Brain Waste, Educational Investments and Growth in Transitional Countries

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Abstract

The paper explores the relationship between skilled migration, investments in education and economic growth in transitional countries. The brain waste phenomenon implies that skilled immigrants work abroad in jobs for unskilled labor. Therefore their qualifications are not properly used. The model developed here shows that brain waste is doubly-detrimental to transitional economies. Firstly, as described in traditional literature on brain drain, the sending countries lose considerable amount of their human capital as many skilled individuals leave the country. As the human capital stock in these countries is reduced, so is the economic growth. Secondly, there is another negative *ex ante* effect: the migration perspectives lower the return on human capital, so many individuals give up studying in order to migrate abroad. This "negative brain effect" additionally reduces the growth rate of the home country. Some empirical evidence confirming the predictions of the theoretical model is presented.

JEL classification: F22, F43, J24
Keywords: brain drain, brain waste, migration, growth, investments in education

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1. Introduction

The relationship between skilled migration and growth has been extensively explored since the second half of the 20th century. The term brain drain itself suggested detrimental effects to the sending economies. However, since the 1990s a new strand of research on skilled migration has appeared. The economists representing this new approach, named "the new economics of the brain drain" (Stark, 2005), argued that emigration of skilled workforce need not be detrimental to the country of origin. They developed several models based on endogenous growth framework, in which they described positive effects of brain drain. This positive feedback included: migrants remittances, return migration with additional skills acquired and the effect of induced education (Docquier, 2006).

The effect of induced education, as described by Lucas (2004) means that emigration increases the return on human capital, inducing additional investments in education. This positive outcome: "brain effect" is confronted with negative "drain effect" – emigration of skilled workforce. Beine et al. (2001) argue that a sending country may experience the Beneficial Brain Drain (BBD) – the positive effect may prevail and *per saldo* more educated people will stay in the country, compared to the hypothetical situation of an autarky. Beine et al. (2003) present some empirical evidence, showing that BBD is possible, at least in some developing countries where the skilled emigration rates are sufficiently low.

These rather optimistic theories have been lately questioned, both on theoretical (Schiff, 2005) and empirical ground (Kangasniemi et al., 2004). Some authors have shown that relation between educational investments and migration perspectives need not necessarily be positive (Faini, 2003), suggesting that this optimistic view may be wrong. The critics of "the new economics of the brain drain" argue that skilled migration is rather detrimental to the countries of emigration.

The discussion concerning the brain drain has been dominated by scholars interested in developing economies. However, the skilled migration is emerging as a very important issue in the transitional countries as well. The models developed within the "new economics of the brain drain" are not a proper tool to analyze the impact of emigration on education and growth in the post-communist nations. Therefore, in this paper a model of brain waste is developed. It is shown that, at least in the transitional countries – the emigration perspectives may in fact lower the *ex ante* investments in human capital. Some individuals can stop their education, hoping to find a better job abroad. This in turn reduces the economy growth rate.

The structure of this article is as follows: in section 2 a brief glance at the situation of transitional countries is presented, with special emphasis on migration strategies and perspectives in the region. Section 3 describes the model of brain waste and its consequences for the educational investments and economic growth of the sending countries. In section 4 empirical evidence is presented, showing that the effects of skilled migration on growth may be even more detrimental than those discussed in traditional literature on brain drain. Section 5, in which some policy implications are described, concludes the paper.

2. Migration from transitional countries

During the cold war, the citizens of Central and Eastern Europe (CEE) countries were strongly restricted to travel abroad. Emigration was therefore a very difficult and risky enterprise. Some individuals were leaving their homelands on irregular basis, defecting abroad during tourist voyages, sport events or business trips. These migration strategies were costly, because they were treated by the authorities as crime and implied that return migration was almost impossible. The exceptions in tough emigration policies were made to some members of ethnic minorities such as Germans or Jews and during the years of political turmoils, as in 1956 (Hungary), 1968 (Czechoslovakia), and in the 1980s in Poland (IOM, 2003).

