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THE DETERMINANTS OF THE ATTRACTIVENESS OF NATIONAL HIGHER EDUCATION SYSTEMS

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In this paper we revealed the factors determining the attractiveness of national higher education systems and then estimated their influence on the foreign students' flows between 129 countries for period 1998-2005. We found that among the education policy-making determinants "Number of national higher educational institutions in the Academic Ranking of World Universities" in host country and "R&D expenditure" in source and host countries the most impact foreign students' flows. The presences of "Common border", "Common language", "Colonial ties in the past" seem to be important predictors of the expanding foreign students' flows. "Distance" negatively influences on the foreign students' mobility. As well our results indicate that there is no presence of close relationship between previous migration flows and foreign students' flows.

Keywords: foreign students' flows, higher education, human capital, gravity model.

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INTRODUCTION

(i) POLICY CONTEXT OF THE STUDY

For last decades the world education market presents a speedily developing sector of the world trade of services. The growth in the number of foreign students all over the world is considerable: from 0.6 millions of students in 1975 to 2.9 millions in 2006[1]. Higher education is no longer just a public good; it is a service that can be sold and bought from providers, both national and foreign. Higher educational institutions are enterprises that supply educational services to the national and international markets and students are consumers who choose the country that system of higher education is seemed to be more attractive for them[2].

World education market became the arena where countries compete with each other for foreign students. European countries realizing that they have lost their leading positions at the world education market during the 20th century in favor of the USA, have pursued, for last decade, a policy aiming to create the European Higher Education Area (Bologna process[3]) with a common higher education degree system that should raise the competitive capacity of the European higher educational institutions at the world education market and thus its attractiveness for foreign students. And individual countries do their best aiming to attract foreign students[4].

Attracting foreign students into national educational institutions provides a wide range of the advantages not only for higher education sphere but as well for economy in a whole. Firstly, foreign students can be considered as an additional source to enlarge both the budgets of higher educational institutions (payment for studying), and the budgets of enterprises of different industries (foreign students during their studying pay for accommodation, buy food, clothes, travel and etc.), and, of course, the state budget (taxes). Secondly, necessity to provide the high-class quality of proposed educational services in order to hold their positions at the world education market encourages national educational institutions to improve their curriculums to make them appropriate to the frequently changing requirements of the labor market. And thirdly, foreign students are potential well-educated, talented, skilled, highly-motivated employees;

[1] OECD. Education at a Glance. 2008. Indicator C3: Who studies abroad and where? www.oecd.org
[2] Lorenz (2006)
[3] Understanding the Bologna process (2005)
[4] Ministry of Education of Finland (2001) – Finland policy; Lorenz (2006) - Dutch policy.

attracting foreign students has become the platform for attracting the "best brains" all over the world.

Looking at the statistics we can state a fact that world education market is already divided by a group of countries. In absolute value the highest number of foreign students can be found in the USA (20.0% of the world education market in 2006), UK (11.3%), Germany (8.9%), France (8.5%), Australia (6.3%), Canada (5.1%), and Japan (4.4%)[5]. But at the same time based on a relative indicator, "the share of foreign students in the total number of students" we observe another situation: the leading positions are taken by Australia (17.2%), New Zealand (15.5%), UK (14.1%), Switzerland (13.7%), Austria (12.0%), France (10.8%), Belgium (7.4%), Canada (7.4%), Ireland (6.8%), and USA (3.8%)[6].

So the structure of the countries - leading exporters of educational services is mixed. These countries vary on the socioeconomic levels of their development, types of the pursuing state policies, sizes, geographical locations, positions at the global markets of goods and services, and etc. Besides the students' flows also differ on their source-host-countries structure: from developed to developed countries, from developing to developed countries. Why do students go abroad for studying? What factors do determine the attractiveness of higher education systems for foreign students? In this paper we are going to find answers on these questions.

(ii) STATEMENT OF THE RESEARCH PROBLEM

The aim of our research is to explore the determinants of national higher education systems' attractiveness and to estimate their influence on the foreign students' flows between129 countries at those 30 OECD countries are considered as host and source countries (inflows and outflows of foreign students), and 99 non OECD countries are considered as source countries (outflows of foreign students to OECD countries) for period 1998-2005.

The modern literature is rather rich in the studies dedicated to different aspects of higher education internationalization. The problems of the development of the international trade in educational services, expansion of GATS/WTO competence for higher education, student mobility, migration and other related issues are widely discussed in the literature for last years. But the most part of works consider the policy-making aspects of these problems. There is a lack of the empirical studies examining the factors which

[5] OECD. Education at a Glance. Indicator C3: Who studies abroad and where? OECD 2008.
[6] ibid.

stimulate student mobility; moreover in that limited amount of the empirical researches that cover the determinants of national higher education systems' attractiveness there is typically (excepting as we know two papers) only a descriptive analysis of these determinants without estimation of their influence on the foreign students' flows.

The contribution of our research to the existing literature is: (i) using the utility-maximization approach to ground the selection of the factors that define the foreign students' choice of a country for studying and thus determine the attractiveness of concrete national education system for foreign students; (ii) applying the augmented gravity model to estimate their influence on the foreign students' flows[7]. Our model includes 22 determinants and we applied it for foreign students' flows between 129 countries worldwide for period 1998-2005.

LITERATURE REVIEW

What specific features should national higher education systems have in order to be attractive for foreign students? To get a clear picture we have to look at the process of higher education internationalization in a whole: from points of view both of individuals and of institutions of higher education, and of national and international authorities.

From individual point of view we can speak about wish of a person to obtain education in the concrete overseas institution of higher education. Our world is an educational meritocracy in which a person's socioeconomic status is limited, presumably, only by his/her educational investment: more educated people are always more productive than less educated people, and this differential productivity is sufficient to explain all social inequities (Baptiste, 2001). A person invests in his/her education in order to increase future earnings both economical and social, if a person considers that education system of foreign country covers his/her requirements in gaining new knowledge and skills in a greater extent than national ones, then he/she takes a decision to go abroad for studying.

The theoretical ground for such decision is provided by the human capital theory. Education is a key

[7] Gravity model has been used before on students' flows data: *Bessey (2007)* included 5 determinants in the model and applied it for foreign students' inflows to Germany for period 1997-2002; *Thissen & Ederveen (2006)* included 9 determinants in the model and applied it for foreign students' flows between OECD countries for period 1998-2002.

aspect of human capital and population quality (Adidam, 2006). The modern concept of human capital was formulated by Schultz T. (1961) as “the knowledge and skills that people acquire through education and training as being a form of capital, and this capital is a product of deliberate investment that yields returns” (cited on Zula & Chermack, 2007). Education is one of investment alternatives that individuals may choose to obtain future benefits: education, training, and development, and other knowledge have a positive impact on productivity and wages (Becker, 1993; cited on Reed & Wolniak, 2005).

Human capital theory recognizes two legitimate social entities: the utility-maximizing individual and the free market. Maximizing behavior (utility-maximization) assumes that human beings only engage in behaviors from which they derive the maximum benefit; as utility-maximizing individuals, humans are incapable of engaging in activities other than those that maximize their benefits (Becker, 1976; cited on Baptiste, 2001). Utility-maximization function allows measuring human preferences for wealth and the amount of risk they are willing to undertake in the hope of attaining greater wealth. In point of education we can state that people aspire to obtain higher level of education just if they see the economic benefits: increasing in wages, career growth, and etc.

Market equilibrium rests on the assumption of perfectly competitive, free markets. Markets are arenas in which goods and services are produced and distributed entirely on the basis of supply, demand, and price (Becker, 1976; cited on Baptiste, 2001). The market is determining, legitimizing, and regulating every aspect of human life and social behavior. All social institutions and phenomena are interpreted as markets because, they all surrender to market forces and obey the law of utility-maximization. The regulatory forces of the market, operating in concert with people’s utility-maximizing nature, ensure that everyone receives mutual and just recompense for their efforts and investments (Baptiste, 2001). In aspect of education we can say that at the international market those higher educational institutions which satisfy in maximum extent the needs of the potential students are attractive both for national and foreign students.

From point of view of higher educational institution the internationalization of higher education provides many challenges. The first of them is how to survive at national and international education markets in the terms of perfect competitiveness.

As an economic agent at the education market the institution of higher education produces the services for consumers who are the students. In this interpretation we face the problem of transforming the nature of

education. Many authors argue that the higher education gradually lost its characteristics as a public benefit and transformed into a commodity with all corresponding properties. For example, Lorenz (2006) presenting a description and analysis of the Dutch policies in higher education before and after the Bologna Declaration concluded that educational policies in the Netherlands can be summarized under the labels of commoditization of knowledge and the marketization of higher education.

In these conditions there are two situations. The first one is when national higher education institutions are highly competitive both at national and foreign markets – here the internationalization brings only benefits. It relates to developed countries. The second situation is when national higher education institutions are attractive for national consumers only at the absence of foreign ones. It is inherent presumably to higher education systems of developing countries.

In these two situations the perspectives of the higher education institutions are extremely different. And the roles of national and international authorities are significantly increasing. National authorities provide the financial support for national producers of educational services and, being the actors of international environments, defend their interests at the world education market including trading aspects.

The regulation and monitoring of international trade is a competence of the GATS/WTO. The problem of trade liberalization in education is on agenda still from the Doha Round of Negotiations[8]. However the majority of nations have yet to make any formal statement in the liberalizing the trade in education and there remains considerable uncertainty about the coverage and implications of GATS in the education sector, and a wide range of opinions about possible benefits and risks for both developed and developing countries (Knight, 2003). The top three risks are commercialization and commoditization of education programs, the increase in the number of foreign "degree mills" and low-quality providers, and brain drain (Knight, 2007).

