

STUDENT MOBILITY AND ECONOMIC GROWTH IN THE EUROPEAN UNION: APPLICATION OF ROY MODEL TO SKILL MIGRATION

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I. *Introduction*

The international migration of skilled workers is becoming an increasingly important issue in the globalized economy. In a world of rapid technological changes, skilled workers are a primary resource for maintaining a competitive and sustainable economy. Accordingly, higher education policy in recent years in major industrialized countries has more visibly reflected their national economic plans. In the United States, the contribution of higher education to economic growth has been a major rationale for the state funding of postsecondary system (Becker and Lewis 1992, Hornbeck and Salamon 1991). In recent years, European countries have placed even more significant emphasis on their human resources strategies to realize regional economic growth. A well-known example is the Bologna Process, a series of higher education schemes that aim at creating a European Higher Education Area. Particularly after the Lisbon Treaty in 2000, the Bologna Process has been closely associated with issues of economic growth, employment policy and social planning (Furlong 2005), what Roeger calls “knowledge investment” in the EU (Roeger et al. 2009). The process is still a work in progress, and it is certainly too early to evaluate the effects of the educational planning on their economy. Nonetheless, the major features of the Bologna Process such as the promotion of skill mobility and quality assurance for the postsecondary system have been steadily evolving and diffusing.¹ One of the most influential US scholars in the study of postsecondary education, Clifford Adelman, says that “the core features of the Bologna Process have sufficient momentum to become the dominant global higher education model within the next two decades” (Adelman 2009).

The mobility enhancement and quality assurance for the Bologna Process derive specific action plans including the provision of mobility grants, the development of transferable credits and degrees, and the establishment of reference points based on which universities in the EU design comparable curriculum. The combination of these actions is a well-designed approach that potentially generates significant synergetic effects. Mobility enhancement facilitates comparability between credits and degrees, which in turn facilitates mobility. In order to

¹ The Bologna Process involves: 1) development of university degrees comparable and compatible among the member countries; 2) condensing undergraduate education into three years, master-level education into two years, and the rest into two or more years, making up a “three cycle system;” 3) introduction and diffusion of the European Credit Transfer and Accumulation System (ECTS), which promotes credit transfers between different institutions in different countries; 4) development of infrastructure for students and scholars to move across-the-board easily; 5) promotion of institutional cooperation and collaboration aiming at educational quality assurance; 6) enhancement of the European higher education system in order to attract students and scholars from outside the EU. These actions can be summarized into two major features: the promotion of intellectual mobility; and the enhancement of education quality.

increase comparability, credits and degrees have to be set out in a common or mutually agreed standard. Following the common or mutually agreed standard, the steps and requirements to acquire credits and degrees become visible. In turn, visibility contributes to the enhancement of performance accountability, thus improving the quality of education. Meanwhile a greater commonality of standard and smoother academic mobility further induces credits and degree transferability. Thus academic quality is continuously improved.

Nonetheless, this ideal cycle does not necessarily occur for all postsecondary institutions participating in the mobility plan. As students and scholars become able to more freely move between institutions, those with higher quality education will attract more students especially, able ones. If those institutions are located in the same country, then that country has a significant advantage in securing skilled human resources. Institutions with lower education quality, on the other hand, would not be able to attract students from other institutions. These institutions would more seriously face deterioration in their quality of education. Furthermore, if these institutions are located in the same countries, generally in poorer ones, those countries may end up losing future skilled members of their workforce.

History shows that institutions with larger inflows of skilled individuals are likely to be located in countries with stronger economies, while institutions with less skilled individuals are likely to be located in countries with weaker economies. Chen (2009) and Egger and Felbermayr (2009) argue that labor market integration tends to lower GDP per capita in a poor source country of emigration. Other studies show that economic openness facilitates an increase in skill premium, and the skill premium is higher in more developed areas than in less developed areas (Zou et al. 2009). Where income per capita is higher, the income inequality is higher. In addition, where human capital endowment is higher, income inequality is higher (Rodriguez-Pose and Tselios 2009).