The fall of iron curtain opens a new era in the migration history of the CEE region. Emigration control was abandoned and people could move abroad freely. In the first years of economic transformation in the CEE the outflow of labor force was very high, mainly because of the migration pressure created during the communist period. The main destinations were rich countries of the West (OECD), namely the USA, Germany, France, Great Britain and others.

However, in the first years of economic transition this massive outflow was dominated rather by relatively unskilled (not educated) individuals[1]. The main explanation is that in centrally-planned economies the returns on human capital were low and wage differentials between skilled and unskilled workers were small. The free market has shown the real value of better educated agents, who obtained well-paid jobs in the growing private sector of the economy. The unskilled workers, on the other hand sought better-paid jobs elsewhere.

[1] In the paper, for the sake of simplicity a skilled worker means an agent with tertiary educational attainment, and the unskilled worker is an individual with the educational attainment lower than tertiary, ie. secondary or primary.

The intensity of skilled migration gained its magnitude only after some years of economic transition, in late 1990s. Some CEE countries experienced economic slowdown, the rates of unemployment rose, which pushed some educated agents to look for a job abroad. Another important factor was the pull one – wage differentials between CEE and OECD countries were still very high. The European Union (EU) enlargements in 2004 and 2007 contributed to intensification of migration flows from transitional countries. Some rich western countries such as Ireland or Great Britain, opened their labor markets to Poles, Czechs, Slovaks and other new members of EU. In the next years the massive emigration from CEE countries is bound to continue.

The most important feature of skilled migration from the CEE region is the brain waste phenomenon. Most of the educated citizens from transitional countries who work abroad, get jobs in posts where their official qualifications are not properly used[2]. There are several explanations to that. Firstly, the lack of harmonization between the educational systems within Europe implies that university diplomas from CEE countries may not be recognized elsewhere. Secondly, the mostly public-financed tertiary education sector produces graduates with country-specific skills rather than the internationally-applicable qualifications (Poutvaara, 2005). For instance, in Poland there is an overproduction of lawyers and graduates in psychology or philology, and on the other hand – too few engineers. Thirdly, the imperfections of labor markets in receiving countries, especially the administrative barriers created to defend the native workers, make finding a skilled job for the foreigner very difficult, if not impossible.

Irrespective of what explanation is more plausible, the reality of brain waste cannot be questioned. As a result, skilled immigrants from transitional countries are, to a large extent, in a situation of having very low returns on their human capital. Some empirical research among the immigrants, especially in the US and in the United Kingdom has been made, confirming this trend (Matto et al., 2005, Drinkwater et al., 2006). The consequences of this brain waste for the economic situation in transitional countries are quite serious and are shown in the next section.

[2] For instance, graduates in history (masters of art) work as waiters, or as cleaning staff.

3. A Brain Waste Model

The theoretical model presented here is a simple modification of the BBD model, developed by Beine et al. (2001) and modified by Hemmi (2005). However, some assumptions made originally by the authors are changed to include the brain waste phenomenon. The subject of the analysis is a small opened economy with overlapping generations. The nature of economic growth is endogenous: there is an intergenerational transmission of human capital. Young generation inherits average level of human capital from their parents' generation. Individuals, with different learning abilities, live for two periods. In the first period, they may invest some of their time in education and (or) work. In the second period they only work, and their productivity depends on the time spent on education in the first period.

3.1 Production sector

In the model there is a representative firm, producing at each period of time (*t*) a composite good in quantity Y_t. To produce this good, a firm uses capital K_t and labor H_t (measured in perfectly substitutable units). The production exhibits constant returns on scale. The production function can be expressed as $Y_t = f(K_t, H_t)$ and output per efficient unit of labor ($y_t = Y_t / H_t$) can then be stated as function of capital per efficient hour worked ($k_t = K_t / H_t$) so $y_t = f(k_t)$.

The factors prices are given by their marginal productivity. The exogenous and constant interest rate *r* is determined on the international capital market, fixing the capital stock per efficient unit of labor and the wage rate. The wage rate is normalized to unity.