Many governments desire to use education to meet certain national objectives, and take the view that there is a real risk that competition from foreign suppliers might compromise their ability to do so (Larsen et al., 2002). As a possible way to alleviate these concerns authors propose to place certain conditions upon market access for foreign suppliers and to create the internationally-supplied educational services meeting certain quality standards. The increasing student mobility leads to develop multicultural skills and increases

[8] Negotiations, implementation and development: the Doha agenda // http://www.wto.org/english/tratop_e/dda_e/dda_e.htm

the quality of universities (Mechtenberg & Strausz, 2006). There can be isolated three effects 1) a competition effect that raises quality; 2) a free rider effect that lowers quality; 3) a composition effect that influences the relative strengths of the two previous effects.

For developing countries those higher education systems are weak the liberalization of trade in educational services are challenged. Their governments hesitate to make any commitments on trade in education because of the perceived loss of discretion in policy making and because of the weaknesses in their domestic regulatory systems (Bashir, 2007).

It's worth to note that situations among developed countries which propose educational services for foreign students also vary one from another, mainly due to the nature and range of educational provision and the characteristics of the demand and expectations of foreign students (OECD Annual report on migration, 2001). There are two main groups of countries: leading exporters and those countries that try to expand their presence at the international education market.

The countries from the former group are presumably highly-developed English-speaking nations (the United States, the United Kingdom and Australia) and non English-speaking countries where English is spreading as a medium of instruction (Sweden and others), particularly in programs designed to attract foreign students (Marginson et al., 2007). As well large countries whose language is more widely used internationally attract a larger number of students, especially if they come from one of the member countries of a regional economic group - EU, NAFTA (OECD Annual report on migration, 2001).

Besides "language" the other factors that increase the attractiveness of a country to study are "overall reputation" and "future employment prospects" (Plompen & Murrell, 2006). In general the directions of student migrations are governed by geographical, linguistic, cultural, historical, institutional and academic considerations.

The countries from the last group aiming to expand their positions at the international education market adopt a wide range of policies. And these policies cover different spheres: migration, foreign relations, culture, language, science and technology (Knight, 2003). For example, the officials of the Ministry of Education of Finland (2001) in their "International Strategy for Higher Education" concluded that in connection with the comprehensive ongoing reform of the foreigners' legislation, immigration and residence statutes should be revised to ensure that people who come to Finland to study can stay on to work

here when they have finished their studies. They noted that Ministry of Education and the immigration authorities should work more closely together to make the immigration of foreign students more flexible.

The approach to consider foreign students' mobility as a form of labor migration is widely spread. A close link between student flows and migration flows was discovered in the study by Dreher & Poutvaara *(2006)*. Using panel data for 78 countries of origin they examined the impact of student flows to the United States on subsequent migration there over the period 1971-2001. The authors found out that the stock of foreign students is an important predictor of subsequent migration: a 10 percent increase in student flows leads to an increase in immigration of between 0.3-0.9 percent.

Parey & Waldinger (2008) investigated the effect of studying abroad on international labor market mobility later in life for university graduates. As a source of identifying variation, they exploited the introduction and expansion of the European ERASMUS student exchange program. Their results indicated that studying abroad increases an individual's probability of working in a foreign country by about 15 to 20 percentage points, suggesting that study abroad spells are an important channel to later migration.

As well there are of a big interest the researches dedicated to analyses of the factors that can stimulate or hamper the student mobility. For example, research by West et al. (2001) which was conducted in five countries – France, Germany, Greece, Sweden and the UK. For each country a review of the literature relating to student mobility and admissions to higher education was carried out. In addition, the conceptual issues relating to student mobility and admissions were examined. The authors identified key barriers to student mobility. Among them there are language barriers, finance (student fees, availability of loans or grants), problems gaining employment whilst studying, gaining a residence permit, cultural barriers.

Other authors studying the relations between education and Research and Development (R&D) intensity found out that the positive externalities of R&D are indirectly influenced by the level of education (Bassanini & Ernst, 2002; cited on Thissen & Ederveen, 2006).

Tremblay (2002) basing on the comparative analyses of the data standardized by the OECD, UNESCO and EUROSTAT evaluated the scale, directions, characteristics and determining factors of student flows. As a result the author pointed out several variables: size of the country of origin and host country, geographical remoteness, languages used in the education system, institutional proximity, and considerations of an economic nature relating to tuition fees and living costs on university sites and campuses.

At the same time much less attention is paid to the estimation how these factors influence on the students' flows. As far we know there are two papers investigating this question. The first is research by Thissen & Ederveen (2006). The authors considered the policy-making aspects of coordination of higher education at European level. They applied the gravity model approach to estimate how social-economical-educational-religious-geographical factors impact on the student's flows between EU countries. Among their results there were ones that can be of interest for our research: they found that the larger countries/schools do not necessarily provide higher quality education; there is evidence that student mobility is a precursor for labor migration; quality does matter for students, and student mobility is increasing.

The second is research by Bessey (2007). The author analyzed international student migration to Germany using an augmented gravity equation. She took 5 determinants as: GDP per capita, population, total student stocks, political freedom, and distance. And author found evidence of strong network effects and of the importance of distance – results familiar from the empirical migration literature. The importance of disposable income in the home country does not seem to be too big for students, while the fact of being a politically unfree country decreases migration flows significantly.

Reviewing the literature we can draw a few conclusions: (i) the theoretical base for exploring the set of the determinants of national higher education systems' attractiveness may serve the human capital theory (the utility-maximization approach); (ii) the practical base for exploring the set of these determinants can be the empirical studies and policy-making papers on the education and related issues; (iii) gravity model approach may be applied to estimate the influence of these determinants on the foreign students' flows.

BRIEF REVIEW OF WORLD EDUCATION MARKET

The world education market is a rapidly growing sector of the world trade of services. Quantitatively the international trade in educational services is estimated by the number of foreign students who are studying at national higher educational institutions (Larsen et al., 2002).

Analyzing the data on distribution of foreign students' flows between all countries worldwide, that is presented at the *Table 1,* the following tendencies can be marked out: (i) the number of foreign students worldwide in period 2001-2005 significantly grew from 1.645 to 2.726 M of students; (ii) intra-OECD

foreign students' flows decreased from 40.4% to 27.58% of total worldwide students' flows; (iii) the flows of foreign students from OECD-countries to non-OECD countries were small, but their values increased from 0.24% to 0.92% of total number foreign students worldwide; (iv) although the number of foreign students on the absolute value in OECD-countries grew from 1.539 to 2.296 M, on the relative value as "share of foreign students in OECD-countries in the total number of foreign students world wide" decreased from 93.56% to 84.23%; (v) the growth of foreign students' flows from world to non-OECD-countries in period 2001-2005 was enough large (from 106 thousands to 429 thousands of students).

Table 1. Distribution of Foreign Students' Flows (millions of students and %)

Foreign students' flows	***2001***		***2002***		***2003***		***2004***		***2005***	
	millions of students	***%***	***millions of students***	***%***	***millions of students***	***%***	***millions of students***	***%***	***millions of students***	***%***
Worldwide	1.645	100	1.898	100	2.118	100	2.651	100	2.726	100
From world to OECD	1.539	93.56	1.781	93.84	1.976	93.30	2.257	85.14	2.296	84.23
From OECD to OECD	0.665	40.43	0,720	37.93	0.734	34.66	0.768	29.37	0.752	27.58
From OECD to non OECD	0.004	0.24	0.006	0.32	0.019	0.89	0.034	1.28	0.025	0.92
From world to non OECD	0.106	6.44	0.117	6.16	0.142	6.7	0.394	14.86	0.429	15.77
To OECD from 129 countries[9]	1.387	84.27	1.626	85.63	1.828	86.31	2.022	76.27	2.007	73.63

Source: OECD. Education at a Glance. 2008. Indicator C3: Who studies abroad and where? www.oecd.org

As our study covers the foreign students' flows between 129 countries all over the world, we should note that the number of foreign students' in the higher education institutions of OECD countries from 129 considering countries on absolute value increased on 0.62 millions of students for 5 years (from 1.387 in 2001 to 2.007 millions of students in 2005), but on relative value their number decreased from 84.27% to 73.63% of total number of foreign students in the whole world.

Analyzing the data on distribution of foreign students in Top host countries (*Table 2*) we can pick out following tendencies: (i) the Top-5 host countries cover a significant share of world education market, but

[9] These countries are included in our dataset.

their share tend to reduce from 62.0% to 58.0%; (ii) the Top-5 host countries steadily keep their places at the world education market for all observed period; (iii) while the shares of Top-5 exporters of education are fluctuated in the direction of reducing, the shares of other leading exporters has been steadily increasing for all period.

Table 2. Foreign Students' Flows to Top-host countries

Country	*Foreign students' flows (as a share of total worldwide), %*					
	2000	*2001*	*2002*	*2003*	*2004*	*2005*
USA	26.1	28.9	30.7	27.7	21.6	21.6
Great Britain	12.3	13.7	12.0	12.1	11.3	11.7
Germany	10.3	12.1	11.5	11.4	9.8	9.5
France	7.5	8.9	8.7	10.6	9.0	8.7
Australia	5.8	7.4	9.5	8.9	6.3	6.5
Total Top-5	***62.0***	***71.0***	***72.4***	***70.7***	***58.0***	***58.0***
Japan	3.7	3.9	4.0	4.1	4.4	4.6
New Zealand	0.5	0.7	0.9	1.3	2.6	2.5
Spain	1.7	2.4	2.4	2.5	1.6	2.2

Source: OECD. Education at a Glance. 2008. Indicator C3: Who studies abroad and where? www.oecd.org

Summarizing mentioned above we can assume that in the nearest 10-20 years we will observe the radical changes at the world education market: (i) the shares of today-Top-5 host countries will possibly decrease; (ii) the shares of other leading exporters of education will increase; (iii) thus, the structure of Top host countries will be significantly diversified, that of course will positively impact on all aspects of higher education internationalization, including directions of students' mobility.

