrictions in recent years, other countries lack a clear position in this respect. This study has shown that the international movements of students can be an effective way of improving the economic exchanges between the countries involved.

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# Table A1. First stage TSLS and Sensitivity analysis (OLS).

| Dependent variable: | International students | | Exports | | | Imports | | |
|---|---|---|---|---|---|---|---|---|
| | First stage Model 3 -Table 3 | | with *Immigrants* | with varying time-dummies | without *Language* | with *Immigrants* | with varying time-dummies | without *Language* |
| *International students* | | | 0.149 * | 0.337 *** | 0.357 *** | 0.433 *** | 0.339 *** | 0.324 *** |
| | | | (0.082) | (0.058) | (0.055) | (0.164) | (0.088) | (0.087) |
| *Immigrants* | | | 0.082 | | | -0.041 | | |
| | | | (0.101) | | | (0.167) | | |
| *International Students in Western Europe* | -0.008 | | | | | | | |
| | (0.080) | | | | | | | |
| *International students in North America* | | 0.406 *** | | | | | | |
| | | (0.082) | | | | | | |
| *GDP partner country* | 0.764 *** | 0.471 *** | 0.653 *** | 0.550 *** | 0.532 *** | 0.752 *** | 0.708 *** | 0.727 *** |
| | (0.071) | (0.072) | (0.074) | (0.055) | | (0.127) | (0.088) | (0.089) |
| *PC GDP partner country* | 0.023 | 0.113 | 0.222 *** | 0.147 *** | 0.213 *** | -0.142 | 0.002 | 0.037 *** |
| | (0.088) | (0.093) | (0.079) | (0.043) | (0.046) | (0.223) | (0.074) | (0.080) |
| *Distance* | -0.256 | -0.311 ** | -0.456 *** | -0.383 *** | 0.085 | -0.391 ** | 0.072 | 0.085 |
| | (0.160) | (0.123) | (0.093) | (0.091) | (0.158) | (0.177) | (0.155) | (0.158) |
| *Governance quality* | -0.049 | -0.112 | 0.136 | 0.225 *** | 0.154 * | 0.907 ** | 0.659 *** | 0.585 *** |
| | (0.157) | (0.159) | (0.116) | (0.080) | (0.087) | (0.351) | (0.123) | (0.133) |
| *Language* | 0.002 | 0.000 | 0.002 | 0.003 | | -0.002 | -0.002 | |
| | (0.003) | (0.003) | (0.002) | (0.002) | | (0.004) | (0.003) | |
| *EU15* | 0.689 * | 1.051 *** | 0.118 | -0.019 | 0.580 ** | -0.424 | 0.462 | 0.509 |
| | (0.405) | (0.388) | (0.208) | (0.217) | (0.241) | (0.415) | (0.373) | (0.384) |
| *EU new countries* | 0.531 * | 0.629 *** | 0.002 | | 0.390 *** | -0.004 | | 0.680 ** |
| | (0.276) | (0.238) | (0.221) | | (0.149) | (0.407) | | (0.291) |
| *Commonwealth* | 1.779 *** | 1.770 *** | 0.304 | -0.164 | -0.231 | 0.272 | 0.397 | 0.377 |
| | (0.237) | (0.211) | (0.253) | (0.192) | (0.168) | (0.386) | (0.316) | (0.297) |
| *Constant* | 4.759 ** | 2.627 * | 3.780 *** | 3.603 *** | -0.045 | 4.349 * | 0.174 | -0.013 |
| | (1.920) | (1.451) | (1.071) | (0.975) | (0.391) | (2.501) | (1.608) | (1.644) |
| *Adjusted R²* | 0.732 | 0.767 | 0.924 | 0.897 | 0.891 | 0.838 | 0.822 | 0.825 |
| *N. of observations* | 1779 | 1780 | 267 | 1774 | 1788 | 267 | 1773 | 1773 |

*All variables, except dummies, are in logs. Robust standard errors in parentheses - \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. Varying time dummies: Eu new countries interactcted with time unit (year).Time-dummies used in the other regressions.*

## Table A2. Variable definitions and sources

| Variable | Definition | Main source |
|---|---|---|
| *International students* | International students: left their country of origin and moved to another country for the purpose of study. Number of students enrolled refers to the count of students studying in the reference period. | *UNESCO.* International flows of mobile students at the tertiary level (ISCED 5 and 6) |
| *Exports / Imports* | International trade, all commodities. Value, current US$. | OECD International trade by commodity statistics, harmonized system, 1998. |
| *GDP* | | IMF - Statistics |
| *PcGDP* | Per capita GDP | IMF - Statistics |
| *Distance* | Great circle distance between capital cities and London. Km. | http://www.chemical-ecology.net/java/capitals.html |
| *Language* | Proportion of people speaking English over total population. | CIA World Factbook |
| *Governance quality* | Worldwide Governance Indicator. Includes six dimensions of governance: Voice and accountability Political stability and absence of violence; Government effectiveness; Regulatory quality; Rule of Law; Control of corruption. | World Bank Developed by Kaufmann et al. (2009). The six indicators are measured in units ranging from about -2.5 to 2.5, with higher values corresponding to better governance outcomes. |
| *Immigrants* | Stock of foreign born population by country of birth (thousands) | OECD International Migration Database |
| *CMW* | Dummy taking value of one if country belongs to Commonwealth during 1999-2009: Antigua and Barbuda, Australia, Bahamas, Bangladesh, Barbados, Belize, Botswana, Brunei, Cameron, Canada, Cyprus, Dominica, Gambia, Ghana, Grenada, Guyana, India, Jamaica, Kenya, Lesotho, Malawi, Malaysia, Maldives, Malta, Mauritius, Mozambique, Namibia, New Zealand, Nigeria, Pakistan, Papua New Guinea, Rwanda, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Singapore, South Africa, Sri Lanka, Swaziland, Rwanda, Tanzania, Trinidad and Tobago, Uganda, Zimbabwe. | |
| *EU15* | Dummy taking value of one if country belongs to the European Union in 1999: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom. | |
| *EU new countries* | EU in 2009 less EU15: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia. | |
| *Europe no EU 27* | Albania, Armenia, Belarus, Bosnia and Herzegovina, Croatia, Iceland, Liechtenstein, Moldova, Norway, Romania, Russia, Serbia and Montenegro, Switzerland, Ukraine, Israel | |
| *North America* | Canada, Mexico, USA | |
| *Sub-Saharan Africa* | Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Congo D.R. of, Congo R. of, Cote d'Ivoire, Eq. Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Mozambique, Mauritania, Mauritius, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, S. Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe. | |
| *Central America and* | Antigua and Barbuda, Bahamas, Barbados, Belize, Costa Rica, Dominica, | |

| | |
|---|---|
| *Caribbean* | El Salvador, Grenada, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Panama, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago |
| *South America* | Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela |
| *Middle East* | Afghanistan, Algeria, Azerbaijan, Bahrain, Egypt, Georgia, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Qatar, S. Arabia, Syria, Tunisia, Turkey, United Arab Emirates, Yemen |
| *Asia* | Bangladesh, Brunei, Cambodia, China, Hong Kong, India, Indonesia, japan, Kazakhstan, South Korea, Kyrgyzstan, Macao, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka, Tajikistan, Thailand, Turkmenistan, Uzbekistan, Vietnam |
| *Oceania* | Australia, Fiji, New Zealand, Papua New Guinea |

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