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STUDENT MOBILITY AND SOCIAL WELFARE: AN EMPIRICAL AND THEORETICAL INQUIRY INTO THE SOCIAL IMPACT OF SKILLED MIGRATION*

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Abstract

In recent years, the global mobility of tertiary students has increased considerably. However, students disproportionately migrate to English-speaking countries, which host nearly half of all international students worldwide. If "two-step migration" takes place, students' transition towards becoming skilled workers within their host countries can bring about non-trivial losses in economic performance and social welfare in their countries of origin. Due to this concern, the first part of this paper empirically demonstrates the countries that receive more international students and why. The second part of the paper presents a theoretical model that explains social welfare changes caused by skilled migration, which includes a simulation to estimate sending countries' losses if students do not return home to work after completing their studies.

By using Japan as the sending country and the US as the receiving country in this case study, we found that Japan loses approximately US$423,721 for each international student that remains in the host country for life. Further, the empirical analyses show that students are more likely to move to countries with stronger economic power, higher income inequality, higher quality of education and research, and greater government funding for tertiary education. This suggests that disparities in education quality and earnings within host countries, as well as between origin and host countries, will widen over time. This paper concludes by highlighting the need to develop a financial arrangement between countries such that they can share the costs and benefits of education to foster a global balance of social welfare.

Keywords: Economic return to mobile students, High skilled migration, Higher education and social welfare, Empirical and theoretical research

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I. *Introduction*

Throughout human history, it has become evident that we are all descendants of migrants who sought to (more or less successfully) escape starvation, violence, the *status quo*, or a lack of opportunities for social or personal development. This paper specifically focuses on one group of migrants: highly skilled tertiary students who are working to attain an academic degree.

According to Kelo et al. (2006), internationally mobile students are those that have crossed a national border to study or undertake other study-related activities for at least one unit of their study program (pp. 209-210). The number of mobile students has been increasing in recent years. Although the COVID-19 pandemic has deeply affected geographic mobility since early 2020, opportunities to study in overseas academic institutions have increased due to a surge in online academic programs. If studying beyond an international border classifies someone as being an international student, the proportion of people defined as such will further increase through the combination of physical and virtual mobility.

After the completion of their international studies, some students return to work in their home countries, while others choose to continue working in their host countries. Assuming that international students tend to have higher will, energy, skills, and that studying in international academic programs gives them "added value," the host countries that retain international students can enjoy what is called a *brain gain*. In fact, the Organisation for Economic Co-operation and Development (OECD, 2010) reports that students' transition into skilled workers often reflects host countries' strategic human resource planning to recruit talented individuals from around the world. A *brain gain* largely takes place within the context of the so-called "two-step migration," in which migrants are first attracted as international students and are then retained as highly skilled long-term workers (p. 41). Whereas host countries enjoy a *brain gain*, the tertiary students' countries of origin suffer from a *brain drain*, whereby they lose the social and economic benefits that they would have otherwise gained if said students had not migrated.[1] In fact, countries of origin not only lose out on a potential increase in economic output and social welfare, they also fail to recover their subsidized investment into students' schooling prior to their departure.

The traditional model to estimate countries' social return on investment in education assumes that taxpayers directly and indirectly redeem the benefits of their investment in education. However, in a world where people move freely across borders, countries that invest in the education of their citizens are often different from those that gain the benefits of that investment, which weakens the justification for subsidized public education. The aim of this study is to explore the relationship between imbalanced student mobility and social welfare. To this end, an empirical and theoretical inquiry is conducted into the migration patterns of students and skilled workers. As such, this study is comprised of two major sections. The first half shows recent trends in international student mobility. This is done to confirm that the mobility of international students is imbalanced, and to identify the origin countries (countries

[1] The discussion of these issues started in the 1960s when Grubel and Scott (1966) addressed the negative impact of skilled migration on origin countries. See also Bhagwati and Hamada (1974) and Bhagwati and Rodriguez (1975) for the argument of human capital transfers from lower-income to higher-income countries.

from which students migrate) and host countries (countries to which students migrate). Subsequently, we examined the socio-economic characteristics of the host countries through statistical examinations.

The second half of this paper focuses on analyzing the changes in social welfare caused by skilled migration. First, we develop an economic model that explains the social welfare of a nation with mobile students and workers. This model is based on a theoretical interpretation of the impact of students and workers' mobility on the European economy and society, as has been discussed extensively in the Bologna Process. Based on this model, we carried out a simulation using data from Japan and the US in order to exemplify how the social benefits of education can decline or increase based on citizens' mobility.

Finally, we address the limitations of our simulation in this study's conclusion. The conclusion also highlights the potential of our theoretical and analytical framework with regards to future research. With an expected increase in virtual mobility, we suggest that the cost-benefit analysis of education will become increasingly complex, but even more important for balanced and sustainable global funding in education.

II. *Trends in Tertiary Students' Mobility*

This section consists of an empirical inquiry into the trends of tertiary students' international mobility.[2] We assessed the imbalance in students' international mobility, while simultaneously exploring the reasons for this imbalance. Following this, we discuss the implications of our findings in terms of the social welfare costs and benefits for host and origin countries.