MODEL SPECIFICATION AND ESTIMATION RESULTS

(i) THEORETICAL MODEL

Across the world, education is perceived to be connected with getting a job and earning wages. Economics has two major theories about education. One is human capital theory, and the other one is signaling theory. In human capital theory education increases an individual's productivity and wages. In signaling theory individuals can exhibit their productivity and diligence by entering and graduating from educational institutions. Here we have to state that the signaling theory doesn't require the increase of productivity.

The relations between mobility and human capital for long have been on the agenda of economic research. The larger part of the literature that deals with this topic analyses the consequences which increasing mobility of skilled labor might have on human capital investments. The characteristics of these models include the assumption that individuals have to decide about their educational efforts or costs before they eventually become mobile.

We assume that potential student has utility-maximizing behavior: he/she compares the education systems of his/her native and foreign countries and choose the one that provides from his/her point of view the best opportunities to gain new knowledge and skills. Student's decision to choose a specific country for studying depends on many factors, which relate to the characteristics of a student as an individual and the characteristics of the student's source country and all potential host countries. Also we assume that higher education market is a free market. When choosing where to study potential student compares both material consumption and other aspects of his/her well-being during and after studying.

Following Zavodny (1997), Pedersen et al. (2004) and Dreher & Poutvaara (2006) who applied the utility-maximization function for migration flows, we write expected utility of foreign student *(k)* from country *i* to study in country *j* in year *t* as:

$$U_{ijkt} = U(S_{ijkt}, D_{ijk}, E_{ijkt}, X_{ijkt}) \quad (1)$$

where:

U_{ijkt} is the student k's expected utility to study in country *j* in year *t.*

S_{ijkt} is a vector of characteristics that affect student *k*'s wish to study in concrete country in accordance with his/her individual preferences.

D_{ijk} is a vector that captures student's flows costs which are time-fixed costs. Other things equal, student's flows costs will be higher if there is a big geographical distance between source and host countries. Cultural and historical differences also increase the student's flows costs.

E_{ijkt} is a vector of characteristics of higher education systems of source and host counties. So E_{ikt} and E_{jkt} are the vectors that represent the push and pull factors of higher education systems that vary across time and affect the student *k*'s choice of a country for studying in the aspect of his/her requirements to the level of development of higher education system.

X_{ijkt} is a vector of characteristics of source and host countries. So X_{ikt} and X_{jkt} are vectors that represent the economic push and pull factors of source and host countries that vary across time and affect the student *k*'s choice of a country for studying in the aspect of his/her financial opportunities and requirements to the living standards in a country for studying.

We assume the student *k*'s utility to be linear in the relevant characteristics. Including an idiosyncratic error ε, the student *k*'s utility function looks as:

$$U_{ijkt} = \alpha_1 S_{ijkt} + \alpha_2 D_{ijk} + \alpha_3 E_{ikt} + \alpha_4 E_{jkt} + \alpha_5 X_{ikt} + \alpha_6 X_{jkt} + \varepsilon_{ijkt} \quad (2)$$

where $\alpha_1 \ldots \alpha_6$ are vectors of the parameters of interest that we estimate.

When choosing where to study, student *k* picks country *j* that results in the highest expected utility. Thus, we can write the conditional probability of student *k*'s choosing country *j* from *n* possible choices ($Pr_{jkt/ikt}$) as:

$$Pr_{jkt/ikt} = Pr[U_{ijkt} = max(U_{ki1t}, U_{ki2t}, \ldots, U_{kint})] \quad (3)$$

But the model (3) can be used for estimation of individual student's location choice. As we use macro data, we have to sum all students' location choices. So the number of students going for study to country *j* whose utility is maximized in that country is given by

$$StN_{ijt} = \sum Pr[U_{ijkt} = max(U_{ki1t}, U_{ki2t}, \ldots, U_{kint})] \quad (4)$$

where: StN_{ijt} is the number of students moving to country *j* from country *i* at time *t*.

We assume a linear form of the variables that influence on students' location choice. Thus we can write the model as:

$$StN_{ijt} = \beta_1 S_{ijt} + \beta_2 D_{ij} + \beta_3 E_{it} + \beta_4 E_{jt} + \beta_5 X_{it} + \beta_6 X_{jt} + \mu_{ijt} \quad (5)$$

Looking through the defined vectors of variables we see that $StNi_{jt}$ is a flow of foreign students between two countries; D_{ij} is a distance (economic and cultural costs) between two geographical entities; X_{it} and X_{jt} reflect the economic characteristics (masses) of these entities; S_{ijt}, E_{it} and E_{jt} describe the additional characteristics. It provides the background for deriving the gravity equation from model (5).

The standard gravity equation in the economic interpretation looks as[10]:

$$Y_{ij} = \alpha X_i^{\beta_1} X_j^{\beta_2} D_{ij}^{\beta_3} \quad (6)$$

where:
Y_{ij} – trade or migration flows from source country *i* to host country *j*;
X_i and X_j – economic "masses" of host and source countries (GDP or Number of population);
D_{ij} – distance between source and host countries;
α - constant of proportionality; $\beta 1, \beta 2$ - positive coefficients; $\beta 3$ - negative coefficient.

[10] The gravity model is one of the most used empirical tools for modeling bilateral trade flows and migration flows (Feenstra et al., 1999; Mayda, 2005; Fratianni et al., 2006; Thissen & Ederveen, 2006). The gravity equation, based on the Newton's physics function that describes the force of gravity, firstly was applied in economics for analyzing bilateral trade flows between geographical entities in the studies of Tinbergen (1962) and Linneman (1966) (cited on Thissen & Ederveen, 2006). In the standard gravity equation, trade flows or migration flows are expected to be dependent negatively on distance and positively on the sizes of the economies measured by GDP or by number of population.

Considering foreign students as the consumers of educational services who choose the country of studying according to their needs in new knowledge and skills we apply the gravity equation for modeling students' flows. Since usually the augmented gravity model that includes additional variables which allow presenting more precise description of the considered phenomena is applied we consider S_{ijt}, E_{it} and E_{jt} as additional variables. Thus, the augmented gravity equation for modeling students' flows looks as:

$$Y_{ij} = \alpha X_i^{\beta_1} X_j^{\beta_2} D_{ij}^{\beta_3} AV_{ij}^{\gamma} \quad (7)$$

where: AV_{ij} is a vector of additional variables that influence on students' flows.

The specification of the ***augmented gravity equation for modeling foreign students' flows*** in the log-form on the base of equations (5) and (7) looks as:

$$LnStN_{ijt} = \alpha + \beta_1 LnX_{it} + \beta_2 LnX_{jt} + \beta_3 LnD_{ij} + \beta_4 LnS_{ijt} + \beta_5 LnE_{it} + \beta_6 LnE_{jt} + \mu_{ijt} \quad (8)$$

Thus, the empirical framework will be based on a gravity model, well known for its empirical success in explaining international trade or migration flows.

(ii) DESCRIPTION OF THE DETERMINANTS

We revealed the determinants of national higher education systems' attractiveness for foreign students accordingly to the results of literature review and availability of the corresponding data.

The **vector S_{ijt}** characterizes students' wish to study in concrete country in accordance with their individual preferences. We include here variable "*Inflows of Migrants to Host Country in Previous Year"*. A large inflow of migrants to the country is evidence that the government pursues the migration policy directed to the attracting of foreigners to the country, creating for them comfortable conditions to live, to work and to study. Besides, students prefer to go for studying to the country where their relatives, friends or just people of the same nationality live. It simplifies their adaptation to the life in foreign country. Thus, we expect the positive sign of the coefficient for this variable.

The **vector D_{ij}** is explained by variables that increase or hamper student mobility in the aspect of geographical, cultural, historical distances between source and host countries. We included here the variables "*Distance",* presence of *"Common Border", "Common language"* and *"Colonial ties"* between host and source countries and whether "*Source/host Country is Land-locked"*.

Excepting "Distance" the rest variables are presented as dummy-variables. We assume that value of

variables “Common borders”, “Common language”, and “Colonial ties” is 1 if the host and source countries have common borders/language/colonial ties, otherwise their value is 0; the value of variable “Source/host country is land-locked” is 0 if none of countries is landlocked, the value is 1 if one of the countries is landlocked, and the value is 2 if two countries are landlocked.

Presence of common borders, common language, and colonial ties speaks about long historical, cultural, economical and political relations between source and host countries both at the interstate level and between people and positively influences on the foreign students’ flows. Thus we hypothesize that the sign of coefficients for these variables will be positive.

The distance increases the costs of mobility and negatively influence on foreign students’ flows. Thus, we expect the negative sign for the coefficient of “Distance”.

If a country is landlocked it also increases the cost of mobility as students are limited in the choice of transportation. The fact of being landlocked is found to decrease trade flows extremely, while the results for migration are less clear[11]. Taking into account that mostly international trade flows are carried by sea transport we assume that landlocked countries have some constraints in trade flows (especially higher transportation costs). In case of foreign students’ flows and migration there are time constraints. Students tend to move by air transport (especially when the destination country is located far away from their home country) in order to save time. Thus we expect an insignificant influence of this variable on the foreign students’ flows (especially in case of OECD countries).

The **vectors** $\boldsymbol{E_{it}}$ and $\boldsymbol{E_{jt}}$ characterize the higher education systems of source and host counties and consist of following variables: “*Public Spending on Education* (as a share of GDP)”, “*Enrollment in Tertiary Education* (as % gross)”, “*Number of National Educational Institutions in the Academic Ranking of World Universities*”, and “*Research and Development Expenditure* (as a share of GDP)”.