3.2 Individual behavior

As stated earlier, the growth in the model is due to the intergenerational transmission of human capital. Each young individual *i* from generation *t* is endowed with identical level of human capital h_t. During the first period of life, agents can invest a given fraction of time in

education ($e_t^i = \bar{e}$) or leave school ($e_t^i = 0$)[3]. In the remainder of the first period they can work. The individual's level of human capital in the second period is:

$$h_{t+1}^i = [1 + a^i e_t^{i\beta}] h_t \qquad (1)$$

where 0<β<1. Therefore h_{t+1}^i is an increasing function of time spent on education ($e_t^i = \bar{e}$ or $e_t^i = 0$) and individual's ability to learn a^i, which is uniformly distributed over the probability space $[0, \bar{a}]$. For the sake of simplicity, the domestic wage rate is normalized to unity, so h_{t+1}^i becomes also income of agent *i* in the second period in the home country.

In the open economy agents have possibility to work not only in their home country, but also abroad. The decision to migrate is made in the frame of uncertainty. It is assumed that educated (skilled) agents can migrate with probability p^S or stay at home with probability $(1 - p^S)$. As in Beine et al. (2001) the migration probability is influenced by internal and external factors. The most important internal factors include: migration policy of the source country, an individual's changing life priorities, economic and political situation at home. The main external factors are: immigration policies of the destination countries and the migratory networks (the importance of support groups, the linkage between migrants and their relatives at home).

However, contrary to BBD model[4], it is also assumed that unskilled workers have a chance to migrate with probability p^U, or to stay at home with probability $(1 - p^U)$. Moreover, as they quit school during their first period of life, they may migrate earlier than educated agents.

The second crucial assumption is the existence of brain waste in receiving economies. Due to a large set of factors (some of them were described in section 2), the qualifications of skilled immigrants are not recognized in the receiving economies. They work together with the unskilled immigrants, performing jobs for the unskilled ones – in construction and cleaning services, as waiters, taxi-drivers etc. For the sake of simplicity it is assumed that the productivity of skilled and unskilled immigrants abroad is identical[5] and given by:

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[3] For the sake of simplicity, only one educational threshold is considered. This assumption is rather realistic, as in most transitional countries there is compulsory and publicly financed education at primary and secondary levels. So the decision whether to invest or not in education appears at the tertiary level.

[4] Beine et al. (2001) assumed that only the educated agents may emigrate.

[5] In reality, the immigrants with higher educational attainment (skilled) my be even less productive than the immigrants with lower educational attainment (unskilled), because the second group can have considerable work experience in the work they perform. This may in turn enforce the negative effect of brain waste for the educated migrants.

$$h_{t+1}^{i*} = w^* h_t \qquad (2)$$

where w^* is the foreign wage rate. In order to migrate, skilled individuals must earn more abroad, even working in menial jobs, than in home country. So w^* must satisfy the following condition:

$$w^* h_t > [1 + a^i e_t^{i\beta}] h_t \qquad (3)$$

As in BBD model, the agents are assumed to be risk neutral. They are trying to maximize they lifetime income:

$$E[h_t(1 - e_t^i) + (\frac{h_{t+1}^i}{1+r})] \qquad (4)$$

where *r* is considered a discount rate. As a consequence, the condition for each individual *i* to invest in education can be described as:

$$h_t(1-\bar{e}) + \frac{p^S w^* h_t}{1+r} + \frac{(1-p^S)[1+a^i \bar{e}^{\beta}]h_t}{1+r} \geq p^U w^* (h_t + \frac{h_t}{1+r}) + (1-p^U)(h_t + \frac{h_t}{1+r}) \qquad (5)$$

From (5) one can obtain the condition for critical agent, i.e. indifferent between investing in education or not:

$$a^i \geq a_E \equiv \frac{\bar{e}(1+r) + (w^* - 1)[p^U(2+r) - p^S]}{\bar{e}^{\beta}(1-p^S)} \qquad (6)$$

All the individuals with abilities above the a_E will invest in education at the tertiary level, even knowing that they may later work abroad in menial jobs. On the other hand, in closed economy, where migration is prohibited ($p^S = p^U = 0$) the critical agent can be described as:

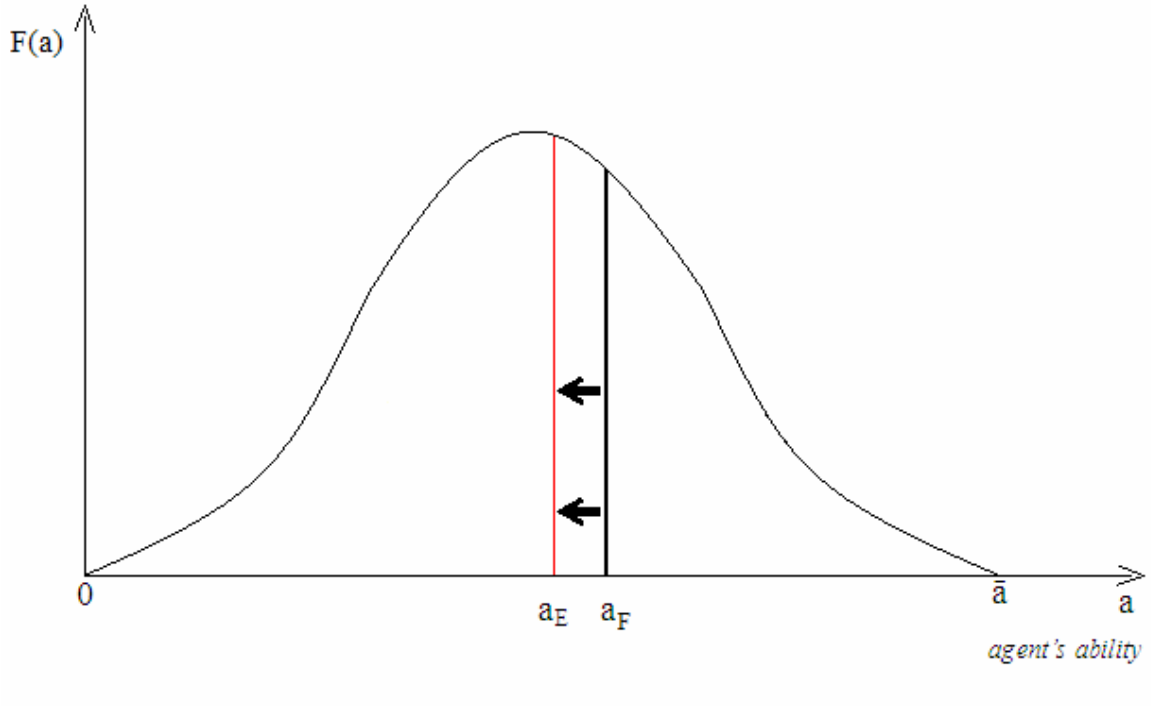
$$a_F \equiv \bar{e}^{1-\beta}(1+r) \qquad (7)$$

The key concept of the Beneficial Brain Drain hypothesis was the existence of "brain effect":

$$a_F > a_E \Rightarrow \frac{\bar{a} - a_E}{\bar{a}} > \frac{\bar{a} - a_F}{\bar{a}} \qquad (8)$$

The migration opportunities increased the returns on education, and by lowering a_E, they increased the *ex ante* (before the migration was netted out) proportion of educated agents in the home country from ($(\bar{a} - a_F)/\bar{a}$) to ($(\bar{a} - a_E)/\bar{a}$) – a fact obviously favorable for growth (see figure 1).

Figure 1



Brain effect as described in BBD model: the possibility of migration increases the returns on investments in education, lowering the ability of the critical agent from a_F to a_E. As a consequence, the ex ante (before the migration is netted out) proportion of educated agents in sending countries rises, and so does the economy's growth rate.