The remainder of this section is organized as follows. First, we review the global trends in tertiary students' mobility by region between 2008 and 2017, focusing on OECD countries, which are the major recipients of international students. Second, we examine the imbalance in tertiary students' migration patterns by analyzing student mobility within OECD countries, as well as between OECD and non-OECD countries. Third, we carry out a statistical analysis of the characteristics of OECD countries with the most international students, and analyze their economic and demographic indicators, labor force and employment indicators, official languages, tertiary education-related indicators, and their level of internationalization.

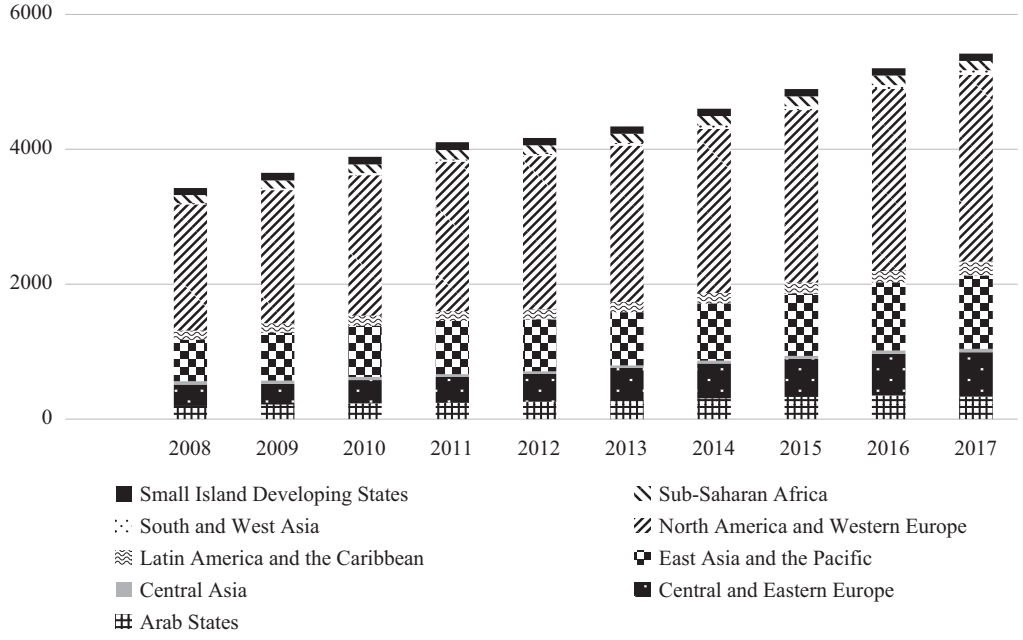
1. Global trends in tertiary students' cross-national mobility

Based on data published by the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Institute for Statistics (UIS), there were 5, 309, 460 international students globally in 2017. International students are those that have crossed a national border for the purpose of education and are enrolled in academic programs outside their country of origin. As shown in Figure 1, the number of international students increased from 3,322,537 in

[2] By using the term "tertiary education", we adhere to the definition of the International Standard Classification of Education (ISCED), which is comprised of levels 5 (short-cycle tertiary education), 6 (bachelor's or equivalent level), 7 (master's or equivalent level) and 8 (doctoral or equivalent level). The ISCED is a statistical framework for organizing information on education, which is used by UNESCO.

2008 to 5,309,240 in 2017, therefore representing an increase of nearly 60% in the last decade. Among the nine regional groups identified by the UIS, there was a remarkable increase in in-bound internationally mobile students in the following regions: North America, Western Europe, East Asia and the Pacific, and Central and Eastern Europe. However, all groups saw an increase in the number of in-bound international students.

FIGURE 1. TOTAL INBOUND INTERNATIONALLY MOBILE STUDENTS (IN THOUSANDS)



Source: UIS: http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT_DS (as of January 10th, 2020).

2. OECD countries as recipients (host countries)

Among the 5, 309, 460 tertiary students enrolled in academic programs outside their countries of origin in 2017, 3,735,674 (70%) studied in OECD countries.[3] Since OECD countries are the main recipients of international students, and because data reported by OECD countries are available in global databases published by the UIS, the OECD, and the World Bank, the subsequent sections of this paper focus on OECD countries as recipients of international students.

Table 1 shows the net flow of international students in tertiary education institutions in

[3] Information on international and foreign student mobility in tertiary education in 2017 is available at: https://www.oecdilibrary.org/docserver/f8d7880den.pdf?expires=1581403952&id=id&accname=ocid177078&checksum=36E2473351C0C7A18C1828A3F8FC3874 (as of January 10th, 2020)

OECD countries. The "Net flow" refers to the number of in-bound international students that any given OECD country receives minus the number of out-bound students; this value helps us identify whether the OECD countries are "importers" or "exporters" of internationally mobile students. The column on the left shows the net flows for OECD countries, including data from all countries (not excluding non-OECD countries); in this column, the listed countries' net flows were calculated as said countries' number of in-bound students coming from OECD and non-

TABLE 1. NET FLOWS OF INTERNATIONALLY MOBILE STUDENTS BETWEEN OECD COUNTRIES AND ALL OTHER COUNTRIES, AND BETWEEN OECD COUNTRIES