Two of these variables are policy-dependent: “Public spending on education” and “Research and development expenditure”. They characterize the level of state financial support of the education and related spheres. These variables are controlled by the governments and thus their coefficients reflect the efficiency of the state education policy. As we consider these variables separately for source and host countries we expect the different directions of their influence on the foreign students’ flows. As for host country we

[11] Bessey (2007)

expect positive sign of the coefficients - the more country invest into its education and research spheres the more competitive at the world education market national higher educational institutions will be and thus the more foreign students will come. As for source country we expect both positive and negative signs of the coefficients. If country invests enough in its education and research spheres then national higher education system has potential for development and is attractive for national students: they prefer to gain education at home country and thus the students' outflows decreases. On the other hand if country develops its education and R&D spheres it stimulates the demand for high-educated labor force, in a case when national education system is not developed enough, it may encourage students' outflow.

The variable "Enrollment in Tertiary Education" characterizes the level of the development of the national higher education system. A large number of people with higher education in a country indicates that national education system is highly developed and attractive both for national and foreign students, and as well national students tend to be more mobile than in a country with low enrollment in tertiary education. Thus, for host country we expect to obtain positive sign of the coefficient; for source country we expect both positive and negative signs.

The variable "Number of national higher educational institutions in the Academic Ranking of World Universities" (later called as "Universities' Ranking") testifies the level of competitiveness of national higher educational institutions at the world education market. Thus, for host country we expect the positive sign of the coefficient, for source country – negative sign.

The **vectors** $\boldsymbol{X_{it}}$ and $\boldsymbol{X_{jt}}$ cover the push and pull factors that describe the levels of socioeconomic development of host and source countries. We included here *"GDP per Capita', "Number of Population", "Unemployment rate with Tertiary Education* (as a share of total unemployment)*",* and *"Openness of the economy"*. In general these variables are under control by the government in the context of the implemented economic policy.

"GDP per capita" is considered as a size of economies of source and host countries. In source country the rise of GDP per capita will improve the financial state of the potential students in order to get education abroad, and thus stimulate the students' outflow. On the other hand, if in a country there is the high level of GDP per capita it means that country has financial opportunity to develop national higher

education system that will satisfy the requirements of home students in new knowledge and skills. Similarly, a lower level of GDP per capita limits students' financial opportunities to study abroad, but at the same time a lower level of GDP per capita limits national recourses allocated to higher education and diversity of educational provision, and thus encourages students to look for possibility to study abroad for gaining more competitive education. Thus, we expect both positive and negative sign for the coefficient of "GDP per capita" in source country.

As for host country: we assume that there is the positive dependence between GDP per capita and level of higher education system development. Taking into account that major exporters of educational services are highly developed countries with a high level of GDP per capita we suggest that arising of GDP per capita in host country will stimulate the inflow of foreign students. At the same time high level of GDP per capita also witnesses about high living costs for potential students during their studying and in this aspect may negatively influence on foreign students' inflows. Thus, we expect both positive and negative sign for the coefficient of "GDP per capita" in host country.

"Number of population" is considered as an alternative size of economies of source and host countries[12]. In source country the bigger number of population causes the bigger number of potential students' outflows. However some studies show that students from smaller countries tend to be more mobile[13], but we assume that it's caused by other factors. Thus, we expect positive sign for the coefficient of this variable. As for host country: the more domestic demand for education from national students the more size of national education system and it's more diversified, that as well provides the base for attracting the foreign students. Thus, we expect the positive sign for the coefficient of "Number of population" in host country.

The variable "Unemployment rate with tertiary education (as a share of total unemployment)" characterizes the situation at the labor markets of host and source countries. Arising unemployment rate with tertiary education in source country sharpens the competition at the domestic labor market and forces students to get more competitive education abroad. We expect the positive sign for the coefficient of this variable in source country. As for host country: as foreign students during and after studying abroad in many

[12] At this aspect the "Number of population ages 15-30" would be more appropriate because the most stock of students are young people, but we couldn't find available data.
[13] Tremblay K. (2002)

cases may wish to get a job or a permanent residence in the country of their studying, the high unemployment rate with tertiary education in host country will decrease their willingness to study in that country. So we expect the negative sign for the coefficient of this variable in host country.

"Openness of the economy" in source and host countries is calculated as a share of trade turnover (export + import) in the GDP. If a country opens its borders for foreign goods and services so it is ready to provide for domestic and foreign citizens the equal opportunity to get education at the educational institutions both national and foreign. Thus the more open the source country the more would be the students' outflow. Similarly the more open the host country the more would be the students' inflow. We expect the positive signs for the coefficients of the "Openness of economy" in source and host countries.

Aiming to estimate the influence of the selected determinants on the foreign students' flows in a coherent way we divide them in a few groups:

- ***gravity equation standard determinants***: "GDP per capita" in source and host countries and all variables of Vector D_{ij};

- ***education policy-making determinants***: all variables of Vector E_{it} and Vector E_{jt};

- ***socioeconomic determinants***: all variables of Vector S_{ijt} and variables of Vectors X_{it} and Vector X_{jt} excepting "GDP per capita" in source and host countries.

(iii) DATA SOURCES AND DATASET

Our analysis is based on the maximum possible geographical coverage of the foreign students' flows.

The data on the foreign students' flows are taken from the OECD Education Database on foreign students (*Education at a Glance: OECD Indicators. Indicator C3: Who studies abroad and where?*). *Indicator C3* is focused on foreign students in tertiary education (including all categories), defined as non-citizens of the country in which they study[14]. The categories of tertiary qualifications are:

– programs at tertiary-type A level (ISCED 5A) are largely theory-based and designed to provide qualifications for entry into advanced research programs and highly skilled professions;

– programs at tertiary-type B level (ISCED 5B) are classified at the same level of competence as tertiary-type A programs, but are more occupationally oriented and lead to direct labor market access. They

[14] Education at a Glance. OECD 2007. P. 301

tend to be of shorter duration than tertiary-type A programs (typically two to three years) and are generally not designed to lead to university degrees;

– advanced research programs at the doctorate level (ISCED 6).

Thus, in our dataset the foreign students are students in tertiary education (in all categories – type A, type B and advanced research programs) who are non-citizens of the country in which they study.

Our main data sources are *Statistical Database of OECD* (for foreign students' flows and previous migration flows) and *World Development Indicators 2008* (for the rest of selected variables). Our study covers a total of 129 countries: 30 OECD and 99 non-OECD countries. The list of countries is presented in *Appendices, Table 1 and Table 2*. The data are collected for the period 1998-2005. The list of variables is presented in *Appendices, Table 3*. The countries are chosen on the basis of their places at the world education market and availability of required data. However, we faced with limited availability of data on foreign students' flows for non OECD countries that constrains our dataset. We can consider non OECD countries just as the source countries and OECD countries as the source and host countries. But taking into account that: (i) share of 30 OECD countries of the world export of education is on average 90.0% in the period 2001-2005; (ii) the biggest importers of education are China and India (that are non OECD countries); we assume that the estimation of our model for OECD countries as the source and host countries and non OECD countries as the source countries will present the precise picture how the determinants of national higher education systems' attractiveness impact the foreign students' flows.

Data for bilateral distance and the dummy variables we took from the work of A.K. Rose[15].

The indicator "Universities' Ranking" has been calculated since 2003 (Shanghai Jiao Tong University - Institute of Higher Education)[16]. Looking through these data we noted that Top-500 Universities in the world are found mainly in the OECD countries and almost all countries in this ranking have been keeping their places for whole observed period (including the Top-5 countries) and for some countries the number of universities in this ranking is unchanged for whole observed period. So we assume that it's possible to use the data of 2003 for all years before (1998-2003).

[15] Rose, Andrew K. Recent Research. http://faculty.haas.berkeley.edu/arose/RecRes.htm
[16] www.ed.sjtu.edu.cn/ranking.htm

Analyzing our dataset we noted that there are a lot of pairs of countries in foreign students' flows database with missing values that sufficiently decreases the number of observations and doesn't allow getting the real picture. In general missing data is a potential problem for our dataset. There are two distinct issues: 1) missing foreign students' flows data; and 2) missing regressors data (especially "Unemployment Rate with Tertiary Education", "Public Spending on Education", "Research and Development Expenditure" and "Enrollment in Tertiary Education"). The first issue has been the subject of more research, and will be discussed further. In the second case there is a lot of missing data because poor countries (non OECD countries) have not well developed National Accounts Data. Observations with missing data are dropped from the regression analysis, seriously reducing the sample size[17]. In our dataset the number of zeros of dependant variable amounts 21.71%. However in regression analysis the number of zeros of dependant variable amounts 11.9%. As we see there is a significant decrease of zeros of dependant variable in regression analysis. Analyzing our dataset we can state that a lot of observations with zero foreign students' flows (especially for non OECD countries) are dropped because of independent variables missing value.

So we can state that missing data is a potential problem for our dataset[18]. When there is a lot of missing observations then most of the expressions for the estimators are no longer appropriate. A simple 'solution' is to discard any individual from the panel that has incomplete information and to work with the completely observed units only. In this approach estimation uses the balanced sub-panel only. This is computationally attractive, but potentially highly inefficient because a substantial amount of information may be "thrown away" (Verbeek, 2004, p. 381).

(iv) ESTIMATION STRATEGY

In our dataset the dependent variable (foreign students' flows) is count data, which takes non-negative integer values. As well the dependant variable takes relatively few values of which "0" values amount 21.71% of all data, "0" – "100" values amount 76.6% of the data, "0" – "300" values amount 85.5% of the data, and etc.

[17] Looking through the data with missing values we observed in many cases the following situations: (i) foreign students' flows from Iceland to Hungary are marked as "missing" in OECD database during 1998-2002, in 2003, 2004 and 2005 the number of foreign students' flows is 2, 1 and 1 respectively; (ii) foreign students' flows from Australia to Luxemburg are marked as "missing" in OECD database for all observed period. In order to include the data with missing values that are adequate to mentioned situations and thus to increase the number of observations in similar cases we put "0" instead of "missing value".