However, in the situation of brain waste the relationship between migration possibilities and investments in education is of completely different nature. The positive "brain effect" is very unlikely to occur. Using (7) in (6) we obtain:

$$a_E \equiv \frac{(w^* - 1)[p^U(2+r) - p^S]}{\bar{e}^{\beta}(1-p^S)} + \frac{a_F}{1-p^S} \qquad (6a)$$

Bearing in mind that: $w^*>1$; $0<p^U<1$; $0<p^S<1$; $0<\bar{e}<1$; $0<\beta<1$; $0<r<1$ the necessary (but not sufficient) condition for the existence of the positive "brain effect" in the situation of brain waste is:

$$p^U(2+r) - p^S < 0 \qquad (9)$$

or to be more precise:

$$p^S > p^U(2+r) \qquad (9a)$$

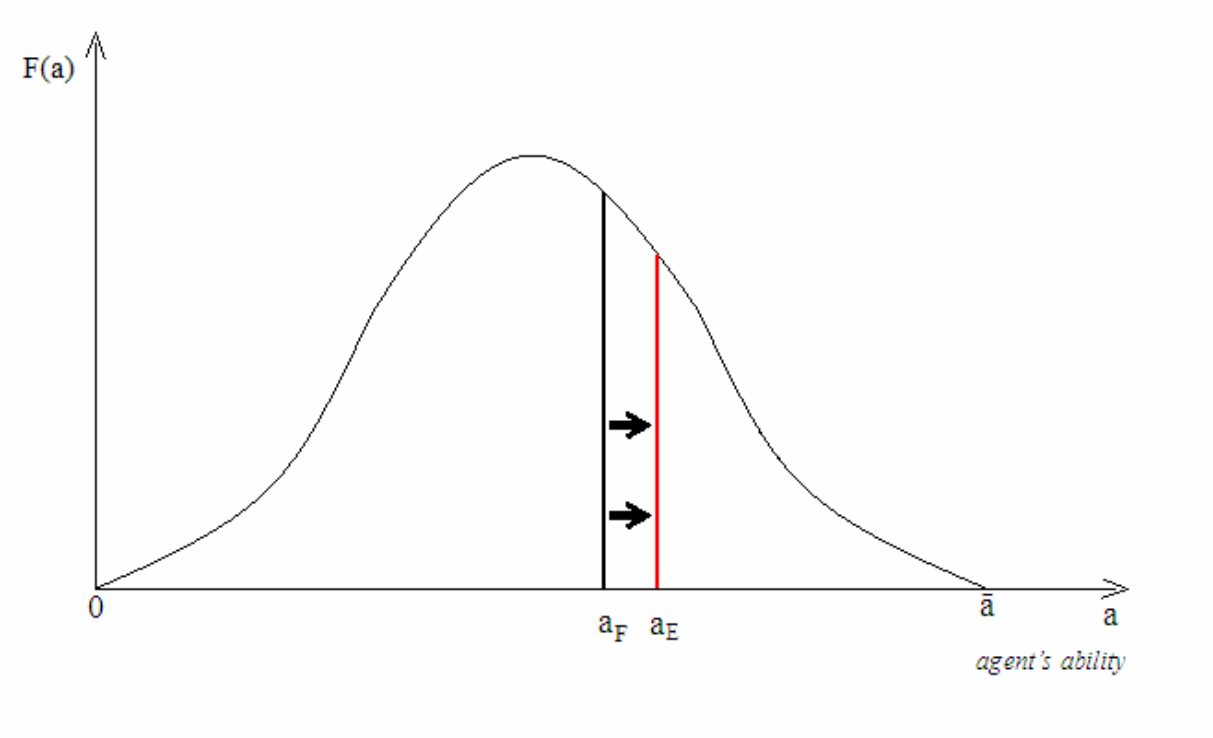
This means that it is not only the migration probability that matters, but also the relationship between the probabilities of migration for different educational groups of workers. The necessary condition for the "brain effect" to occur implies that the skilled ones must have more than double higher migration possibility than the unskilled workers.