Incentives to promote mobility with the enhancement of education quality thus could cause greater disparity in skill mobility, and then in the quality of higher education. Considering that our current economy needs a higher-skilled population to maintain its growth, the EU-originated schemes might result in greater economic disparity among the participants in the schemes.

This paper applies the Roy Model (1951), a robust theoretical framework often used in the areas of demographic study, labor economics, skills and income distribution, to explore relations between economic power and academic mobility in the European Higher Education Area. Influential studies that applied the Roy Model include Borjas (1987), who explains immigration decisions and earning distributions by using the model, McLaughlin (1994), who applies the model for occupational mobility, and Heckman and Sedlacek (1985), who refer to the model in their empirical analysis of market wages in self selection in the labor market.

In this study, the model is applied for academic mobility and economic disparity. In this specific area, Dahl (2002) shows that migration flows of people with different skills respond strongly to differences in the return to education, implying that the greater the income inequality, the more skilled migration the country receives. Based on the extended version of the Roy model, Brucker and Defoort (2009) show that higher inequality in the distribution of earnings in both the receiving and the sending country affects the skill bias of the migration population favorably.

The paper is organized as follows: First the Roy Model is described by using econometric expressions. Next, exploratory analysis is performed on the relation between student mobility

and economic growth in the European Higher Education Area. Currently available data do not allow full evaluation of skill distribution, institutional quality and economic growth. By using: 1) data on student flow on the Erasmus Programme, and 2) GDP per capita in purchasing power standards, the analysis tests the applicability of the basic insight of the Roy Model as to the relation between student flow among different countries and their relative economic power.

II. Roy Model

The following describes the Roy Model by using explanations applicable to empirical analyses.

Let “ Y_{1i} ” be the utility of individual “ i ” in moving to country “A,” and “ Y_{2i} ” be the utility in living in country “B.” By “utility,” we might suppose the benefit of living in the respective country, including additional earnings, better employment, and better quality of life in the receiving country. Suppose that individual “ i ” moves to country “A” if $Y_{1i} > Y_{2i}$. We assume that (Y_1, Y_2) have a joint normal distribution, with means (μ_1, μ_2) . The covariance matrix will be shown as:

$$\begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{bmatrix}$$

We then define:

$$u_1 = Y_1 - \mu_1, u_2 = Y_2 - \mu_2, \sigma^2 = \text{Var}(u_1 - u_2)$$

$$Z = (\mu_1 - \mu_2)/\sigma \text{ and } u = (u_2 - u_1)/\sigma$$

Then if $Y_1 > Y_2$, $u < Z$ and the expected utility of the individual living in country “A” is given by:

$$E(Y_1 | u < Z) = \mu_1 - \sigma_{1u} \varphi(Z) / \Phi(Z)$$

where $\sigma_{1u} = \text{Cov}(u_1, u_2)$, $\varphi(\cdot)$ is the density function and $\Phi(\cdot)$, the distribution function, of the standard normal.

The mean utility of an individual who lives in country “B” will be provided by:

$$E(Y_2 | u > Z) = \mu_2 - \sigma_{2u} \varphi(Z) / [1 - \Phi(Z)]$$

where $\sigma_{2u} = \text{Cov}(u_2, u)$.

Since $\sigma_{1u} = (\sigma_{12} - \sigma_1^2)/\sigma$ and $\sigma_{2u} = (\sigma_2^2 - \sigma_{12})/\sigma$, we have $\sigma_{2u} - \sigma_{1u} > 0$. We then consider the following different settings:

If $\sigma_{1u} < 0$, $\sigma_{2u} > 0$, the mean utility of those living in country “A” is greater than μ_1 , and the mean utility of those living in country “B” is greater than μ_2 . Thus, those who choose to live in country “A” are better off than the average people who already live in country “A.” Also, those who choose to live in country “B” are better off than the average people who already live in country “B.”