[18] In our dataset there are approximately 30720 country pair observations of which 21779 observations are dropped because of missing data.

Looking at the *Figure 1* one can note that the data are strongly skewed to the right, so we can clearly state that OLS regression would be inappropriate. Count data are highly non-normal and are not well estimated by OLS regression[19]. Count data often follows a Poisson distribution, so some types of Poisson analysis might be appropriate. Moreover in their recent work Santos Silva & Tenreyro (2006) found that the standard empirical methods used to estimate gravity equations are inappropriate. The basic problem is that log-linearization (or, indeed, any non-linear transformation) of the empirical model in the presence of heteroskedasticity leads to inconsistent estimates. Authors propose a simple Poisson pseudo maximum likelihood method which is robust to different patterns of heteroskedasticity and, in addition, provides a natural way to deal with zeroes in data.

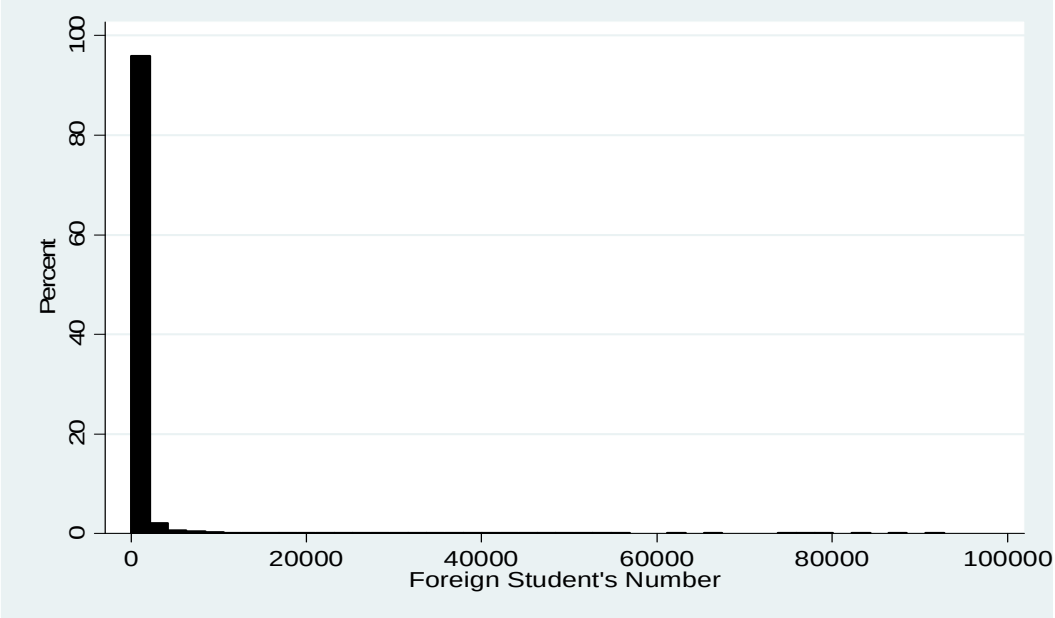

Figure 1. Distribution of foreign students' flows

All mentioned above allows us to conclude that the Poisson model is a most appropriate technique for estimation of our model. Because the assumption $V[yi|x] = E[yi|x]$ is unlikely to hold, this estimator does not take full account of the heteroskedasticity in the model, and all inference has to be based on an Eicker-White robust covariance matrix estimator (Eicker, 1963 and White, 1980; cited on Santos Silva & Tenreyro, 2006). So we estimate the Poisson model with heteroskedasticity-robust standard errors[20]. When we estimate the Poisson models with heteroskedasticity-robust standard errors the difference between the usual standard

[19] See *Appendices, Table 5, Column 1*.
[20] See *Appendices, Table 5, Column 2*.

errors and the heteroskedasticity-robust standard errors are very large and use of the robust *t* statistics dramatically changes the statistical significance of independent variables[21].

In our dataset there is strong over dispersion, that is, greater variance than might be expected in a Poisson distribution[22]. Count data are often very over dispersed, which causes computed Poisson maximum likelihood *t* statistics to be considerably over-inflated. This can lead to very erroneous and overly optimistic conclusions of statistical significance of regressors. In these cases an alternative to Poisson regression is to specify a more general distribution than the Poisson that does not impose equi-dispersion and to perform standard maximum likelihood inference. The standard distribution used is the Negative Binomial regression model[23], with variance assumed to be a quadratic function of the mean (Cameron, 1998, p. 60). Negative binomial model relaxes the Poisson assumption that the mean equals the variance. The Poisson model is obtained as a parametric restriction on the Negative Binomial model (Greene, 2002, p. 744). So we can state that when variance much larger than the mean Negative Binomial regression does better with over dispersed data.

In many cases, a large proportion of zeros will not only affect the precision of inference, but rather speak directly against the Poisson regression model. When the data displays a higher fraction of zeros, or non-occurrences Zero-Inflated Poisson or Zero-Inflated Negative Binomial models addresses the problem[24]. Economic applications of Zero-Inflated models are often based on the Zero-Inflated Negative Binomial model (Winkelmann, 2008, p. 189). So here we can state that if there are more zeros than would be expected by either a Poisson or Negative Binomial models Zero-Inflated regression models do better with zeros.

We used "countfit" function in Stata written by Long & Freese. "Countfit" runs user-specified count models (Poisson, Zero-Inflated Poisson, Negative Binomial, and Zero-Inflated Negative Binomial) with

[21] OLS model (*Appendices, Table 5, Column 1*) is estimated with usual standard errors because the difference between the usual standard errors and the heteroskedasticity-robust standard errors are not very large, and use of the robust *t* statistics does not change the statistical significance of any independent variable. The robust standard errors and robust *t* statistics are justified only as the sample size becomes large (Wooldridge, 2006, p. 268).

[22] The variance of dependant variable "foreign students' flows" is nearly 15500 times larger than the mean.

[23] See *Appendices, Table 5, Column 3*. Here we presented NegBin II (function of expected mean) model results. Within the maximum likelihood framework, the NegBin II (function of expected mean) model is preferred to NegBin I (constant dispersion) because it has a higher log likelihood value, with the same number of parameters.

[24] See *Appendices, Table 5, Column 4*.

user-specified variables and compares the models' residuals. Small residuals are indicative of good-fitting models, so the models with lines closest to zero should be considered for our data.

On the *Figure 2* we observe that our four models perform very similarly for counts greater than four, and that they all differ mostly from the actual values and each other at the zero and four counts. At the zero and four counts, Negative Binomial model appears slightly better than the other models. Thus it seems that we might prefer the Negative Binomial model because it is simpler. However when we performed a heteroskedasticity-robust *RESET test* (Ramsey, 1969)[25] in order to check the adequacy of the estimated models we saw that according to the results only the Negative Binomial and Zero-Inflated Negative Binomial models pass the test (*RESET test p* value for Negative Binomial model is 0.41 and for Zero-Inflated Negative Binomial model is 0.86) that is, the RESET test provides no evidence of misspecification of our model estimated using the Negative Binomial and Zero-Inflated Negative Binomial models[26].

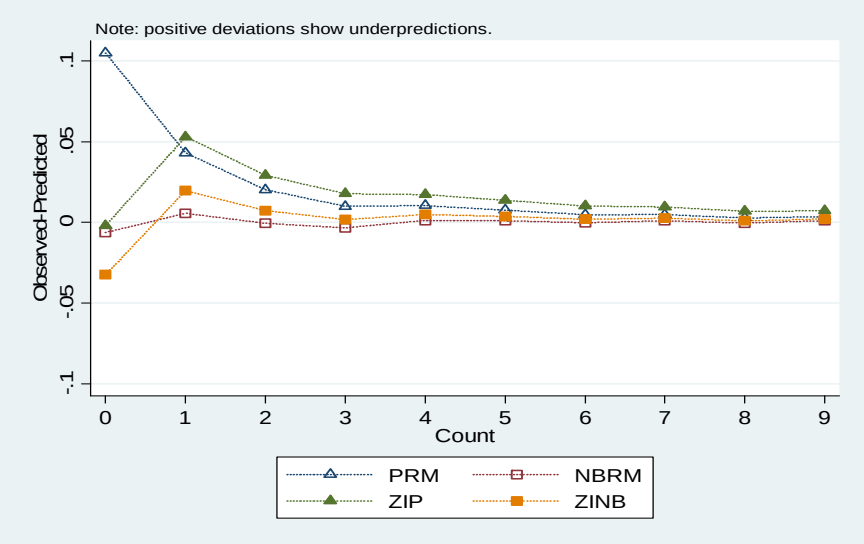

Figure 2. Poisson, Zero-Inflated Poisson, Negative Binomial, and Zero-Inflated Negative Binomial models residuals

In order to choose the most appropriate model between Negative Binomial model and Zero-Inflated Negative Binomial model we consider the result of *Vuong test*[27]. The *Vuong test* result is in favor of Zero-Inflated Negative Binomial model.

[25] For Poisson, Zero-Inflated Poisson, Negative Binomial, and Zero-Inflated Negative Binomial models we run the RESET test following Santos Silva and Tenreyro // http://privatewww.essex.ac.uk/~jmcss/LGW.html

[26] None of the two rest models passes the RESET test (RESET test p value for Poisson model is 0.01 and for Zero-Inflated Poisson model is 0.00) that is, the RESET test provides evidence of misspecification of our model estimated using Poisson and Zero-Inflated Poisson models.

[27] *Vuong test* = 15.13 (p=0.00) favoring Zero-Inflated Negative Binomial model over Negative Binomial model.