OECD Countries' Net Flows Relative to All Countries (2016)			OECD Countries' Net Flows Relative to other OECD Countries (2017)		
	COUNTRY NAME	NET FLOW		COUNTRY NAME	NET FLOW
IMPORTERS	US of America	883,065	IMPORTERS	US of America	453,157
	United Kingdom	383,981		United Kingdom	221,359
	Australia	315,446		Australia	153,574
	France	135,786		Japan	71,737
	Canada	129,301		Canada	65,221
	Japan	111,892		Netherlands	39,871
	Germany	90,095		Austria	34,642
	Austria	50,702		Switzerland	26,580
	Netherlands	50,015		New Zealand	23,084
	New Zealand	48,290		Denmark	21,209
	Turkey	40,502		Czechia	14,795
	Switzerland	35,984		Belgium	9,278
	Czechia	30,208		Hungary	3,876
	Poland	30,035		France	971
	Denmark	28,930	EXPORTERS	Sweden	-1,245
	Italy	26,159		Estonia	-1,378
	Belgium	26,025		Iceland	-1,644
	Hungary	14,556		Latvia	-2,197
	Spain	11,657		Germany	-2,261
	Finland	8,974		Slovenia	-2,429
	Portugal	6,934		Finland	-3,248
	Sweden	4,472		Spain	-3,370
	Ireland	2,419		Ireland	-4,388
	Latvia	875		Chile	-7,189
EXPORTERS	Slovenia	-260		Israel	-8,070
	Estonia	-614		Luxembourg	-8,356
	Iceland	-1,402		Lithuania	-8,387
	Lithuania	-6,690		Portugal	-8,450
	Luxembourg	-7,320		Poland	-10,322
	Norway	-8,255		Norway	-12,937
	Chile	-9,401		Mexico	-21,163
	Greece	-10,528		Turkey	-22,454
	Israel	-14,145		Slovakia	-24,350
	Slovakia	-21,881		Greece	-26,530
	Colombia	-32,127		Colombia	-26,860
	Mexico	-32,762		Italy	-37,458
	Republic of Korea	-43,801		Republic of Korea	-50,659

Note: This table was developed by the authors using UIS data. The column on the left is based on 2016 data, as some data for non-OECD countries were missing in the 2017 sample. The column on the right is based on 2017 data.

OECD countries minus the number of out-bound students enrolled in academic programs in OECD and non-OECD host countries. The column on the right shows the net flows of OECD countries relative to other OECD countries, in which net flows were calculated as the number of in-bound students coming from other OECD countries minus the number of outbound students enrolled in academic programs in other OECD countries.

We found significant imbalances among OECD countries' net flows relative to other OECD countries and relative to non-OECD countries. The US, the United Kingdom, and Australia were the top three importers of international students overall; comparatively, other importers had far fewer inbound international students. The ranking of OECD importers and exporters varied depending on whether the net flow calculation only took into account OECD countries or if it included both OECD and non-OECD countries. For instance, Germany, Turkey, Poland, Italy, Spain, Finland, Portugal, Sweden, Ireland, and Latvia exhibited negative net flows (and were classified in the exporter group) when only exchanges between-OECD countries were taken into account in the net flow calculations; in contrast, they exhibited positive net flows (and were classified in the importer group) if both OECD and non-OECD countries were considered in the net flow calculations.

3. Where and why do they move?

We now present data regarding the characteristics of host countries. Specifically, we explore how the imbalances shown above are explained by country-level characteristics reflected through economic, demographic, and employment indicators, including the languages spoken in the host countries, the characteristics of their tertiary institutions, and their degree of internationalization. Several studies have examined regional and national factors that determine the mobility of tertiary students. For example, Abbott and Silles (2016) studied 18 host countries and 38 origin countries and found that the determinants of students' mobility differed between developed and developing countries, except for language, which was a significant determinant in all students' choice to study in another country. Additionally, Caruso and De Wit (2014) examined 33 countries in Europe and found that education expenditure per student, GPD per capita, and economic openness were significant positive determinants of student mobility, whereas crime rate was a significantly negative determinant. In addition, González et al. (2011) examined data from 29 European countries in the Erasmus Program and found that distance and language were significant determinants of students' mobility.

This study contributes to the student mobility literature by including data on international student mobility from OECD and non-OECD countries. The data analyzed in this study were obtained from UNESCO (including student mobility and science innovation data), the World Bank (including world development indicators and government expenditure data), the OECD (including data on education indicators), and the Quacquarelli Symonds (QS) World University Rankings.[4] These data were merged and developed into a panel dataset for the years 2008-2017. The analyses were based on the gravity model to analyze national students' mobility by

[4] The dataset named Data for Higher Education Mobility Study (DHEMS) was developed with support from Japan Ministry of Education, Culture, Sports, Science and Technology through Kaken (17H02678) to comprehensively analyze mobility in higher education by merging data extracted from open data sources provided by UNESCO, the OECD, the World Bank and domestic data from Asia.

examining the characteristics of host countries (including economic and demographic national characteristics, as well as institutional quality), assuming that host countries attract international students from the rest of the world. Specifically, our analyses are based on the following model:

$$ln\ (S_{odt}/S_{ot}) = \beta_0 + \beta BED_{dt} + \beta_2 LFE_{dt} + \beta_3 OLS_{dt} + \beta_4 TER_{dt} + \beta_5 LOI_{dt} + \varepsilon_{odt}$$

where $ln\ (S_{odt}/S_{ot})$ is the flow of students from a country of origin o to a country of destination d divided by the number of tertiary students in a country of origin o in a given year (t = 2008, ... , 2017). We use the natural logarithm of the weighted value to normalize the distribution and to make the distributions less skewed. *BED* denotes the basic economic and demographic indicators of d in a given year. *LFE* represents the workforce and employment indicators for d in a given year. *OLS* represents the official language spoken in d in a given year. *TER* represents the tertiary education-related indicators of d in a given year. *LOI* represents the level of internationalization of d in a given year. ε is the stochastic error term, while $\beta_{1\sim5}$ indicate the coefficients of the respective variables.

