

# The Impact of EU Accession on Human Capital Formation

## Can Migration Fuel a Brain Gain?

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## Abstract

Can a brain drain be good for development? Many studies have established the theoretical possibility of such a brain gain. Yet it is only recently that the relaxation of data constraints has allowed for sound empirical assessments. In utilizing the dramatic policy change that accompanied European Union accession as a natural experiment, this paper is able to assuage fears of reverse causality between migration and human capital formation.

The results highlight a significant impact of European Union accession on human capital formation indicating that the prospect of migration can indeed fuel skill formation even in the context of middle-income economies. And, if accompanied by policies to promote return migration, as well as a functioning credit market to enable private investment, international labor mobility could represent a powerful tool for growth.

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# The Impact of EU Accession on Human Capital Formation: Can Migration Fuel a Brain Gain? \*

Emily Farchy

## 1 Introduction

This paper sets out to quantify the benefits, in terms of human capital formation, that result from accession to a regional trade block. The motivation behind the analysis that follows is to provide an empirical test of recent arguments (Beine et al 2001, Mountford 1997, Stark, Helmenstein, and Prskawetz 1998) that posit the existence of a brain gain—an increase in stocks of human capital—following labor market deregulation.

Migration is generally thought to have a negative impact on human capital stocks, as educated individuals leave their country in order to take advantage of higher wages abroad.<sup>1</sup> This phenomenon has become known as the brain drain. In contrast the counter-intuitive notion of the brain gain rests on the assumption of the endogeneity of the human capital investment decision. It supposes that the increase in returns to education, prompted by the opportunity to migrate,

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<sup>1</sup>Another mechanism through which migration opportunities increase the return to investment in skills is analyzed by David Wildasin, who avers that the increased specialization that follows human capital investment exposes skilled workers to region-specific earnings risks, risks that can be mitigated by international mobility of skilled labor.

will encourage more individuals to invest in education. A net brain gain results if the positive effect raises human capital stocks above the levels expected in the absence of migration.

In order to assess the likelihood of a net brain gain, it is first necessary to question the magnitude, indeed the existence, of the gross effect of migration on human capital formation. If this gross effect can be quantified it should enable a more informed consideration of the impact of labor market liberalization; of the trade-off between human capital formation and capital flight - the brain gain, and the brain drain.

To examine the magnitude of the brain gain this paper utilizes the natural experiment provided by EU accession. Upon joining the EU, the citizens of the accession country become subject to Article 39 of the EC Treaty—the free movement of persons. If brain gain models are to be given credence there should exist a positive relationship between the increased opportunities for migration prompted by this policy change and enrollment in tertiary education. To test this relationship the analysis of this paper rests on two strategies: firstly a simple difference-in-difference estimation, utilizing the disparate timings of accession negotiations with the Czech Republic and Slovakia, and secondly, a panel regression of 13 countries that have joined the EU. Taken together the results of these two strategies provide evidence in support of the endogeneity of the human capital investment decision, and thus the potential for a net brain gain.

What follows is organized into two sections. The first presents a review of the related literature; the second discusses the analytical methods and main results of the estimated impact of EU accession on human capital formation.

## **2 Economic Theory and Literature Review**

The phenomenon of the brain drain is not new (Bhagwati 1970, Grubel and Scott 1966). It has long been recognized that the outflow of a country's most

skilled and educated workers can have profound implications on the economy they leave behind, in terms of equity and efficiency, in the short and the long-term.

However, recent developments, both theoretical and empirical, have prompted renewed interest in the area of skill migration. From a theoretical perspective, models that endogenize growth (Romer 1986) have highlighted profound potential long-term implications of the brain drain, while models that endogenize demand (Krugman 1991) highlight how the reducing transportation costs involved in trade encourage agglomeration and with it the pull of skill segregation. Combined with the empirical observation of the acceleration of skilled labor from developing countries—recent labor force survey data show that highly skilled migrants accounted for around 38%<sup>2</sup> of EU migration inflow—there is little doubt as to why the magnitude of the brain drain has once more become an urgent question.

## 2.1 The Movement of Skilled Labor: The Brain Drain

In 1966 when Grubel and Scott first analyzed the brain drain in the context of perfectly competitive markets, they found it had no welfare implications. Wages were equated with the marginal productivity of labor, thus a migrant “removes both his contribution to national output and the income that gives him claim to this share, so that other incomes remain unchanged.” (Grubel and Scott 1966) Yet this reasoning ignores the positive externalities associated with human capital. If one assumes that the skills of workers are complements such that the productivity of a worker depends positively on the productivity of her co-workers, the reduction in opportunities to work with skilled agents following an outflow of skilled labor reduces the welfare of the remaining population. This can be illustrated following a simplified version of Kremer’s 1993 O’Ring model.

Take for example an economy in which output is produced via two tasks, for

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<sup>2</sup>Highly skilled migrants are here defined according to the International Standard of Classification on Occupation categories 1-3 (includes managers, professionals and associate professionals) Quoted in Auriol and Sexton 2001

example research and policy implementation. Let  $s_i$  denote the skill level of a worker involved in task  $i$  where  $i \in \{1, 2\}$ . Thus

$$y = f(s_1, s_2) \quad (1)$$

Furthermore, suppose that the skill of a worker involved in the production of task  $i$  may take either of two possible levels:

$$s_i \in \{e_i, u_i\} \quad (2)$$

This may be thought of, for example, as reflecting the level of education of the worker, where

$$e > u > 0 \quad (3)$$

In order to ascertain which workers, from task 1 and task 2 will choose to work ('match') together in equilibrium, we note that a stable match will be one where it is not possible for an individual to rematch and improve her productivity.<sup>3</sup>

Assume the wage of a worker involved in task 1 is set according to

$$MPL : w_1 = \frac{\partial f(s_1, s_2)}{\partial s_1} \quad (4)$$

And skills are assumed to be complements, such that:

$$\frac{\partial w_1}{\partial s_2} = \frac{\partial^2 f(s_1, s_2)}{\partial s_1 \partial s_2} > 0 \quad (5)$$

Given this complementarity, in this context:

$$\frac{\partial f(s_1, e)}{\partial s_1} > \frac{\partial f(s_1, u)}{\partial s_1} \quad (6)$$

That is, switching to an educated partner from an uneducated partner will

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<sup>3</sup>We assume utility is defined narrowly in terms of wages, and thus productivity.

always increase the productivity of an educated worker. Thus an uneducated worker will never be able to profitably incentivize an educated worker to match with him.