Summarizing all mentioned above we can draw a conclusion that the best model which fits our data well is ***Zero-inflated Negative Binomial model***, because it passes *RESET test* and as well *Voung test* result is in favor of this model. Unless otherwise noted, all presented results will be based on Zero-inflated Negative Binomial model.

(v) ESTIMATION RESULTS

We begin by estimation the gravity model (8) using panel data techniques. According to recent developments in the theoretical foundation of gravity equations it is important to control for "multilateral resistance" effects (Anderson & van Wincoop, 2004). Taking into account those "multilateral resistance" effects we must consider not only the foreign students' flows resistance between any two countries (country pair fixed effects), but also the fact that different countries have different multilateral resistance for foreign students' flows (country fixed effects). Country fixed effect is necessary to control for countries unobservable characteristics in order to limit potential biases due to omitted variables in the estimation[28].

All results presented in tables include destination and origin countries' fixed effects and have robust standard errors clustered by country pair, to address heteroscedasticity and allow for correlation over time of country-pair observations. That is, using cluster option we assume that the observations may be correlated within country pairs, but would be independent between country pairs. We also include year dummy variables to control for time-specific effects or to account for common shocks.

We first estimate the simple form of model (8) (*Table 3, Column 1*), that includes ***gravity equation standard determinants*** - where vector X includes variables "GDP per capita" in source and host countries, and vector D includes variables "Distance", "Common border", "Common language", "Colonial ties", and "Landlocked".

Consistent with trade and migration flows studies, we found that the gravity framework is very powerful tool in explaining foreign students' flows. According to the results the determinant "*Distance*" has expected negative sign and is highly statistically significant providing evidence for the predictions of the gravity equation.

[28] Pair fixed effect would be superior. Unfortunately we cannot get the results of Zero-Inflated Negative Binomial model for panel data estimation with country pair fixed effects.

Table 3. Determinants of foreign students' flows

Variables	*(1)*	*(2)*	*(3)*	*(4)*
Gravity equation variables				
LnGdpSCP	0.809***	0.713***	1.332***	1.146***
	(0.125)	(0.177)	(0.236)	(0.265)
LnGdpHCP	-0.022	-0.620	-1.873***	-1.714***
	(0.294)	(0.411)	(0.504)	(0.509)
ComBord	0.704***	1.125***	0.953***	1.246***
	(0.231)	(0.284)	(0.245)	(0.288)
ComLang	1.320***	1.150***	0.823***	1.062***
	(0.099)	(0.138)	(0.143)	(0.149)
Colony	2.328***	1.494***	1.564***	1.280***
	(0.193)	(0.231)	(0.185)	(0.218)
LandLocked	-0.789*	0.121	0.344	0.593
	(0.399)	(0.424)	(0.417)	(0.446)
LnDist	-1.574***	-1.436***	-1.454***	-1.380***
	(0.050)	(0.058)	(0.054)	(0.061)
Education policy-making variables				
PubSpEdS		0.026		-0.027
		(0.021)		(0.023)
PubSpEdH		-0.101***		-0.051
		(0.037)		(0.047)
SchoolEnS		-0.002		-0.004
		(0.002)		(0.003)
SchoolEnH		0.022***		0.021***
		(0.003)		(0.003)
R&DExpS		-0.108		-0.245**
		(0.106)		(0.117)
R&DExpH		0.078		0.245***
		(0.082)		(0.104)
LnUnRnkS		0.055		-0.058
		(0.096)		(0.106)
LnUnRnkH		0.281***		0.163*
		(0.110)		(0.092)
Socioeconomic variables				
LnPopnS			0.918	0.498
			(0.646)	(0.772)
LnPopnH			-4.084***	2.636**
			(1.446)	(1.212)
LnPremigr			0.025	0.028
			(0.030)	(0.031)
OpEcS			0.002**	0.002
			(0.001)	(0.001)
OpEcH			-0.009***	0.002
			(0.004)	(0.002)
UnmTerS			-0.011***	-0.011***
			(0.002)	(0.002)
UnmTerH			0.004	-0.006
			(0.004)	(0.005)
Observations	29273	12124	14272	8941
Log pseudo likelihood	-125737.9	-57807.95	-69037.69	-44213.51

Estimation using ZINB model. Source and host country as well as time dummy variables are included but not reported. Standard errors, clustered by country pair, are presented in parentheses, ***, **, and * denote 1%, 5%, and 10% significance levels, respectively.

As well all cultural determinants of foreign students' flows have expected signs and are statistically significant at least at the 10% level. On the other hand surprisingly the determinant "*GDP per capita"* in host country is economically and statistically insignificant (has not the expected sign and is not statistically significant).

We next estimate the extended form of model (8) (*Table 3, Column 2*) checking the impact of ***education policy-making determinants*** to foreign students' flows. We found that mostly education policy-making determinants are economically and statistically not significant or their impacts are relatively negligible. As well inclusion of these determinants does not lead to qualitative changes in the remaining coefficients, except that the determinant "Landlocked" becomes statistically insignificant.

Then we explore the impact of ***socioeconomic determinants*** to foreign students' flows (*Table 3, Column 3)*. We observe that mostly socioeconomic determinants are economically and statistically not significant or their impacts are relatively negligible. As well inclusion of these determinants does not lead to qualitative changes in the remaining coefficients.

Finally we present the ***baseline regression results*** with all the determinants mentioned above (*Table 3, Column 4)*. As we can see the results of *Table 3, Columns 1, 2, and 3* are in general robust with our baseline regression results *(Table 3, Column 4)*.

Baseline regression results:

Considering the ***gravity equation standard determinants*** we see that the foreign students' outflows are greater from more rich countries as it was expected. One percent increasing of "*GDP per capita*" in source country increases foreign students' outflow by 1.14%. Quite surprisingly we found that the determinant *"GDP per capita"* in host country has unexpected negative sign and highly statistically significant contrary to the positive sign discussed in student mobility literature (Thissen & Ederveen, 2006)[29]. This fact could be explained in a few ways. First explanation could be that foreign students' flows to developed countries (OECD countries) are dominated by flows to countries which have relatively small GDP per capita. Second, as shown by Santos Silva & Tenreyro (2006) standard OLS estimates, which have been widely used in the literature, tend to be strongly biased upwards.

[29] We also estimated our baseline regression without host country fixed effects. The sign of determinant "GDP per capita" does not change but its impact decreases almost by 5.5 times. Results of the baseline regression without host country fixed effects are not reported here, but are available upon request from the authors.

The determinants that describe cultural, historical and geographical similarities between host and source countries are seemed to be of a great importance for analyzing foreign students' flows. Distance definitely negatively influence on foreign students' flows. One percent increasing of "*Distance*" decreases foreign students' flows between host and source countries by 1.38%. Between countries that share *common language* the foreign students' flows are almost 1.8 times higher than between countries that don't share common language. The presence of *colonial ties in the past* or *common border* between source and host countries multiplies the foreign students' flows almost 2.5 times.

Among ***education policy-making determinants*** "U*niversities' ranking"* in host country and "*R&D expenditure"* in source and host countries have the most impact to the foreign students' flows. According to the results 1% increasing of "U*niversities' ranking"* in host country increases the foreign students' inflow by 0.16%. Although the coefficient of the *"Universities' ranking"* in source country is economically significant (has the expected sign) its impact is too small and is not statistically significant. One can note that the coefficients of determinants "*R&D expenditure"* in source and host countries are equal in absolute value. One unit increasing of "*R&D expenditure"* in source country decreases students' outflow by 24.5%, and one unit increasing of "*R&D expenditure"* in host country increases foreign students' inflow by 24.5%. The impact of other variables of this group either relatively very small or they are economically and statistically not significant.

Considering the ***socioeconomic determinants*** we can state that the impacts of the *"Unemployment rate with tertiary education"* in source and host countries are relatively very small and economically and statistically not significant. In the literature the relationships between student mobility and migration are widely discussed. Dreher & Poutvaara (2006) found out that the stock of foreign students is an important predictor of subsequent migration. In our results we found no relationship between migration flows and foreign students' flows. Although the coefficient of the variable "*Inflows of migrants to host country in previous year"* is economically significant (has the expected sign) its impact is too small and is not statistically significant.

Robustness checks:

Next we assess whether our baseline regression results are robust using different panel data estimation techniques[30]. We estimate our baseline regression with four estimation techniques: pooled with time effect, country fixed effect, country fixed effect with time effect and time varying country fixed effect (*Table 4*).

Accordingly to Anderson & van Wincoop (2004) in a panel framework separate country fixed effects should be included for each year as "multilateral resistance" effects may change over time. The problem with this estimation is that there may be omitted variables that affect foreign students' flows, because time varying country fixed effects don't remove bias that comes from the correlation between the determinants of bilateral foreign students' flows that have been included and the determinants that are unobservable. Recognizing this, Baldwin & Taglioni (2006) argue in favor of using time invariant country pair effects in addition to time varying country fixed effects. Unfortunately we can't use this technique in our case because we cannot get the results of Zero-Inflated Negative Binomial model for panel data estimation with country pair fixed effects.

One can note that these four estimation techniques don't lead to any qualitative changes in the significance of coefficients on the variables that we presented in the simple form of model (8) (*Table 3, Column 1*). Although the coefficients of education policy-making and socioeconomic determinants are sensitive to the estimation techniques, in overall these variables' coefficients economically and statistically are insignificant.

It is also useful to check whether the inclusion of other determinants influences on the parameters estimated in our baseline regression. To check this we added four additional variables to our baseline regression: "Unemployment rate" and "Expenditure per student in tertiary education" in source and host countries. Adding these four variables doesn't lead substantial qualitative changes in the significance of the coefficients of the variables especially on education policy-making variables. Results of the extended form of our baseline regression are not reported here, but are available upon request from the authors.