1) Basic economic and demographic indicators

As shown in Table 2, to investigate the effects of 'economic indicators' on international student mobility, we measured the gross domestic product (GDP) per capita (in current US$), GDP growth (annual %), and the Gini index estimated by the World Bank. To analyze the effects of countries' demographic indicators on international student mobility, we measured life expectancy at birth (total years)[5] and fertility rate (total births per woman). A significant positive effect was illustrated on the GDP per capita of students' inflow, suggesting that tertiary students are more likely to move to countries with greater GDP per capita. Conversely, the GDP growth rate had a significant negative effect on student mobility, indicating that countries with greater student inflow have a lower GDP growth rate. The GINI index had a significantly positive effect on student inflow. This suggests that countries with higher student inflow also have greater inequality in terms of income distribution. The effect of GDP per capita became negative when

TABLE 2. REGRESSION OF INTERNATIONAL STUDENT INFLOW ACCORDING TO ECONOMIC AND DEMOGRAPHIC INDICATORS

	Economic indicators				Demographic indicators added			
	B	Std. Error	T	Sig.	B	Std. Error	T	Sig.
(Constant)	-12.037	0.127	-95.067	0.000	-34.028	0.596	-57.131	0.000
GDP per capita (current US$)	1.68E-05	0.000	23.969	0.000	-5.6E-06	0.000	-6.141	0.000
GDP growth (annual %)_	-0.013	0.004	-2.896	0.004	0.006	0.004	1.378	0.168
GINI index (World Bank estimate)	0.068	0.004	19.114	0.000	0.065	0.004	18.476	0.000
Life expectancy at birth, total (years)					0.282	0.008	37.420	0.000
Fertility rate, total (births per woman)					0.282	0.057	4.996	0.000
Number of observation	22453				22453			
Adj. R^2	0.031				0.089			

[5] Defined as the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout his/her lifetime.

demographic factors were included in the regression analysis. This is largely due to a strong correlation between GDP per capita and life expectancy at birth, as countries with stronger economies are more likely to have citizens with higher life expectancy. The effects of life expectancy at birth and the fertility rate were positive and statistically significant, indicating that students are more likely to move to countries where life expectancy and fertility rates are higher.

2) Workforce and employment indicators

As shown in Table 3, to assess the effects of the workforce and employment indicators on student mobility, we analyzed countries' researchers per 1,000 workers; the gross domestic expenditure on research and development (R&D) per 1000 full-time equivalent (FTE) researchers (current PPP$); and unemployment with advanced education (% of the total workforce with advanced education). We found that gross domestic expenditure on R&D per FTE researcher had a positive effect on the inflow of tertiary students. This suggests that countries with higher R&D budgets are more likely to receive tertiary students from other countries. Unemployment with advanced education had a negative effect on the inflow of international students, suggesting that countries with greater student inflow have more employment opportunities for individuals with advanced education. These findings have important implications on the retention of international students in host countries.

TABLE 3. REGRESSION OF INTERNATIONAL STUDENT FLOW ACCORDING TO RESEARCH AND EMPLOYMENT INDICATORS

	B	Std. Error	T	Sig.
(Constant)	-10.517	0.064	-163.555	0.000
Researchers per 1,000 labour force (FTE)	0.005	0.005	0.994	0.320
Gross domestic expenditure on R&D per researcher, FTE (in '000 current PPP$)	0.008	0.000	45.027	0.000
Unemployment with advanced education (% of total labor force with advanced education)	-0.014	0.005	-2.739	0.006
Number of observations	28811			
Adj. R^2	0.073			

3) Official languages spoken in host countries

As shown in Table 4, we examined the effect of language on student mobility. For each language, we used dummy variables (1, 0). The constant included languages other than English,

TABLE 4. REGRESSION OF INTERNATIONAL STUDENT INFLOW ACCORDING TO FIRST LANGUAGES SPOKEN

	B	Std. Error	T	Sig.
(Constant: Other languages)	-9.552	0.016	-601.969	0.000
English	1.951	0.031	62.605	0.000
French	0.768	0.039	19.878	0.000
German	0.224	0.042	5.328	0.000
Spanish	-0.236	0.058	-4.042	0.000
Number of observations	33959			
Adj. R^2	0.129			

French, German, and Spanish. English-speaking countries were the most likely to host international students, followed by French- and German-speaking countries. Spanish-speaking countries were the least likely to host international students.