If $\sigma_{1u} < 0$, $\sigma_{2u} < 0$, the mean utility of living in country “A” is larger than μ_1 . The mean utility of living in country “B” is less than μ_2 . This means that those who choose to live in country “A” are better off than the average people who already live in both country “A” and “B,” but they are better off in country “A” than in country “B.” Those who choose to live in

country “B” are below average in both countries “A” and “B,” but they are better off in country “B” than in country “A.”

In case of $\sigma_{1u} > 0$, $\sigma_{2u} > 0$ the reverse condition of the case $\sigma_{1u} < 0$, $\sigma_{2u} < 0$, will occur. Case $\sigma_{1u} > 0$, $\sigma_{2u} < 0$ is not possible, provided the definition of $\sigma_{1u}\sigma_{2u}$.

It is important to note here that the case $\sigma_{1u} < 0$, $\sigma_{2u} < 0$ is likely to occur when σ_1 is significantly greater than σ_2 . Then, those who have better skills will go to a country with higher variance in utility, in this case, to country “A.” Then country “B” will have people with relatively lower skills whose utility will be below average in both “A” and “B” countries.

III. *What the Roy Model Suggests to EU Student Mobility*

The Roy Model is formulated under the condition that: 1) individuals can move between countries freely, 2) there is a common standard or reference points for utility in these countries, based on which individuals decide to move between countries, and 3) anyone can access the information stated in 2). Indeed, the Bologna Process seems to attempt to satisfy these conditions. There are two specific projects designed to pursue A) the mobility promotion and B) quality assurance – the two primary objectives of the Bologna Process explained above. Those are: 1) The Erasmus Programme, and 2) European Credits Transfer and Accumulation System (ECTS) as well as the Tuning Project. The Erasmus Programme was launched in 1987 with the objective of promoting student mobility and cooperation among higher education institutions in the EU². Its major feature is its scholarship programme. The programme sponsors more than 180 thousand students and scholars each year to study and research abroad. The amount of scholarship is generous enough for students even from lower income countries to afford both studying and living expenses in higher income countries. The Erasmus thus is designed to allow free mobility of individuals.

Another main feature, the Tuning Project, started in 2000 by university professors as a response to the Bologna Process in academic perspectives. The project aims to establish academic reference points where professors in the EU community can share common standards on the content and outcome for academic subjects, courses, and programmes. Referring to that information, professors can design their teaching content, workload of students in learning the content, and the outcome that students are expected to attain through the learning. The Tuning Project thus enables European universities to communicate in their academic discipline in a common language, making their academic profiles comparable and compatible. Also as the tuning process is combined with ECTS, the-EU wide scheme for credits accumulation, the process and requirement to attain degrees could be expressed in detail, and become transparent to all students in the EU. Thus Erasmus, Tuning, and ECTS are, in combination, designed to share the same utility standard usable among different countries, which satisfies another condition on which the Roy Model works. Furthermore, information dissemination is a primary

² The primary objective of the Erasmus Programme is to create a European Higher Education Area and foster innovation throughout Europe. In addition, for student mobility that supports individual students studying abroad, the programme sponsors higher education institutions working together for intensive programmes, academic and structural networks and multilateral projects. More than 90% of European universities participate in Erasmus, and 2 million students have been sponsored by the programme since 1987 when it started. For more details see: http://eacea.ec.europa.eu/erasmus_mundus/index_en.php

emphasis of the Directorate-General for Education and Culture at the European Commission³. Through their website, and at every branch office in the member countries, the information on Erasmus as well as ECTS is widely announced and distributed. The European Committee thus obviously emphasizes the importance of providing information to anyone in the world.

Let's consider, based on the Roy Model, how students and scholars select the countries in which they wish to study. When the variability of utility for education is larger in a receiving country, individuals with high ability will select to go to that country, and lower ability individuals will stay in the home country. This is the case, $\sigma_{1u} < 0$, $\sigma_{2u} < 0$, and country "A" is the host country, and "B," the home country. This case implies that a country with the postsecondary education system offering higher ability students greater advantages obtains better human resources.