[30] In different panel data estimations (especially with time varying country fixed effects) when trying to get Zero-Inflated Negative Binomial model estimates using standard "zinb" command Stata gives the message "Convergence not achieved". It is caused by the fact that for certain data configurations, the maximum likelihood estimates do not exist. To overcome this problem we used the strategy that Santos Silva & Tenreyro (2009) described in their recent work.

Table 4. Robustness checks

Variables	*pooled with time effect*	*country fixed effect*	*country fixed effect with time effect*	*time varying country fixed effect*
	(1)	**(2)**	**(3)**	**(4)**
Gravity equation variables				
LnGdpSCP	0.278***	1.362***	1.146***	0.890***
	(0.096)	(0.223)	(0.265)	(0.178)
LnGdpHCP	-0.516***	-1.463***	-1.714***	-4.218***
	(0.185)	(0.454)	(0.509)	(0.616)
ComBord	1.157***	1.247***	1.246***	1.258***
	(0.350)	(0.288)	(0.288)	(0.279)
ComLang	1.310***	1.063***	1.062***	1.057***
	(0.176)	(0.149)	(0.149)	(0.143)
Colony	0.976***	1.274***	1.280***	1.325***
	(0.286)	(0.217)	(0.218)	(0.209)
LandLocked	0.019	0.578	0.593	0.733
	(0.138)	(0.445)	(0.446)	(0.448)
LnDist	-0.845***	-1.380***	-1.380***	-1.381***
	(0.075)	(0.061)	(0.061)	(0.059)
Education policy-making variables				
PubSpEdS	0.107**	-0.003	-0.027	-0.033
	(0.048)	(0.022)	(0.023)	(0.147)
PubSpEdH	0.147**	-0.014	-0.051	-0.305***
	(0.070)	(0.043)	(0.047)	(0.127)
SchoolEnS	0.005	-0.001	-0.004	-0.002
	(0.004)	(0.003)	(0.003)	(0.005)
SchoolEnH	-0.012**	0.023***	0.021***	0.003
	(0.006)	(0.003)	(0.003)	(0.008)
R&DExpS	0.043	-0.176	-0.245**	0.359
	(0.087)	(0.112)	(0.117)	(0.274)
R&DExpH	-0.096	0.382***	0.245***	-1.953***
	(0.087)	(0.096)	(0.104)	(0.400)
LnUnRnkS	-0.118	0.026	-0.058	-0.498***
	(0.096)	(0.102)	(0.106)	(0.202)
LnUnRnkH	1.209***	0.203**	0.163*	4.729***
	(0.167)	(0.091)	(0.092)	(0.774)
Socioeconomic variables				
LnPopnS	0.603***	1.165*	0.498	0.901***
	(0.062)	(0.684)	(0.772)	(0.088)
LnPopnH	-0.264*	3.470***	2.636**	2.381***
	(0.145)	(1.126)	(1.212)	(0.956)
LnPremigr	0.407***	0.057**	0.028	-6.801***
	(0.088)	(0.028)	(0.031)	(1.926)
OpEcS	0.001	0.003**	0.002	-0.003*
	(0.002)	(0.001)	(0.001)	(0.002)
OpEcH	-0.008***	0.002	0.002	-0.032***
	(0.002)	(0.002)	(0.002)	(0.005)
UnmTerS	-0.007	-0.011***	-0.011***	-0.043***
	(0.005)	(0.002)	(0.002)	(0.010)
UnmTerH	-0.018*	-0.003	-0.006	0.081***
	(0.009)	(0.005)	(0.005)	(0.023)
Observations	8941	8941	8941	8941
Log pseudolikelihood	-46589.1	-44218.73	-44213.51	-43985.29

Estimation using ZINB model. Source and host country as well as time dummy variables are included but not reported. Standard errors, clustered by country pair, are presented in parentheses, ***, **, and * denote 1%, 5%, and 10% significance levels, respectively.

The role of geography:

Taking into account that our dataset consists of all OECD countries which are considered as source and host countries and developing countries which are considered as source countries a first question which arises is whether the determinants of foreign students' flows or their impact are the same for OECD and the remaining countries. As well the panel approach immediately raises the issue as to whether our results broadly hold for different sub samples (Robustness checks). Using our baseline regression we first consider foreign students' flows between developed (OECD) countries and from developing (non OECD) countries *(Table 5, Columns 2 and 3)*. We also estimate foreign students' flows between Asian and non Asian countries. Results are not reported here, but they are available upon request from the authors.

According to the obtained results the impact of the selected determinants on the foreign students' flows for non OECD countries is stronger than their impact on the foreign students' flows for OECD countries. As one could have expected the impact of *"R&D Expenditure"* on foreign students' flows is much higher and more significant for non OECD countries. The coefficients of the determinants "*R&D Expenditure*" for foreign students' flows between OECD and non OECD countries are economically and statistically significant while the similar coefficients for foreign students' flows between OECD countries are only economically significant (have the expected signs). The impact of *"Distance"* is more for foreign students' flows from non OECD countries than for foreign students' flows between OECD countries but the difference is not much. As well the determinants "*Common Border"* and "*Common Language"* have much more impact to foreign students' flows from non OECD countries.

We also estimate the impact of *"Distance"* over time for both OECD and non OECD countries *(Table 6)*. According to results for OECD countries distance has almost constant impact to foreign students' flows over whole time period. For non OECD countries the impact of distance is increasing over whole time period.

Table 5. Role of geography

Variables	*All countries*	*OECD countries*	*Non OECD countries*
	(1)	*(2)*	*(3)*
Gravity equation variables			
LnGdpSCP	1.146***	-0.022	1.375***
	(0.265)	(0.448)	(0.362)
LnGdpHCP	-1.714***	-0.014	-3.082***
	(0.509)	(0.586)	(0.820)
ComBord	1.246***	0.828***	1.546***
	(0.288)	(0.332)	(0.350)
ComLang	1.062***	0.366**	1.684***
	(0.149)	(0.183)	(0.199)
Colony	1.280***	1.189***	1.190***
	(0.218)	(0.302)	(0.255)
LandLocked	0.593	0.283	2.914
	(0.446)	(0.473)	(1.883)
LnDist	-1.380***	-1.358***	-1.473***
	(0.061)	(0.074)	(0.088)
Education policy-making variables			
PubSpEdS	-0.027	0.000	0.018
	(0.023)	(0.048)	(0.024)
PubSpEdH	-0.051	-0.028	-0.073
	(0.047)	(0.053)	(0.070)
SchoolEnS	-0.004	-0.005*	0.009*
	(0.003)	(0.003)	(0.005)
SchoolEnH	0.021***	0.021***	0.018***
	(0.003)	(0.004)	(0.005)
R&DExpS	-0.245**	-0.155	-0.475***
	(0.117)	(0.105)	(0.198)
R&DExpH	0.245***	0.103	0.366**
	(0.104)	(0.119)	(0.165)
LnUnRnkS	-0.058	-0.151	0.202
	(0.106)	(0.126)	(0.188)
LnUnRnkH	0.163*	-0.115	-0.048
	(0.092)	(0.283)	(0.089)
Socioeconomic variables			
LnPopnS	0.498	0.962	1.796*
	(0.772)	(1.131)	(1.024)
LnPopnH	2.636**	2.150	3.090
	(1.212)	(1.628)	(1.913)
LnPremigr	0.028	0.030	0.050
	(0.031)	(0.042)	(0.048)
OpEcS	0.002	0.010***	-0.002
	(0.001)	(0.003)	(0.002)
OpEcH	0.002	0.006**	-0.001
	(0.002)	(0.003)	(0.003)
UnmTerS	-0.011***	-0.010***	-0.009***
	(0.002)	(0.004)	(0.003)
UnmTerH	-0.006	0.000	-0.015*
	(0.005)	(0.005)	(0.009)
Observations	8941	4069	4872
Log pseudolikelihood	-44213.51	-22378.45	-21172.73

Estimation using ZINB model. Source and host country as well as time dummy variables are included but not reported. Standard errors, clustered by country pair, are presented in parentheses, ***, **, and * denote 1%, 5%, and 10% significance levels, respectively.

Table 6. Impact of "Distance" over time

Year	OECD countries	Non OECD countries
1999	-1.042*** (0.086)	-1.056*** (0.076)
2000	-1.084*** (0.078)	-1.079*** (0.073)
2001	-1.148*** (0.076)	-1.247*** (0.069)
2002	-1.107*** (0.075)	-1.263*** (0.074)
2003	-1.082*** (0.074)	-1.276*** (0.079)
2004	-1.080*** (0.075)	-1.376*** (0.083)
2005	-1.136*** (0.075)	-1.459*** (0.083)

Estimation using ZINB model. All determinants of baseline regression (Table 3, Column 4) excluding distance are included, but not reported. Source and host country as well as time dummy variables are included but not reported. Standard errors, clustered by country pair, are presented in parentheses, ***, **, and * denote 1%, 5%, and 10% significance levels, respectively.

CONCLUSIONS

In this paper we revealed the factors determining the attractiveness of national higher education systems and then estimated their influence on the foreign students' flows applying the gravity equation augmented with education policy-making and socioeconomic determinants. Our analysis covered foreign students' flows between 129 countries (at those 30 OECD countries are considered as host and source countries, and 99 non OECD countries are considered as source countries) over the period 1998-2005.

We found that among the education policy-making determinants the "Number of national higher educational institutions in the Academic Ranking of World Universities" in host country and "R&D expenditure" in source and host countries have the most impact the foreign students' flows. The influence of other variables of this group either relatively very small or they are economically and statistically not significant.

As well our results show that mostly socioeconomic determinants (excluding "GDP per capita" in source and host countries) are economically and statistically not significant or their impacts are relatively negligible.