4) Tertiary education-related indicators:

We also assessed the effects of tertiary education-related indicators on the inflow of international students. To analyze the institutional characteristics related to student mobility, we analyzed countries' student-teacher ratios, the number of universities ranked in the top 700,[6] initial government funding per tertiary student as a percentage of GDP per capita, and initial household funding per tertiary student as a percentage of GDP per capita. As shown in Table 5, the student-teacher ratio did not have a statistically significant effect on student mobility. Conversely, we found that host countries' number of tertiary education institutions that ranked in the top 700 in the QS World University Ranking had a significantly positive effect on the inflow of international students. Further, initial government funding per tertiary student as a percentage of GDP per capita had a significantly positive effect on the inflow of international students. Additionally, initial household funding per tertiary student as a percentage of GDP per capita had a significantly negative effect on the inflow of international students. This suggests that countries with more government funding and less household funding for tertiary education are more likely to host international students.

TABLE 5. REGRESSION OF INTERNATIONAL STUDENT INFLOW ACCORDING TO TERTIARY EDUCATION-RELATED INDICATORS

	B	Std. Error	T	Sig.
(Constant)	-11.195	0.163	-68.850	0.000
Pupil-teacher ratio in tertiary education	-0.001	0.004	-0.136	0.891
Number of tertiary institutions ranked among the top 700 universities	0.069	0.002	30.864	0.000
Initial government funding per tertiary student as a percentage of GDP per capita	0.055	0.006	9.885	0.000
Initial household funding per tertiary student as a percentage of GDP per capita	-0.045	0.008	-5.358	0.000
Number of observations	4642			
Adj. R^2	0.323			

5) Internationalization indicators

To assess the effects of internationalization on the inflow of international students, we analyzed the following indicators: international migrant stock (% of population), national tertiary students enrolled abroad compared to those enrolled in domestic institutions, and the number of foreign students per national student abroad. As shown in Table 6, international migrant stock as a percentage of the population showed a significantly positive effect on the inflow of international students, implying that countries with larger migrant populations are

[6] The number of universities that ranked in the top 700 was based on the QS World University Ranking in 2017: https://www.topuniversities.com/university-rankings/world-university-rankings/2018 (as of April 2018)

Table 6. Regression of International Student Inflow According to Internationalization Indicators

	B	Std. Error	T	Sig.
(Constant)	-9.554	0.047	-201.443	0.000
International migrant stock (% of population)	0.018	0.004	4.175	0.000
Percentage of national tertiary students enrolled abroad (%)	-0.036	0.003	-11.702	0.000
Number of foreign students per national student abroad (number)	0.144	0.006	25.046	0.000
Number of observations	6722			
Adj. R^2	0.176			

more likely to host international students. Conversely, OECD countries' percentage of national tertiary students enrolled abroad had a significant negative effect, whereas the number of foreign students per national student abroad had a significant positive effect. These results indicate that countries with more foreign students are less likely to send their students to study abroad.

6) Regression of integrated variables

Table 7 shows the results of the regression analysis, including all the variables described above. It is noteworthy that some variables' effects and statistical significance changed when other variables were added. For example, GDP per capita became positive, whereas the effect of the fertility rate became negative and statistically significant. Additionally, there were major changes in the effect of official languages; after adding all the available variables, the effect of the variables representing English- and German-speaking countries became negative, although this was not statistically significant. Conversely, the effect of the pupil-teacher ratio in tertiary education became positive and statistically significant.

We cannot conclusively determine which variables increased or decreased the mobility of tertiary students. However, certain factors consistently and significantly affect the mobility of students. For example, it is very likely that countries with a strong economy and slow growth host a greater number of international students. These results are consistent with prior studies including Caruso and De Wit (2014). It is also crucial to consider the fact that the positive effect of the Gini index is consistent throughout the analyses, which suggests that internationally mobile students usually move to countries with strong economic power and greater income inequality. This result is consistent to a theoretical discussion by Miyagiwa (1991) suggesting that high-skilled workers are likely to move where the marginal returns to their skills are higher thus causing greater inequality between skilled and unskilled workers.

The effect of the variable for French-speaking countries was robust for a greater inflow of international students. Further, the student-teacher ratio also had a significant positive effect on inflow. Additionally, the effect of university rankings was consistently positive and significant. Due to the limited data available on the quality of education and research, we were unable to conduct a thorough investigation on the effect of education- and institutional-related factors on international student inflow. However, even the limited data show that institutional and educational characteristics have an important influence on the inflow of students. Thus, we must pay more attention to institutional, education and research quality indicators as determinants of

TABLE 7. REGRESSION OF INTERNATIONAL STUDENT INFLOW BY ECONOMIC, DEMOGRAPHIC, RESEARCH AND EMPLOYMENTINT, LANGUAGES, TERTIARY EDUCATION AND INTERNATIONALIZATION INDICATORS