The result in a competitive market is a unique stable match involving positive assortative matching, such that skilled and unskilled workers are segregated. If the initial match is non-assortative, then assortative matching makes high-skilled workers strictly better-off and low-skilled workers strictly worse-off. In this manner a brain drain can increase the incentives for future generations to migrate creating a poverty trap. The impact on equity is all the more pronounced when one considers the likelihood that education is publicly-subsidized such that the migration of highly-skilled workers imposes a fiscal loss on the remaining inhabitants of the origin country (Bhagwati and Hamada 1974). This can be particularly inequitable if, given the mobile nature of the skilled workers, taxes fall predominantly on the uneducated (Venables, 2005).

Developments in economic geography (Krugman 1991) have highlighted how, as transportation costs fall, in response to policy changes or technological advances, this tendency for skill segregation is likely to increase. The idea behind the simplest economic geography models is that industrial location is demand dependant. Furthermore, demand differences are themselves likely to be endogenous<sup>4</sup>, such that an initial industrial expansion attracts additional labor, which in turn increases demand for goods and services, attracting further labor, and fuelling a continuous feedback cycle. The limit of this cumulative cycle is provided by agricultural production which cannot relocate to industrial hubs and so generates decentralized demand (via agricultural labor) for industrial goods and services. The degree of industrial concentration will be dependent on the relative importance of economies of scale and transport costs.<sup>5</sup> When transportation costs are high, production is constrained to locate near demand

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<sup>4</sup>Either because of mobility of workers (Krugman 1991) or because of mobility of firms demanding intermediate goods (Venables 1996).

<sup>5</sup>Krugman (1998) lists other such forces such as; thick labor markets and pure external economies on the centripetal side and land rents and pure external diseconomies on the centrifugal side. Krugman simplifies modelling however, by focusing only on economies of scale and transport costs.

and, provided the latter begins relatively dispersed across the two countries agglomeration will never get underway and skilled labor will earn approximately the same real wage irrespective of location. As trade costs fall economies of scale will become relatively more important in the location decision. Industry will cluster in one country, and skilled workers will follow in order to take advantage of their higher marginal productivity. In this manner, models of economic geography illustrate how, in the presence of endogenous demand, initial inequalities can be exacerbated by labor mobility (Krugman and Venables 1995).

Accession to the EU, and the associated policy changes, represents a significant reduction in transport costs as tariffs reduce and the movement of factors becomes less costly. Thus one might expect skilled labor from accession countries to flow out, upon accession, in order to agglomerate with the existing skilled labor in Central Europe. In short an increase in the brain drain. Indeed, in her analysis of industrial location in the EU, Amiti (1998) finds that industries most subject to scale economies are highly concentrated and located in central EU countries.

## **2.2 The Creation of Skilled Labor: The Brain Gain.**

It has long been accepted in the migration literature that if human capital is characterized by network externalities, the levels of investment in education can be characterized by multiple equilibria, where migration and the relocation of skilled labor can perpetuate a bad equilibrium. However, accepting the presence of positive externalities in education, the negative prognosis presented above—that migration will perpetuate a low-education equilibrium—depends entirely on the assumption of a negative relation between migration and domestic human capital stocks.

More recent research has used dynamic models that endogenize the human capital investment decision to question this negative relation, purporting conversely that migration may encourage a brain gain. The hypothesis is that the possibility to migrate and achieve higher wages abroad, modifies the human



capital formation decision calculus, raising the expected private return to education. Thus the indirect effect of the migration is to raise the proportion of the population willing to invest in education, concomitantly raising the level of human capital in the economy towards the social optimum level without the use of taxes or subsidies (Stark and Wang 2002).

The relative magnitude of these two effects of migration; the relocation versus creation of skilled labor—or the net brain effect—will have profound implications for the development of the origin country. If one admits for the possibility of network externalities a positive net brain effect may push an economy from a low equilibrium out of a poverty trap and onto a virtuous cycle toward a high education equilibrium<sup>6</sup>, higher productivity levels, and, given the assumption of positive externalities resulting from education, stronger productivity growth.<sup>7</sup>

Recent literature has modelled the possibility of the brain gain; under assumptions of, heterogeneous labor (Mountford 1997), and under assumptions of imperfect information and return migration (Stark et al 1997). The model presented below is adapted from Stark et al (1998). Throughout the analysis that follows, education is assumed to be internationally transferable and a necessary but not sufficient condition for migration.<sup>8</sup>

Represent the income choices of a two period lived agent as follows:

$$y_{1i} = (1 - \pi_i) \cdot w(\pi) \quad (7)$$

$$y_{2i} = \phi(\pi_i) \cdot w(\pi) \quad (8)$$

Where we assume:

- Each agent is endowed with 1 unit of labor per period.

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<sup>6</sup>See Mountford 1997 for an analysis of this ‘big push’ in the context of heterogeneous ability

<sup>7</sup>If the average human capital level increases, raising  $p$ , this will raise initial stocks of  $p$  the following period. This in turn will increase the return for young agents considering investing in human capital, which will, in turn cause another rise in  $p$ . This is potentially a perpetual process of endogenous growth.