It is important to note that, in the case of $\sigma_{1u} < 0$, $\sigma_{2u} < 0$, the larger the variance of utility for education, the larger the advantage for able students becomes. But the contrary is also the case. The larger the variance, the larger the "disadvantage" for low ability individuals. This suggests that student mobility would possibly increase economic disparity derived by a difference in the quality of human resources.

The following is an explorative analysis to examine the applicability of the Roy Model to the relation between student flow and economic disparity. More specifically, this attempts to determine whether richer countries, which are more likely to produce greater returns to skills, attract more students and scholars from other countries.

IV. *Empirical Application*

The following analysis examines the relation between student mobility and economic growth. For data on student mobility, mobility flow in the Erasmus Programme in 2007 and 2008 is used, which shows the number of students studying abroad within the EU, by home and host country⁴. The negative side of using this dataset is that it treats only those who move between countries through Erasmus, and thus does not take a comprehensive picture of all EU student mobility. The positive side is that the students are given a constant condition provided by Erasmus, which is consistent to all mobility students, and is thus free from any external shock affecting student mobility. If for instance, students move to other countries due to political chaos in their home countries, the mobility may be counted as studying abroad, but their choice to move out is due to an external force, which violates the Roy Model assumption for self-selection. In fact, it is not really necessary to cover all the mobility population. This analysis focuses on mobility flows between different countries, given a specific economic disparity between these countries.

For data on the level of economic growth, GDP per capita in purchasing power standards is derived from Eurostat for the year 2008. The purchasing power standards have been estimated by setting the average GDP rate of 27 EU countries as 100, then calculating relative scores to that average for each of 27 countries. My dataset includes 27 EU countries plus

³ The dissemination policy and activities at the Directorate-General for Education and Culture are available at the following site: http://ec.europa.eu/dgs/education_culture/valorisation/index_en.htm

⁴ The data is publically available at the following site: http://ec.europa.eu/education/erasmus/doc920_en.htm

EFTA countries including Island, Liechtenstein, Norway, and also Turkey. Thus the numbers of samples are $31 \times 30 = 930$. For each case, the dataset has information on one way mobility with all other countries. For each case, the mobility ratio is calculated by the following formula.

$$\text{Mobility ratio} = \frac{\sum \cdot \text{mobility}_{a-b}}{\sum \cdot \text{mobility}_{b-a}},$$

where “a-b” means students or scholars who move from country “a” to country “b,” and “b-a,” from country “b” to country “a.” The economic ratio is calculated by the following formula:

$$\text{Economic ratio} = \frac{RS_{a-b}}{RS_{b-a}}$$

where *RS* is relative score, the GDP per capita in purchasing power standard relative to the average GDP in the EU as 100. “a-b” means that *RS* is for country “a” against country “b,” and “b-a,” of country “b” against country “a.”

Table 1 shows the result of the regression of mobility by economic condition⁵. In order to normalize the mobility ratio, the score has been transformed to natural log. This result shows how the economic power of one country, relative to another country, affects student flows between the two countries. One additional unit of the economic growth increases by 1.024 points in student mobility, meaning more than 100 percent. Thus the level of economic growth is a very strong factor that determines the host countries. The stronger the host country's economy, the more likely it is that students and scholars move to that country.

Let's look at the relations between economic power and mobility more closely by looking at their distribution. Graph 1 shows the linear and quadratic effects of the economic parity to mobility.