Unlike to Dreher & Poutvaara (2006) who found out that the stock of foreign students is an important predictor of subsequent migration, our results indicate that there is no presence of close relationship between previous migration flows and foreign students' flows.

Obtained results demonstrate that among determinants reflecting the foreign students' mobility costs caused by the geographical and cultural similarities the presences of "Common border", "Common language" and "Colonial ties" seem to be the most crucial factors. It's connected with more easy adaptation of foreign students to new social environment in the country of studying. "Distance" between host and source countries as it was predicated by the gravity equation negatively influences on the expanding of foreign students' flows.

APPENDICES

Table 1. List of host countries

1	Australia	11	Hungary	21	Norway
2	Austria	12	Iceland	22	Poland
3	Belgium	13	Ireland	23	Portugal
4	Canada	14	Italy	24	Slovakia
5	Czech Republic	15	Japan	25	Spain
6	Denmark	16	Korea	26	Sweden
7	Finland	17	Luxembourg	27	Switzerland
8	France	18	Mexico	28	Turkey
9	Germany	19	Netherlands	29	United Kingdom
10	Greece	20	New Zealand	30	United States

Table 2. List of source countries

1	Australia	33	Angola	65	Georgia	97	Nigeria
2	Austria	34	Argentina	66	Ghana	98	Oman
3	Belgium	35	Armenia	67	Guatemala	99	Pakistan
4	Canada	36	Azerbaijan	68	Guinea	100	Panama
5	Czech Republic	37	Bahamas	69	Haiti	101	Peru
6	Denmark	38	Bahrain	70	Honduras	102	Philippines
7	Finland	39	Bangladesh	71	Hong Kong	103	Qatar
8	France	40	Barbados	72	India	104	Romania
9	Germany	41	Belarus	73	Indonesia	105	Russia
10	Greece	42	Bolivia	74	Iran	106	Rwanda
11	Hungary	43	Botswana	75	Iraq	107	Saudi Arabia
12	Iceland	44	Brazil	76	Israel	108	Senegal
13	Ireland	45	Bulgaria	77	Jamaica	109	Singapore
14	Italy	46	Cameroon	78	Jordan	110	Slovenia
15	Japan	47	Cape Verde	79	Kazakstan	111	South Africa
16	Korea	48	Chile	80	Kuwait	112	Sri Lanka
17	Luxembourg	49	China	81	Kyrgyzstan	113	Sudan
18	Mexico	50	Colombia	82	Latvia	114	Suriname
19	Netherlands	51	Comoros	83	Lebanon	115	Syria
20	New Zealand	52	Congo	84	Libya	116	Thailand
21	Norway	53	Democr. Rep. of Congo	85	Lithuania	117	Togo
22	Poland	54	Costa Rica	86	Madagascar	118	Trinidad&Tobago
23	Portugal	55	Croatia	87	Malaysia	119	Tunisia
24	Slovakia	56	Cyprus	88	Mali	120	Turkmenistan
25	Spain	57	Dominican Republic	89	Malta	121	Uganda
26	Sweden	58	Ecuador	90	Mauritania	122	Ukraine
27	Switzerland	59	Egypt	91	Mauritius	123	Unit. Arab Emirates
28	Turkey	60	El Salvador	92	Mongolia	124	Uruguay
29	United Kingdom	61	Estonia	93	Morocco	125	Uzbekistan
30	United States	62	Ethiopia	94	Mozambique	126	Venezuela
31	Albania	63	Fiji	95	Nepal	127	Viet Nam
32	Algeria	64	Gabon	96	Niger	128	Zambia
						129	Zimbabwe

Table 3. List of variables

Abbreviations	Variables
StdN	Flows of foreign students
LnGdpSCP	Log of GDP per capita in source (in constant prices 2000)
LnGdpHCP	Log of GDP per capita in host (in constant prices 2000)
ComBord	Common border between source and host countries
ComLang	Common language in source and host countries
Colony	Colonial ties between source and host countries (in the past)
LandLocked	Source and/or host countries are landlocked
LnDist	Log of distance between source and host countries
PubSpEdS	Public spending on education in source country
PubSpEdH	Public spending on education in host country
SchoolEnS	School enrollment in source country
SchoolEnH	School enrollment in host country
R&DExpS	R&D expenditure in source country
R&DExpH	R&D expenditure in host country
LnUnRnkS	Log of University ranking in source country
LnUnRnkH	Log of University ranking in host country
LnPopNS	Log of population number in source country
LnPopNH	Log of population number in host country
LnPreMigr	Log of the inflows of migrants to host country in previous year
OpEcS	Openness of source country
OpEcH	Openness of host country
UnmTerS	Unemployment rate with tertiary education in source country
UnmTerH	Unemployment rate with tertiary education in host country

Table 4. Descriptive statistics of the variables

Variables	Observations	Mean	Std. dev.	Min	Max
Dependant variable					
StdN	30187	426.98	2572.67	0.00	92774.00
Gravity equation variables					
LnGdpSCP	29940	7.90	1.58	4.40	10.85
LnGdpHCP	30720	9.75	0.72	8.21	10.85
ComBord	30528	0.02	0.15	0.00	1.00
ComLang	30528	0.11	0.31	0.00	1.00
Colony	30528	0.03	0.16	0.00	1.00
LandLocked	30528	0.38	0.56	0.00	2.00
LnDist	30528	8.05	0.87	4.77	9.42
Education policy-making variables					
PubSpEdS	22395	4.51	1.66	0.98	31.87
PubSpEdH	28800	5.29	1.21	2.95	8.44
SchoolEnS	24638	32.12	23.04	0.58	91.69
SchoolEnH	29696	54.50	18.47	9.60	91.69
R&DExpS	18041	0.99	0.96	0.01	4.77
R&DExpH	29312	1.72	0.92	0.37	4.25
LnUnRnkS	30720	0.56	1.04	0.00	5.14
LnUnRnkH	30720	1.96	1.23	0.00	5.14
Socioeconomic variables					
LnPopNS	30540	16.16	1.66	12.52	20.99
LnPopNH	30720	16.53	1.52	12.52	19.51
LnPreMigr	28032	11.02	1.38	8.04	13.87
OpEcS	29880	85.41	50.48	15.86	447.30
OpEcH	30720	85.41	49.54	19.06	293.87
UnmTerS	17566	18.19	14.23	0.20	77.90
UnmTerH	28672	16.60	10.12	2.90	47.30

Table 5. OLS, Poisson, Negative Binomial and Zero-Inflated Poisson models results

Variables	OLS	Poisson	Negative binomial	Zero-inflated Poisson
	(1)	(2)	(3)	(4)
Gravity equation variables				
LnGdpSCP	1.257***	1.142***	1.017***	1.135***
	(0.257)	(0.293)	(0.272)	(0.293)
LnGdpHCP	-0.989**	0.586	-1.529***	0.506
	(0.465)	(0.799)	(0.506)	(0.797)
ComBord	0.894***	-0.136	1.414***	-0.145
	(0.073)	(0.238)	(0.290)	(0.238)
ComLang	0.710***	1.169***	0.915***	1.176***
	(0.056)	(0.192)	(0.151)	(0.193)
Colony	1.394***	0.604**	1.394***	0.599**
	(0.090)	(0.275)	(0.222)	(0.274)
LandLocked	-0.428	0.659	0.309	0.699
	(0.507)	(0.551)	(0.425)	(0.554)
LnDist	-1.130***	-1.317***	-1.447***	-1.309***
	(0.024)	(0.089)	(0.060)	(0.089)
Education policy-making variables				
PubSpEdS	-0.011	-0.047	-0.037	-0.047
	(0.032)	(0.039)	(0.023)	(0.039)
PubSpEdH	-0.122**	0.093	-0.141***	0.103
	(0.061)	(0.090)	(0.049)	(0.090)
SchoolEnS	-0.002	-0.014***	-0.003	-0.014***
	(0.003)	(0.005)	(0.003)	(0.005)
SchoolEnH	0.017***	0.018***	0.023***	0.018***
	(0.004)	(0.005)	(0.003)	(0.005)
R&DExpS	-0.217**	0.096	-0.206*	0.096
	(0.109)	(0.129)	(0.117)	(0.129)
R&DExpH	-0.036	0.659***	0.050	0.675***
	(0.125)	(0.187)	(0.110)	(0.186)
LnUnRnkS	-0.063	-0.445*	-0.056	-0.440*
	(0.172)	(0.228)	(0.108)	(0.229)
LnUnRnkH	-0.043	0.236	0.092	0.243
	(0.122)	(0.166)	(0.092)	(0.166)
Socioeconomic variables				
LnPopnS	-0.058	0.044	0.633	0.044
	(0.864)	(1.071)	(0.786)	(1.070)
LnPopnH	1.595	-1.026	1.076	-0.850
	(1.238)	(1.675)	(1.255)	(1.671)
LnPremigr	-0.038	0.153***	-0.002	0.162***
	(0.028)	(0.057)	(0.030)	(0.057)
OpEcS	0.002	0.004	0.002	0.004
	(0.002)	(0.003)	(0.001)	(0.003)
OpEcH	0.000	-0.001	0.005**	-0.002
	(0.003)	(0.006)	(0.002)	(0.006)
UnmTerS	-0.008**	-0.001	-0.011***	-0.001
	(0.003)	(0.004)	(0.003)	(0.004)
UnmTerH	0.005	0.019**	0.002	0.017*
	(0.004)	(0.009)	(0.004)	(0.009)
Observations	8941	8941	8941	8941
Log pseudolikelihood	-	-1404090.8	-44495.157	-1390063

Source and host country as well as time dummy variables are included but not reported. Standard errors, clustered by country pair, are presented in parentheses, ***, **, and * denote 1%, 5%, and 10% significance levels, respectively.

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