<sup>8</sup>This is an extreme and disputed assumption, (see Borjas (1990) for a model of negative self-selection of migrants) yet it nevertheless highlights a trend observable in empirical surveys (see Dustmann and Liebig and Sousa-Poza (2004)) and has been justified on the grounds that skilled migrants generally face smaller costs due to informational advantages and secured jobs.

- $\pi_i \in [0, 1]$  is the amount of period 1 labor each individual devotes to investment in human capital;
- $\pi$  is the average level of education in the population st  $\pi = \Sigma \pi_i$
- Wages  $w(\pi)$  are a positive function of  $\pi$ . This represents the positive externalities of education.<sup>9</sup>
- Costs of education are represented as the opportunity cost of forgone labor earnings
- $\phi(\pi_i)$  is the amount of productive human capital available in second period measured in efficiency units of labor. Thus  $\phi(\pi_i)$  represents the skill premium. Where  $\phi'(\pi_i) > 0$  and  $\phi''(\pi_i) < 0$
- Workers consume their entire wages both in period one and in period two.
- Lifetime utility can be represented as:

$$U(y) = u(y_1) + \rho u(y_2) \quad (9)$$

where  $U'(y) > 0$  and  $U''(y) < 0$  and  $\rho$  represents the discount factor.

From the above assumptions it can be seen that whilst income in period one is decreasing function of  $\pi_i$ , period two income is an increasing in  $\pi_i$ . Furthermore, income in both periods is positively effected by the average skill level in the economy

A representative agent therefore chooses  $\pi \in [0, 1]$  to maximise:

$$u[(1 - \pi_i) \cdot w^d] + \rho \cdot [p \cdot u(\phi(\pi_i) \cdot w^f) + (1 - p) \cdot u(\phi(\pi_i) \cdot w^d)] \quad (10)$$

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<sup>9</sup>The positive externalities of education, beyond the strictly private gains anticipated by those who invest, have been characterized in a variety of ways. Vidal (1998) models these benefits by assuming an intergenerational transfer whereby the higher human capital level of one generation, the more effective is the human capital of the next generation. Under this premise skilled migration makes future human capital acquisition cheaper in the destination country and dearer in the origin country. Mountford (1997) posits a production externality such that the current MPL depends positively on the share of the population who had education in the previous period. Beine Docquier and Rapaport (2001a) make Mountford's hypothesis explicit by allowing the average skill of one generation to pass directly to the next, who can then build on it.

Where the ex-ante uncertainty involved in making education decisions contingent on migration prospects is captured by  $p$ , the probability of migration<sup>10</sup> ( $0 \leq p \leq 1$ ). Sources of uncertainty can include: emigration policies set by source countries, immigration authorities in destination countries, and the time lag between the two decisions; education and migration.

If the agent successfully migrates overseas she can expect to achieve wage:

$$w^f = w(\pi^f) \quad (11)$$

where wage is a positive function of the aggregate human capital stocks in 'domestic' or 'foreign'. Thus, since we assume  $\pi^f > \pi^d$  we have that  $w^f > w^d$

First order conditions for maximization imply:

$$\phi'(\pi_i) = \frac{1}{\rho} \cdot \frac{w[(1 - \pi_i) \cdot w^d]}{p \cdot w(\phi(\pi_i) \cdot w^f) \cdot \frac{w^f}{w^d} + (1 - p)w(\phi(\pi_i) \cdot w^d)} \equiv \psi(\pi_i, p) \quad (12)$$

Given that  $w(y) > 0$ , and  $w^d$  is an increasing function of  $\pi^d$ , we can see that the nominator (resp. denominator) is an increasing (decreasing) function of  $\pi^d$ . Thus it must be that  $\partial\psi(\pi_i, p)/\partial\pi^d > 0$ .

Implicit differentiation of (12) yields:

$$\frac{\partial\psi(\pi_i, p)}{\partial p} + \frac{\partial\psi(\pi_i, p)}{\partial\pi_i} \cdot \frac{d\pi_i}{dp} = \phi''(\pi_i) \cdot \frac{d\pi_i}{dp} \quad (13)$$

or rewritten:

$$\frac{\partial\psi(\pi_i, p)}{\partial p} = \left[ \phi''(\pi_i) - \frac{\partial\psi(\pi_i, p)}{\partial\pi_i} \right] \cdot \frac{d\pi_i}{dp} \quad (14)$$

Given the assumptions on the concavity of the skill premium,  $\phi''(\pi_i) < 0$ , we need only show that

and at  $\partial\psi(\pi_i, p)/\partial\pi^d > 0$ , and since  $\phi''(\pi_i) < 0$ , it is clear that all we require

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<sup>10</sup>Note that the case of an economy closed to migration is incorporated into equation for as the case when  $p=0$

in order that  $d\pi_i/dp > 0$  (a positive brain gain) is that  $\partial\varphi(\pi_i, p)/\partial p > 0$ .

$$\frac{\partial\varphi(\pi, p)}{\partial p} = -\frac{u[(1-\pi_i) \cdot w^d] [u'(\phi(\pi_i), w^d) \cdot (w^f/w^d) - u'(\phi(\pi_i), w^d)]}{\rho [p u'(\phi(\pi_i), w^f) \cdot (w^f/w^d) - (1-p) u'(\phi(\pi_i), w^d)]} \quad (15)$$

Thus theory would predict that openness to migration should lead to an increase in domestic human capital formation if, and only if:

$$u'(\phi(\pi_i), w^f) \cdot w^f > u'(\phi(\pi_i), w^d) \cdot w^d \quad (16)$$

Note that this condition is met by any utility function  $u(x)$  that maintains  $u'(x) + xu''(x) > 0$  for all  $x$ ,<sup>11</sup> Or alternatively, by any utility function exhibiting relative risk aversion smaller than one.