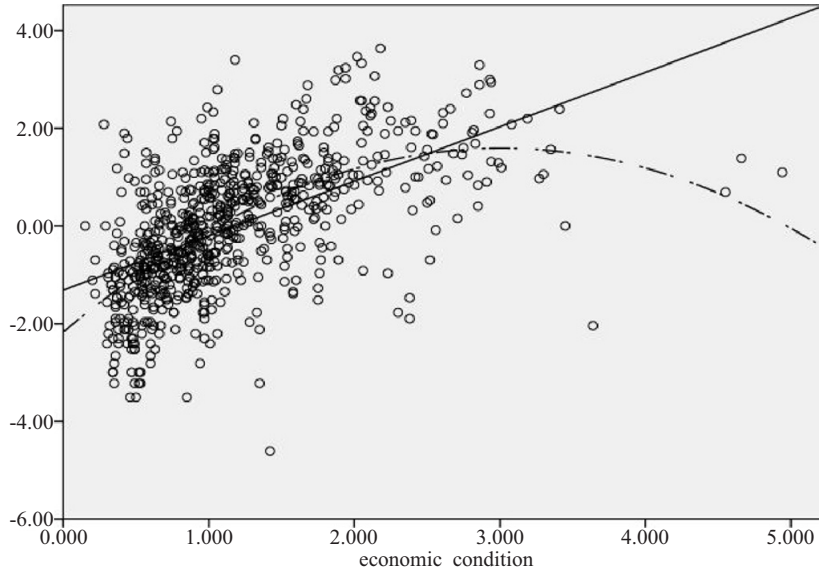
Although there are some exceptions, mobility increases as economic power increases. Especially when economic disparity is small to medium, the effect of economic power on mobility is significant. Compared with the linear function, the first coefficient of the quadratic function shows a very strong effect of economic difference on mobility. This effect then declines as the economic disparity becomes larger. This may indicate the diminishing effect of one factor to another in economics of scale. But it may also suggest that too large an economic gap could restrict the flow of people, particularly from very poor countries. Although the Erasmus Programme offers reasonable funding, private costs would not be minimal. Thus for students in a country with considerable economic difficulty, studying abroad may not be an option, or only an option for a very limited number of affluent students.

TABLE 1. REGRESSION OF MOBILITY BY ECONOMIC CONDITION

Variable	Coef.	T statistic	Sig.
Economic condition	1.024	17.875	.000
Constant	-1.214	-15.443	.000
Adjusted R2	.298		
Number of obs	885		

⁵ There is one case with an extreme gap between the in- and out-flow of students—between France and Malta, while Malta receives 88 students from France, France receives only one student from Malta, thus the ratio is 88. This is seen as an unusual condition where factors other than economy affect the mobility. Thus the case is excluded from the sample.

FIG. 1. RELATION BETWEEN MOBILITY AND ECONOMIC CONDITION



Model Summary:

Dependent V; Log Mobility

Independent V; Economic Condition

	Coef.1	Coef.2	F.	Sig.
Variable: Economic condition				
Linear	1.114		360.91	.000
Constant	-1.312			
Adjusted R2	.325			
Quadratic	2.499	-.415	236.13	.000
Constant	-2.169			
Adjusted R2	.387			
Number of obs	885			

IV. Conclusion

This paper introduces the Roy Model for the examination of recent students and scholars mobility in the European Union. The model is applied to analysis of the relation between the mobility and differences in economic capacity between host and home countries. The results show that countries with higher per capita income receive more students and scholars. Provided that higher income countries offer higher returns to those with a higher level of education, countries with greater economic power are likely to receive more skilled individuals, suggesting that those that already have economic power can further strengthen their human resources. As

skilled individuals are another significant resource for economic growth, countries with strong economies will gain more economic capacity, thus creating larger economic disparity.

To determine whether the Roy Model sustains in the skill flow in the European Union, however, the analysis has to include such additional data as returns to education by countries, and the distribution of the returns. Also for more reliable investigation, more micro-level data on the quality of postsecondary institutions in which students move in and out have to be examined. Thus this study is as yet at the initial stage of investigation, but possibly a departure for further studies on the important impact of the Bologna Process on the EU higher education system and on their human resource development.

In fact, the impact of the Bologna Process is no longer discussed within the EU horizon. The Erasmus Programme has been expanding its arm to outside the EU. Particularly through the establishment of Erasmus Mundus, which aims at partnerships between the EU and the rest of the world with emphasis on masters and doctorates, the EU has been sponsoring students and scholars in countries all over the world. Thus EU-oriented quality assurance and student mobility, especially the mobility of high-end human resources, are now taking place worldwide. This implies that economic disparity based on the different distribution of skills will soon have to be discussed from an international perspective.

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