	B	Std. Error	T	Sig.
(Constant)	-14.801	4.373	-3.384	0.001
GDP per capita (current US doller)	7.228E-05	0.000	2.747	0.006
GDP growth (annual %)	-0.067	0.040	-1.694	0.090
GINI index (World Bank estimate)	-0.046	0.019	-2.417	0.016
Population growth (annual %)	-0.706	0.156	-4.539	0.000
Life expectancy at birth, total (years)	0.084	0.058	1.449	0.147
Researchers per 1, 000 labour force (FTE)	-0.700	0.067	-10.431	0.000
Gross domestic expenditure on R&D per researcher, FTE (in '000 current PPP$)	-0.001	0.001	-1.333	0.182
Unemployment with advanced education (% of total labor force with advanced education)	0.144	0.030	4.866	0.000
English	-0.719	0.508	-1.416	0.157
French	2.950	0.343	8.600	0.000
German	-0.933	0.479	-1.948	0.052
Spanish	-1.770	0.262	-6.755	0.000
Pupil-teacher ratio in tertiary education	0.048	0.013	3.737	0.000
Number of tertiary institutions ranked among the top 700 universities	0.014	0.018	0.782	0.434
Initial government funding per tertiary student as a percentage of GDP per capita	0.022	0.019	1.180	0.238
Initial household funding per tertiary student as a percentage of GDP per capita	-0.015	0.022	-0.656	0.512
Percentage of national tertiary students enrolled abroad (%)	0.021	0.025	0.859	0.390
Number of foreign students per national student abroad (number)	0.307	0.071	4.346	0.000
Number of observations	3445			
Adj. R^2	0.355			

student mobility. Finally, countries with more government funding and less household funding had a greater number of international students.

III. *The Implications of Imbalanced Student Mobility on Social Welfare*

Our findings above showed that students are more likely to move to countries with a stronger economy, greater income inequality, higher quality of education and research, and more public funding for tertiary education. Our next interests is their post-graduate mobility.

Extensive research shows that many international students stay in their host countries after completing their degrees. Furthermore, brain drain can have serious consequences on sending countries. For OECD countries as a whole, the OECD (2011) reports that 25% of international students who did not renew their student permits changed their student status in the host country; in most cases, this was for work-related reasons. Finn and Pennington (2018) studied

the residency status of foreign doctorate recipients from U.S. academic institutions in 2013; they found that a 5-year stay rate for foreign students who had temporary visas at graduation was 70 percent, and the 10-year stay rate was 62 percent.

The transition of international students into skilled workers contributing to host countries has been researched by Gérard and Uebelmesser (2014). They showed that those who studied abroad tended to become high skilled immigrants in host countries that have significant effects on host countries' economies. Their formulation underlies the need for strategic fiscal policy and organizing education funding in such a way that it responds to the mobility of people between nations. Further, Gerard and Uebelmesser (2015) argue that the regional imbalances associated with the mobility of students and high skilled workers are substantial. They suggest that the costs and benefits resulting from educating high skilled workers must be shared among all the involved regions.

Conversely, other studies posit that the imbalance of mobility is a non-issue. For example, Boeri et al. (2012) argue that within the context of global competition among high skilled workers, countries with an outflow of skilled individuals are not necessarily losers in the exchange of international student mobility. Their results support the "brain circulation hypothesis," according to which highly skilled individuals that circulate throughout the globe benefit both origin and host countries.[7]

According to Adelman (2016), the patterns of student mobility resemble a complex Jackson Pollock painting, "with lines crossing and curling across a canvas that pays no heed to topography." However, he also insists that the more complex the mobility becomes, the more we need to understand its patterns and outcomes, both quantitatively and qualitatively. This understanding is crucial, since skills mobility will have greater impacts on the social welfare of both sending and receiving countries as the national boundaries for intellectual exchanges are almost disappearing.

1. Estimation of mobility impact on social welfare

1) Theoretical model

Gérard (2007) defined the origin country principle as a case in which a country of origin pays the cost for studying abroad, and the host country principle as a case where the host country pays the cost.[8] Furthermore, he examined the optimization of social welfare in each case. In this section, we assume the origin country principle.

Consider n as a set of people who have completed a bachelor's degree in country j, received a graduate degree in country i, and decided to stay in country i to work. The origin country's social welfare W was calculated using the following formula:

$$W^j = \rho^j_{ji}\theta f(n_{ji}) - \gamma q_{ji} n_{ji} - c n_{ji} - w n_{ji} + \rho^i_{ji}\tau^{ij}_{ji} j n_{ji} \quad (1)$$

where $\rho^j_{ji}\theta f(n_{ji})$ is the expected social benefit produced by n, who completed undergraduate education in their home country j and received a graduate degree in country i. Additionally, ρ^j_{ji}

[7] For more discussions that support the positive impact of mobility on both origin and host countries, see Mountford (1997), Star and Wang (2002), and Theoharides (2018).

[8] See the latest formulation of these principles in Gérard and Sanna (2017) and Gerard and Sanna (2020) .

is the ratio of people who return to their origin country j. θ indicates the share of social benefit. q_{ji} indicates the amount of consumption n spent. γ is a multiplier that defines the relationship between consumption and income. c represents the education cost of n, which is a negative value, as it is assumed to be paid by the sender country j. Additionally, w is the opportunity cost incurred by n , including taxes that could have been obtained from their foregoing earnings during school. τ_{ji}^{ij} is the asset that will be transferred from country i to country j when they return to their country of origin.

Formula (1) can be used to estimate the optimal number/amount of each factor included in the equation.[9] In this study, we use the formula to estimate the amount of social welfare transferred from the origin country to the host country when a student decides to indefinitely stay in the host country for work.

2) Simulation

For our simulation, we established Japan as the sending country and the US as the receiving country. Japan's public spending in higher education is one of the lowest among OECD countries.[10] Thus, we assume that the loss caused by the brain drain is relatively lower in OECD countries, providing a conservative estimation of social welfare loss. The US has the largest number of international students from Japan; thus, this simulation could reflect real world condition.