The fundamental relationship emerging from this theory is a positive link between migration opportunities and the proportion of young individuals who decide to invest in education. Some workers migrate and with them goes a higher level of human capital than had they migrated without factoring in the possibility of migration—a brain drain. But, counterbalancing this, other workers stay in the origin country, and with them stays more human capital than would have done in the absence of the migration possibility—a brain gain.<sup>12</sup>

Yet, some have claimed that this brain gain literature is excessively optimistic and likely to remain little more than a theoretical possibility. Schiff (2005) disputes assertions that there will always be a positive level of migration such that next period human capital stocks increase in the origin economy, believing that risk aversion, heterogeneous labor, and the benefits accruing from unskilled migration all combine to ensure that the net brain gain is likely to be negative. Despite extensive theoretical contention, empirical analyses have to date been severely limited by data issues.

<sup>11</sup>If  $u'(x) + xu''(x) > 0$  then  $xu'(x)$  is a strictly increasing function. Hence for  $x_2 > x_1$ , we have that  $x_2 u'(x_2) > x_1 u'(x_1)$ . Setting  $x_2 = \phi(\pi_i), w^f$  and  $x_1 = \phi(\pi_i), w^d$ , the inequality, as stated above, holds.

<sup>12</sup>This model does not incorporate the possibility that human capital formation is subsidized by the origin country government.

## 2.3 Empirical Literature

Until recently there has been no harmonized migration data on the skill levels of international migrants disaggregated by country.<sup>13</sup> Many origin countries do not collect any such qualitative data, and the data collected by destination countries display much heterogeneity particularly with regards to the educational attainments of international migrants. As such much of the quantitative assessment of this much-debated phenomenon has been either anecdotal or cross sectional.

Anecdotal evidence of a potential brain gain has been strong. Kangasniemi et al (2004) have found that 40% of migrant doctors working in the UK were 'influenced' to train in medicine by the prospect of migration. Whilst Lucas (2004) notes that despite low domestic returns on skills 72% of all students enrolled in higher education in the Philippines were enrolled in private institutions. Lucas takes this, along with the finding that the choice of field of study responds to shifts in international demand, as evidence that the domestic skill premium is unlikely to be the primary driver for the decision to invest privately in education.

Beine et al (2001a) attempted a cross-sectional empirical test of the brain drain and found that migration appeared to boost human capital formation in poor countries, and further, that the stock of human capital positively influenced growth. However the analysis was severely constrained by data problems such as the need to use gross migration rates as a proxy variable for data on the brain drain. A second attempt (Beine et al (2003)) found results in support of their earlier work other than the finding that the marginal effect of migration on human capital does not differ with the wealth of the origin country. This work, however, was reliant on a dataset compiled by Carrington and Detragiache (1998), that is itself subject to problems.<sup>14</sup>

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<sup>13</sup>A recent World Bank sponsored study by Docquier and Marfouk has made tentative steps toward filling this void by providing emigration rates by education attainment for all countries in 1990 and again in 2000

<sup>14</sup>The US census data, on which it was based, does not record where the education took place; furthermore it includes foreign students, such that graduate students may account for

Similarly, and also relying on the Carrington and Detragiache dataset, Faini (2002) compares gross enrollment rates across 51 countries to measures of the extent of high skilled migration to the OECD from these countries, and finds little evidence that a greater rate of emigration of the highly skilled induces greater domestic enrollments in higher education.<sup>15</sup>

As with all cross country regressions, the robustness of these studies are severely hampered by the potential for omitted variable bias resulting from cross country heterogeneity. Most recently, Beine, Defoort and Docquier (2007) have gone some way to addressing this problem. And, using a panel of 6 observations per country, have found that the impact of skilled migration on education is contingent on the country level of development, that is, it is only ambiguously perceptible in lower income countries while it is unambiguously imperceptible in middle and higher income countries. There are, however, remaining concerns.

Beine et al (2007) highlight the potential endogeneity of the migration rates of skilled workers with respect to the change in the human capital level. Indeed, stylized facts and empirical findings (Docquier et al 2006) suggest that *ceteris paribus* and increase in natives' average level of schooling reduces the skilled emigration rate. This may result from: quota restrictions on the number of educated immigrants accepted, such that the higher the proportion of educated adults, the lower the probability that each of them will be able to leave the country - this is the option discussed in Beine et al (2007), alternatively endogeneity may result from complementarities in skilled labor such that an increase in the educated workforce encourages others to stay, conversely and finally more skilled graduates may reduce the wage premium pushing more to migrate.

Beine et al (2007) correct for this endogeneity using lagged migration rates as an instrumental variable for current migration rates. The assumption behind

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a substantial proportion of individuals with tertiary education; lastly, the data does not cover the former Soviet Union nor Eastern Europe. As a result of these problems the assumptions (such as the generalisation of the US Census data to apply across the rest of the OECD) made by Carrington and Detragiache cause concerns that significant amounts of data manipulation do little to assuage.

<sup>15</sup>Faini does find evidence of induced increases in secondary education but believes this indicates would be migrants choose to pursue their higher education abroad

the use of lagged migration rates as an instrumental variable is that increased enrollment in time  $t$  cannot influence the migration rates at time  $t - 1$ . However, it is possible to imagine that rational agents will be able to foresee changes in human capital the following year, for example, in an economic downturn, it may be expected that, as the job market shrinks, the opportunity cost of higher education is reduced and hence more people are likely to enroll the following year. If this is the case then the lagged migration rates, employed by Beine et al (2007), may not entirely eradicate the endogeneity problems.

Since a failure to account for some potential reverse causality is likely to result in biased estimates this paper utilizes the natural experiment of EU accession and the exogenous impact this has on the parameter  $p$  (the probability of successful migration). Furthermore, to avoid the data issues that have stymied much of the previous research, this paper has an altogether narrower focus: does an increase in migration opportunity lead to an increase in investment in human capital? The analysis that follows abstracts from measurements of the brain drain—the relocation of skilled workers—focusing instead on the incentivization effect of migration. In order to do this I look at the impact of an exogenous increase in  $p$  (the probability that intended migration will succeed) on levels of human capital in the origin country.

### 3 Analytical Methods and Main Results

Accession to the EU provides a natural experiment to test theories of migration fuelled increases in human capital. This is because, as a member of the EU, a countries citizens benefit from the free movement of persons<sup>16</sup> (Article 39 of the EC Treaty). In terms of the brain gain model outlined in section 1.4, such a policy change represents a significant increase in the parameter  $p$  (the possibility of successful migration)<sup>17</sup>. And, whilst the available data limits analysis of

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<sup>16</sup>The relevant rights are complemented by a system for the co-ordination of social security schemes and by a system to ensure the mutual recognition of diplomas.

<sup>17</sup>Note that freedom of movement does not increase  $p$  to the level that  $p = 1$ . If it were to do so there would be no possibility of a brain gain because all those who invest in education

migration flows disaggregated by education level,<sup>18</sup> the magnitude of the change in enrollment that follows this increase in  $p$  should give some indication as to the feasibility of the brain gain hypothesis that migration may increase the stock of human capital.

To capture investment in education I use the Gross enrollment Ratio; the number of pupils enrolled in tertiary education, regardless of age, expressed as a percentage of the population in the theoretical<sup>19</sup> age group for tertiary education. The GER is calculated according to the following formula:

$$GER^t = \frac{E^t}{(P_a^t) \cdot 100} \quad (17)$$

Where:

- $GER^t$  is the Gross enrollment Ratio at time  $t$ ,
- $E^t$  is the enrollment at time  $t$ ,<sup>20</sup>
- $P_a^t$  is the population in age-group  $a$  which corresponds to tertiary education in school-year  $t$ <sup>21</sup>.

It should be noted at this point that, if it is the case that enrollment in tertiary education increases with accession to the EU, this is unlikely to be solely a result of students wishing to use their new rights to migrate. Accession to the EU will almost certainly also effect domestic employment opportunities -

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in order to migrate will do so. The time lag and uncertainty about the future ensure that whilst migration is a right it remains that  $p < 1$ . This is because there are many other factors involved in the translation of intention to migrate into reality, for example changing personal/economic circumstances may have a substantial impact given the extended time period required to gain a tertiary qualification. Indeed, micro-level surveys on intentions to migrate consistently exceed actual migration figures. Note further that the indiscriminate nature of the freedom of movement of people implies that of the two reasons a potential migrant may wish to invest in education; firstly as a vehicle for exit, and secondly to benefit from the increased wage advantage abroad, only the second is relevant here. Thus the findings are likely to represent a lower bound on the estimated incentive effect of increased migrational opportunities.

<sup>18</sup>As mentioned above the recent dataset by Docquier and Marfouk has begun to relax this constraint.

<sup>19</sup>For the tertiary level, the population used is the five-year age group following on from the secondary school leaving age.

<sup>20</sup>Many thanks to Lucy Mei Hong (UIS UNESCO) for obtaining the historical data not publicly available on the internet.

<sup>21</sup>See <http://esa.un.org/unpp/forUNDPdataonline>.



through increased Foreign Direct Investment (henceforth FDI), as well as increasing trade flows - thus increasing returns to investment in human capital may also result from an improved domestic climate. Nevertheless, the impact of increased FDI and trade flows will likely have been felt for several years preceding the accession date. Indeed research into the effect on FDI of EU accession (Bevan et al 2001) finds that as far back 1994 when the EU announced its commitment to enlargement, front-runner candidate countries in Eastern Europe experienced significant increases in inflows of FDI. Barriers to trade were also reduced in anticipation of accession. Thus, if a positive effect on education is identified, the role of the labor market mobility resulting from accession, in increasing enrollment in tertiary education, should not be undermined.

The relative importance, in the decision to invest in education, of FDI flows and the migration opportunity, can be examined through the lens of economic geography models as outlined above. The degree to which accession encourages dispersion across Europe (and hence inward flows of FDI to accession countries) or agglomeration in Central Europe (and with it outward flows of skilled labor from accession countries) is dependent on the relative importance of exogenous parameters such as economies of scale and transport costs. And, although transport costs are likely to be less significant in high skilled sectors, the impact of increased FDI and trade flows represents a possible source of upward bias on the results. Thus, in the panel regression that follows, I control for FDI levels as well as exports.

In order to assess the impact of European accession on enrollment in tertiary education this paper employs two strategies. Firstly, in section 3.1, with a simple difference-in-difference approach which, along the lines of a simplified propensity score matching methodology, exploits the division of Czechoslovakia in 1993. This enables the use of Slovakia as a counterfactual against which to assess the impact of the EU negotiations that began with the Czech Republic in 1997. Secondly, in an attempt to support these results, section 3.2 examines the impact of EU accession on tertiary enrollment across a panel of 13 countries

that have joined the EU.<sup>22</sup>

## 3.1 Czech Republic/Slovakia Case Study

### 3.1.1 Method

The goal of this section is to assess the impact that EU accession negotiations had on the GER of the Czech Republic. To do this I follow Abadie's methodology using a difference-in-difference estimation but rather than create a synthetic counterfactual, I utilise the disparate timing of the opening of EU accession negotiations with the Czech Republic (in November 1997) and Slovakia (in January 2000) to use Slovakia as a Czech counterfactual. If the brain gain hypothesis is correct, and agents incorporate information relating to the probability of a successful migration into their investment decision, I expect to see a rise in the disparity between Czech and Slovak GER following the 1997 announcement of negotiations with the Czech Republic and a fall following the 2000 announcement of negotiations with Slovakia.