The available data that can correspond to the theoretical model (1) are:

A) The present value of social benefits when completing higher education (bachelor's degree or higher), corresponding to $\theta f(n_{ji})$
B) Fraction or probability of returning or not returning, corresponding to ρ_{ji}^{j}
C) Amount of consumption/spending in the host country, corresponding to q_{ji}
D) Tuition and other fees for studying in the host country, corresponding to c
E) Opportunity costs, such as taxes, that could have been paid out from foregone earnings, corresponding to w

There is no available data for τ_{ji}^{ij}, which reflects the assets that would be transferred from the host to the origin country if the student returned to the origin country. Thus, the loss of social welfare tends to be underestimated and conservative.

The available data are explained as follows:

A) The present value of social benefits when completing higher education (bachelor's degree

[9] For instance, the optimal number of students studying abroad can be estimated using Formula (1):

$$f'(n_{ji})=\frac{c-\gamma q_{ji}+w}{\theta}=>n_{ji}^{E}=\left[\frac{\sigma\theta}{c+w}\right]^{\frac{1}{1-\sigma}}$$

See Gerard and Uebelmesser (2015) for the development of the formulation.

[10] In 2017, Japan's total expenditure on tertiary education as a percentage of GDP was 0.4%, which was the lowest among OECD countries. The average percentage for OECD countries was 1.0% and the highest was 1.8% (Norway). See Figure C2.2. Total expenditure on educational institutions as a percentage of GDP, by source of funds (2017) in *Education at Glance* (2020).

TABLE 8. PUBLIC COSTS AND BENEFITS FOR A MAN ATTAINING TERTIARY EDUCATION

	Direct costs	Foregone taxes on earnings	Total costs	Benefits			Unemployment benefits effect	Total benefits	Net financial returns	Internal rate of returns
				Income tax effect	Social contribution effect	Transfers effect				
	(1)	(2)	(3)=(1)+(2)	(4)	(5)	(6)	(7)	(8)=(4)+(5)+(6)+(7)	(9)=(8)+(3)	(10)
Japan	-23 000	-11 200	-34 200	77 700	70 300	0	5 800	153 800	119 600	10%
U.S.	- 48 600	- 4 900	- 53 500	257 500	69 200	0	11 900	338 600	285 100	14%
OECD average	- 45 900	- 2 600	- 48 500	132 500	51 900	600	3 100	188 100	139 600	10%

Prepared by authors based on OECD (2018) Education at Glance, Table A5.2a

or higher), which corresponds to $\theta f(n_{ji})$

The OECD calculates the lifetime wage premium for individuals who have completed a bachelor's degree or higher, compared with those who have completed a high school or junior college program, based on data provided by each member country. Table 8 shows the public costs and benefits of higher education for men in Japan and the US, as well as the OECD average. The total benefits are $153,800 in Japan and $338,600 in the US. If we focus on the benefits for the US economy, US figures should be used. If we focus on losses for Japan, Japan's figures should be used as opportunity costs. In this case, since we are considering Japan's losses, $153,800 will be used.

B) Probability of returning to the origin country: ρ_{ji}^{j}

Many studies have been conducted worldwide on the return or stay rate of students that study abroad.[11] For Japanese international students, we obtained the latest information from a database consisting of the education and career histories of individuals who received doctoral degrees in the US.[12] There were considerable differences in terms of years of schooling and place of employment, depending on the students' academic field; therefore, we focused on the field of economics. We analyzed individuals who had completed doctoral courses between 5 and 35 years of age. Of the 44 individuals who completed a bachelor's degree in Japan and received a PhD in the US, 11 (25%) were working in the US, and 23 (52.3%) were working in Japan. Further, 0.4% of the respondents were working in other countries. In this paper, we use a value of 25% to calculate the social welfare loss for Japan in the case that international students do not return to Japan after completing a doctoral course in the US.

C) Money spent in the host country: q_{ji}

Regarding expenses associated with studying abroad, the per capita expenditure of international students (according to data published by Times Higher Education) was applied to Formula (1). The amount of consumption expenditure was $23110.55 per

[11] Besides the aforementioned studies by Finn and Pennington (2018) and the OECD (2011), Bouwel and Veugelers (2012) estimated the stay rate of doctoral degree recipients to be 70% in OECD countries. They also found that the post-graduate stay rates affect the ten-year stay rates of host countries.

[12] The database was developed with the support of Japan Scientific Research (Kakenhi; grant number: 20H00097 and 17H02678).

year,[13] which included housing expenses (including rent, communication and transportation expenses, as well as living expenses, including meals and entertainment expenses). The average number of years required from the completion of a master's course to the completion of a doctoral course was 6.82 years. Therefore, by multiplying the annual expenditure by the average number of schooling years, the average money spent in the host country was $157151.7

D) Tuition and other fees for studying in the host country: c
Using the same sources as above, the average annual tuition and other tuition fees paid by international students in the US was $31806.43 per person, which was multiplied by the average number of schooling years (6.82). Thus, the cost of tuition and other fees paid by Japanese international students is $ 216919.8 in our model.

E) Opportunity costs (e.g. taxes) that could have been paid out from foregone earnings: w
Opportunity costs such as taxes that could have been paid out from the foregone earnings of individuals during their schooling were $ 11,200, according to Table 1.