I have chosen these countries for two reasons. The first is obvious; until 1993 they were just one country and whilst there were economic differences<sup>23</sup> they were at least subject to the same policy environment and political shocks. The second motivation behind this choice is the micro level survey data (IOM 1998) suggesting these are the two countries with the highest potential migration.

Ultimately the Czech Republic and Slovakia joined the EU at the same time, and so this example can only be utilized to look at the effect of accession negotiations on enrollment. This creates a number of problems with the timing.

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<sup>22</sup>Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Greece, Portugal, and Spain.

<sup>23</sup>Prior to their separation on January 1<sup>st</sup> 1993 the Czech and Slovak republics operated under similar institutions and policies and by the time of their separation were considered to have progressed more rapidly toward a market system than their East European neighbours (with the exception of East Germany). However differences do remain: the Czech Republic privatized faster, offered less generous social security benefits, and had a higher proportion of smaller firms offering more opportunities for entrepreneurial activities. In addition the Czech Republic's long border with Germany enabled many workers to commute beyond its borders. And, whilst the supply of more educated workers, following the fall of communism, increased in both the Czech Republic and Slovakia; labor demand did not. The Slovakian economy experienced higher unemployment than the Czech Republic.

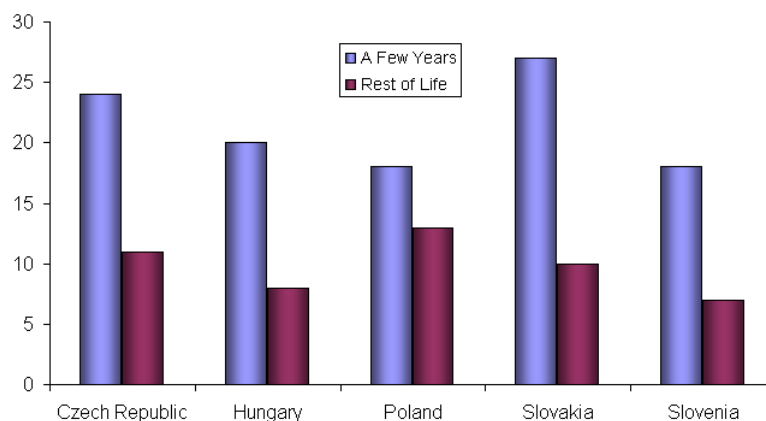


Figure 1: Trends in Gross enrollment Ratio of the Czech Republic and Slovakia

Firstly there may be credibility delays; given that the investment required to enrol in tertiary education is significant, both in terms of time and forgone income, it may be the case that risk-averse agents did not respond immediately to this signal of accession (and concomitantly future higher returns to investment in education). Indeed it is likely that agents would wait to see how negotiations progressed, to examine their credibility and content, before enrolling in a tertiary course. Secondly there are likely to be delays in the data. This is because the GER does not measure new students enrolled each year but only the total number of students enrolled in tertiary education in any given year. As a result the impact of increasing enrollment on GER is likely to be gradual. In order to account for these potential delays in the impact of accession negotiations, after looking first at the immediate impact I then consider a lagged impact, of three years.<sup>24</sup>

### 3.1.2 Results

Below (figure 2) is a plot of the trend behaviour of the GER of the Czech Republic and Slovakia following their separation in 1993. The vertical lines represent the opening of accession negotiations: the first with the Czech Republic, the

<sup>24</sup>Three years is half of the average delay between the accession of the Czech Republic and Slovakia, and the opening of accession talks. It is therefore used as a benchmark for establishing the credibility of talks and the speed of progression.

second with Slovakia. The third line represents the accession of the Czech Republic and Slovakia to the European Union in 2003.

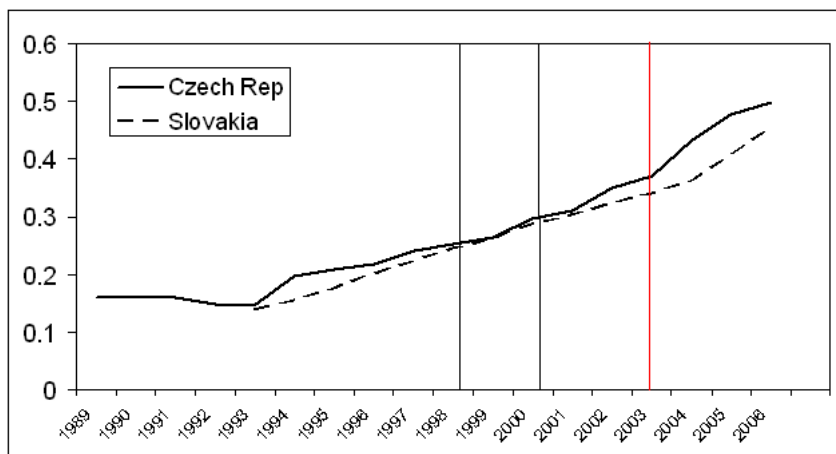


Figure 2: Trends in Gross enrollment Ratio of the Czech Republic and Slovakia

Initially table 1 appears to present pretty damning evidence against the brain gain hypothesis. The opening of EU accession talks does not appear to have had a significant effect on the GER in the corresponding period; there was very little difference in the GER of Czech Republic and Slovakia in the years following the opening of accession talks with the Czech Republic; the difference in difference between 1997 and 2000 is in fact negative. The difference in difference following the opening of talks with Slovakia (table 2) is similarly unimpressive. Here we would hope for a negative sign, indicating that Slovakia had begun closing the GER gap, and in fact we find a positive.

If however, the possibility of a delay in the impact of EU accession is considered, and lags the GER 3 years, as discussed above, a discernable difference emerges (Figure 3).

Between 2000 and 2002 (the opening of negotiations with the Czech Republic lagged three years) the difference in GER between the Czech Republic and

	Pre-Treatment: Talks with Cz	Post Treatment	Difference
Slovakia	0.222346	0.261852	0.03951
Czech Republic	0.240419	0.264245	0.02383
Difference	0.018073	0.00239	-0.01568

Table 1: Difference-in-Difference of GER at time  $t$  (Treatment 1: The Opening of Accession Negotiations with the Czech Republic)

	Pre-Treatment: Talks with Slovakia	Post Treatment	Difference
Slovakia	0.261852	0.303742	0.03951
Czech Republic	0.264245	0.308823	0.04458
Difference	0.00239	0.00508	-0.00269

Table 2: Difference-in-Difference of GER at time  $t$  (Treatment 2: The Opening of Accession Negotiations with the Slovakia)

Slovakia increases by nearly 280% of its pre-treatment difference (Table 3).

	Pre-Treatment: Talks with Cz ( $t+3$ )	Post Treatment	Difference
Slovakia	0.287256	0.323255	0.035999
Czech Republic	0.294225	0.349701	0.055476
Difference	0.006969	0.026446	0.019477

Table 3: Difference-in-Difference of GER at time  $t$  (Treatment 1: The Opening of Accession Negotiations with the Czech Republic ( $t+3$ ))

Similarly it can be seen from Table 4 that in the last observations the Slovak GER begins to rise at a greater rate than the Czech GER thereby beginning to close the difference. This finding supports the hypothesis that the widening difference-in-difference was a result of the disparate timings of the opening of accession negotiations.

However, whilst the lack of immediate impact can be justified by considering risk-averse agents, two concerns remain. Firstly, it is important to bear in mind that Slovakia does not represent a perfect counterfactual to the Czech Republic. From 1993 the two countries separated and became subject to separate policies

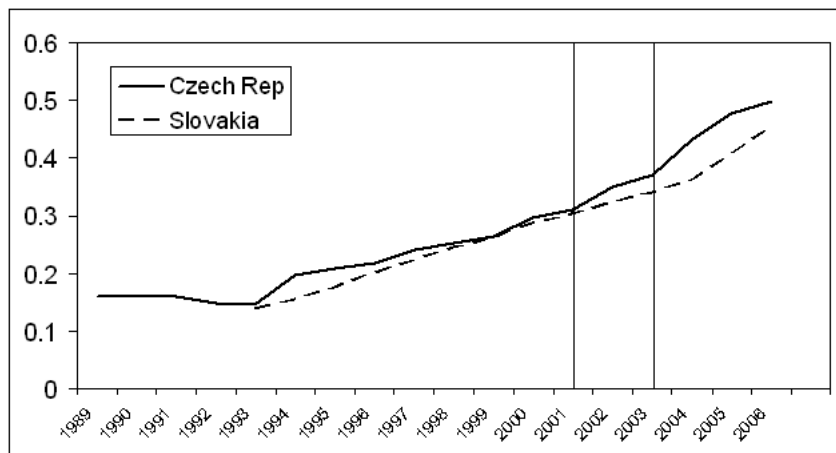


Figure 3: Trends in Gross enrollment Ratio of the Czech Republic and Slovakia

	Pre-Treatment: Talks with Slovakia	Post Treatment	Difference
Slovakia	0.361551	0.453154	0.0916
Czech Republic	0.431591	0.498499	0.06691
Difference	0.07004	0.04535	-0.0247

Table 4: Difference-in-Difference of GER at time  $t$  (Treatment 2: The Opening of Accession Negotiations with the Slovakia ( $t+3$ ))

and shocks. As a result there is the possibility that the trends identified above are affected by omitted variable bias. A second problem, that has already been mentioned, is the impact of FDI on increasing domestic returns to education. As argued above, the EU's announcement of its intention to enlarge in 1994 led to significantly increased FDI inflows to the front-runner candidates in Eastern Europe. Nevertheless, at this point, following the announcement of the opening of accession negotiations the effects of remaining increases FDI flows may impact upon domestic opportunities. This is because the opening of negotiations represents a clear signal of the credibility of the candidate economy. After this point the impact on FDI of actual accession could be expected to be less significant.

In order to address these two concerns and further test the relationship between EU accession and increased enrollment in education, section 3.2 analyzes

a cross-country regression using panel data comprising of 13 countries that have completed accession.

## 3.2 Cross-Country Panel Regression

The cross-country panel consists of the AC-10<sup>25</sup> as well as Spain, Portugal, and Greece, who joined the EU in the 1980s. This earlier Southern EU expansion is included whilst the incorporation of Austria, Finland, and Sweden in 1995 is omitted, because in the 1995 expansion, there was no significant GDP per capita gap between the accession countries and the EU member states. Furthermore free movement of people was already in place in these countries as they were members of the European Economic Area.

### 3.2.1 Method

Having ensured, via a Dickey-Fuller unit root test, that the assumption of non-stationary appears valid,<sup>26</sup> I can be confident that OLS results will not suffer from the spurious regression problem. However, initial inspection of a GER time plot suggests that a linear trend may not be appropriate thus, in order to stabilize the variance I use a natural logarithmic transformation of the GER. The empirical approach is therefore to a run panel data regression on 13 countries that have joined the EU of the following form:

$$\ln GER_{ct} = \alpha + \beta \cdot acc_{ct} + \delta D_c + \varepsilon_{ct} \quad (18)$$

Where  $\ln GER_{ct}$  represents the natural logarithm of the Gross Enrollment Ratio of country  $c$  in time  $t$ ,  $acc_{ct}$  is a dummy that switches on when country  $c$  has completed accession,  $\delta D_t$  is the time fixed effect,  $\gamma D_c$  is the country fixed effect and  $\varepsilon$  is an error term. Fixed effects at the country level control for the usual array of cross-country differences in history, geography, culture,

<sup>25</sup>Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia.