Therefore, it is possible to estimate the public benefits generated from individuals studying in the US (for both Japan and the US) when they choose to stay and work in the host country, or when they return to the origin country. Here, we focused on the amount of social welfare loss in Japan when students did not return to Japan.

$$\delta W\,\mathrm{j} = .25 * 153{,}800 + 157151.74 + 216919.8 + 11{,}200 = 423721.5$$

As a result, a social welfare loss of approximately US$423721.5, which is around 46 million Japanese yen, was incurred per person. Since this amount does not account for the "added value" that would be generated by studying abroad, the real amount could be higher. Table 9 shows the number of Japanese students studying in the US in 2019, which was 18,105. Most Japanese graduates returned to Japan, including graduates who returned to Japan 5 to 35 years after completing their academic programs. Thus, we cannot say that the above estimation based on *lifelong* income can reflect the real loss incurred by student mobility. However, it would be useful to manipulate the estimation by changing the fraction in order to evaluate the magnitude of the social welfare loss.

The main purpose of this simulation was to apply the available data to a theoretical model

TABLE 9. NUMBER OF JAPANESE STUDENTS IN U.S. HIGHER EDUCATION

Type of schooling	Number of students
Undergraduate	9,001
Graduate	2,875
OPT (Training)	1,516
Non degree	4,713

Note: Based on the 2019 Open Doors Report[14]

[13] The price information was given as ¥2,634,056, and this was converted to US dollars at the rate of 109.65, which was the average rate of year 2000.

with which we could roughly estimate the economic effects of student mobility. Our focus was to examine the extent to which studying and working abroad affect the social welfare of the country of origin. Although the simulation cannot be accurate enough to reflect real-world circumstances, it is enough to understand why more than a few countries have been interested in "two step migration" discussed above. In two-step migration, the host county seemingly reaps most of the benefits. However, sending countries can simultaneously be host countries, which makes them potential beneficiaries. Thus, student mobility should be addressed from a multilateral perspective to maintain social welfare, which transcends regional boundaries.

Without the development of a transnational social welfare scheme, origin countries have become hesitant to sponsor international students' mobility, making them increasingly reliant on private funding (Johnstone & Marcucchi, 2000). Further, as private spending overtakes government spending, individuals who cannot afford to study abroad have fewer opportunities to develop their skills and competences in a global setting. If this trend continues, disparities in education and mobility will continue to grow.

Meanwhile, the rise in online education provides students from all social strata with various learning opportunities. This surge in virtual mobility could help students overcome several barriers, as the availability of courses, degrees, and employment opportunities will become increasingly diverse. Therefore, the private benefits of education remain attainable. However, the social benefits of education will become less visible and attainable, although they will continue to exist. If public spending on education is justified to the extent that education realizes social return to juristically defined beneficially, growing online education in a global setting will require even more effort to find sustainable means to identify the social benefits of education.

The economic simulation carried out in this study focused on Japan and the US. Future studies require a more comprehensive analysis through which we can explore the complex environment of global higher education. We also need to cover disciplines in the major academic categories, which will facilitate comparative analyses. Moreover, we can include additional attributes such as gender and age into our analysis to improve the validity and reliability of our findings. An important issue to consider is that we lack reliable and consistent data from less developed countries in which the brain drain is a serious issue. Remittance has to be also taken into consideration for the analysis of less developed countries, as it reduces the loss of origin countries.

IV. *Conclusion*

Our findings showed that international students are more likely to move to English-speaking countries, which host nearly half of all international students. Further, we found that students tend to move to countries with stronger economic power where income distribution tends to be unequal; at the same time, the quality of education and research tends to be higher (as education institutions receive more government funding) in such countries, and there are more high-ranked universities. These findings imply that high-quality education and income

[14] This data was obtained from: https: //opendoorsdata.org/data/international-students/academic-level-and-places-of-origin/ (as of August 20, 2020)

disparity within a host country, as well as between the origin and host countries, are linked. Additionally, our simulation indicates that origin countries could face non-trivial losses in economic performance and social welfare if their citizens do not return to work.

Every country aims to maximize its own welfare (reflected by the welfare of its citizens). However, the present residents are not always future residents of the age of global mobility. Thus, for education to be a quasi-public good for a nation, some cross-national funding systems must be arranged to attain social welfare for their respective partner countries. In practice, this would imply taking into account income contingent loans, graduate taxes, the Bhagwati tax, as well as establishing an international coordination committee that is designed to provide international students with continuous learning opportunities, while ensuring that this is beneficial for both origin and host countries.

Establishing this social welfare scheme requires cross-regional policies, whereby governments of OECD countries would be collectively responsible for developing instruments and institutions to manage higher education and research with the aim of making mobility sustainable. Due to the global impact of the COVID-19 pandemic, the physical mobility of students and workers will decrease. However, global higher education trends will remain the same with regard to expenses and investment. In a remote context, such as through MOOCs, the demand for higher education offered by other countries may become even higher. Students will continue to seek degrees from tertiary institutions with higher education and research quality, which tend to belong to countries with stronger economic power and greater income inequality. Therefore, enacting a multilateral arrangement to reduce imbalances in student mobility and skill distribution will become even more important.

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