<sup>26</sup>using the Dickey-Fuller unit root test approach given by Holden and Perman in B Bhaskara Rao Conintegration for the Applied Economist 1994

policy and economic structure that have been constant over the sample period. Whilst the year dummy controls for general trends and shocks affecting tertiary enrollment across countries.  $\beta$  is the coefficient of interest measuring the effect of EU accession on the change in tertiary GER.

### 3.2.2 Results

VARIABLES	(OLS)	(OLS)	(Clustered)	(Clustered)
	LnGER	LnGER	LnGER	LnGER
Accession	0.207*** (0.0542)	0.291*** (0.0597)	0.207* (0.0992)	0.178 (0.105)
FDI		-0.00612 (0.00568)		-0.00219 (0.00305)
Exports		-0.00381*** (0.00128)		0.000954 (0.00374)
Year Fixed Effects	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes
Observations	222	174	222	174
Number of country	15	15	15	15
$R^2$	0.888	.	0.888	0.885

Standard errors in parentheses

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Estimate of impact of accession talks on  $\ln GER$ . The data are for the 13 countries over the period 1970–2004. Czechoslovakia split into Czech Republic and Slovakia in January 1993, and, after this date, they are included as separate observations. The panel therefore consists of a total of 442 possible observations with deviations accounted for by missing data.

The results in table 5 suggest that accession to the EU does indeed have an impact on the levels of enrollment in tertiary education. Indeed, *ceteris paribus*, it can be expected that on average the GER will be approximately



20 percent higher following EU accession. Column 2 presents the OLS results controlling for FDI and Exports, column 3 presents the results clustered at the country level to assuage concerns of serial correlation.<sup>27</sup> Clustering does indeed substantially raise the standard errors indicating that there may be serial correlation among countries; nevertheless the results remain highly significant at the 6 percent level. Finally column 4 presents the results clustered at the country level and additionally controlling for FDI and exports, in this final regression the results are less significant. Nevertheless, they remain significant at the 12 percent level and the robustness of the coefficient to these various specifications is encouraging.

The impact of EU accession on enrollment in tertiary education identified above, lends support to the assumption of the endogeneity of human capital formation and hence the hypothesis that increased migration opportunities encourage greater levels of human capital formation that may, given the right parameters, offset or even overpower the brain drain that results from the relocation of skilled labor. Such a substantial increase in enrollment suggests that even in the presence of large outflows of human capital, there is the potential for a positive net effect.

Further work may wish to redo the above analyses after some time has passed. This would allow a number of refinements. Firstly, it would enable a comparison of the post accession trends of the Czech Republic and Slovakia therefore providing a check on the validity of the difference in difference approach. Secondly, the pass of time would provide more data to analyse the impact of the Eastern expansion of 2004, it would also increase the sample by enabling the inclusion of the most recent expansion of 2007 to include Romania and Bulgaria. Lastly, given data continuing to a later date, it may be interesting to look more closely at the possibility of lagged effects.

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<sup>27</sup>Bertrand, Duflo, and Mullainathan (2004) present an analysis of the dangers in ignoring serial correlation in panel data, using Monte Carlo data and randomly generated placebo laws to illustrate frequency of inaccurate conventional standard errors. Using standard difference-in-difference standard errors they find a statistically significant effect in 45% of the placebo interventions.

Another avenue for further work would be an analysis of the effects of differing levels of public funding for education on the above results. This would enable an analysis more focused on the welfare implications of labor market liberalization, and as such may identify more policy prescriptions. Clearly a positive net effect on human capital stocks is not enough to conclude that the economic impact of labor market liberalization is positive if the gains from increased participation in tertiary education are funded entirely from the public purse. The positive implications of the brain gain rely on an increase in the private investment in human capital.

Empirical analyses that attempt to quantify the net brain effect continue to be severely hampered by data deficiencies. Nevertheless incremental steps such as those presented in this paper, can help to clarify what has for a long time been, and will likely continue to be, a highly contentious area.

## Conclusion

The brain gain literature relies for its positive prognosis on the assumption that human capital is endogenous. This paper has shown that this assumption is well founded. It has examined the relationship between migration opportunities and the private decision to invest in higher education, looking first at the impact of the announcement to open negotiations, through a difference-in-difference comparison between the Czech Republic and Slovakia, and secondly at the impact of accession on a cross-country panel of 13 current EU members. Taken together these results represent evidence that an increase in the opportunity to migrate, heralded by accession to a free-trade area such as the EU, has a significant effect, both economically and statistically, on the proportion of the population that choose to invest in higher education, and hence the skill level of the country. While it is important to remember that this result cannot be entirely attributed to the increased migration opportunities, as increased FDI and trade flows will also raise the domestic return to education, micro-level survey data regarding

intentions to migrate indicate that migration to achieve a higher wage abroad plays a significant role.

The example of the brain gain analyzed here represents a very narrow focus on the gross impact of migration opportunities on human capital formation. Clearly the net brain effect will depend also on outward flows of skilled labor. However, if recent policy trends towards a focus on increasing temporary and return migration are successful, the gross effect of migration on human capital formation, identified in this paper, could enable migration to be utilized as a powerful tool for development.

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## Online Resources

UNDP online data: <http://esa.un.org/unpp/> UNESCO UIS online data: <http://www.uis.unesco.org/> World Bank Development indicators: <http://publications.worldbank.org/WDI/>