When the condition (9a) is not met, migration in fact *lowers* the returns on education. The ability of critical agent a_E rises and the *ex ante* (before the migration) proportion of educated workers in sending country is falling as compared to the situation of autarky:

$$a_E > a_F \Rightarrow \frac{\bar{a} - a_F}{\bar{a}} > \frac{\bar{a} - a_E}{\bar{a}} \quad (10)$$

causing a "negative brain effect" as shown in figure 2. In this situation the brain waste is doubly-detrimental to the sending country. First, as in brain drain the *ex post* proportion of skilled workers falls due to migration – effect called by Beine et a. (2001) as "drain effect". Secondly, there is an *ex ante* "negative brain effect": some agents quit the school in order to emigrate.

Figure 2



The negative effect of Brain Waste: the possibility of migration lowers the returns on investments in education by rising the ability of the critical agent from a_F to a_E. As a consequence, the ex ante (before the migration is netted out) proportion of educated agents in sending countries falls, which is additionally detrimental to growth.

However, there is a chance that the condition (9a) is met. In this case, there exists a possibility of positive "brain effect", as described in BBD model – but this effect would be considerably smaller than in BBD case in the situation of brain waste. Unfortunately, this implies that the possibility of emigration for skilled workers (p^S) is much higher than the prospects of emigration for the unskilled ones (p^U). The *ex post* (after the emigration) proportion of skilled agents in home country is then given by:

$$P_E = \max\{0; \frac{(1-p^s)(\bar{a}-a_E)}{(1-p^U)a_E + (1-p^s)(\bar{a}-a_E)}\} \quad (11)$$

This in turn means that the negative "drain effect" would be particularly strong, very probably offsetting the positive "brain effect". The overall effect would still be negative, and the possibility of Beneficial Brain Drain would be rejected.

4. Empirical analysis

To evaluate the impact of emigration on the formation of human capital, and the importance of human capital for economic growth in transitional countries, two equations have been estimated:

- human capital equation, where investments in education were used as explained (dependent) variable, and skilled migration rate was one of the explanatory (independent) variables;
- growth equation, in which the growth per capita was used as explained (dependent) variable, and investments in education were used as one of the explanatory (independent) variables.

However, before turning to estimation results, some specification and data issues must be explained.

4.1 Econometric issues

The first econometric problem arises when choosing the analyzed period for the estimation. The EU enlargements in 2004 and 2007 caused so profound economic changes in the "old" EU-15 countries, as well as in the "new" EU-12 countries, that the analysis of the impact of migration on economic performance in last years is heavily biased by a set of other factors, many of which are hard to include in the estimation equation[6]. Thus the period included in estimation is between 1999 and 2003, the last year before the EU enlargement.

There is also a specification issue, which arises with the endogeneity of skilled migration variable. The model assumes that the perspectives of migration affect the

[6] For the transitional countries, this factors include: the inflow of foreign capital - both private and public (especially structural and cohesion funds and the subsidies from common agricultural policy), rapid increase in export's volume, the boost of tourist services and many others.

investments in education in the sending country. However, there also exists the opposite link: the more individuals study at tertiary level, the "richer" is the outflow of labor force from this country. So the human capital variable affect the migration rate. To cope with this problem, usually additional migration equation is estimated and the instrumental variable method is applied.

However, in this case another solution to the endogeneity problem has been found. The proxy variable for the investments in human capital is the gross enrollment rate at the tertiary level[7]. Thanks to Beine et al. (2006), who improved the Docquier and Marfouk database on skilled migration rates (2005), there are accessible new estimates of skilled migration rates for the year 2000, including the migrants' age of entry into the destination country. As the explanatory variable (mig22) there were used the migration rates for the individuals who arrived in the year 2000 (or earlier) in the destination country after age of 22. On the other hand, the explained variable in the human capital equation is the enrollment rate at the tertiary level in the years 1999-2003. So only the individuals who studied in 1999, graduated in 2000 and decided to migrate shortly afterwards influence the mig22 variable – a group which is hardly to bring any considerable bias on the human capital equation.

4.2 Estimation results

The analyzed sample includes 10 transitional countries[8] in one period: 1999-2003. Thus the cross-country data is used. All the variables and sources of data are described in Table 1. Equation 12 is a simple OLS estimation, equation 13 is estimated in logs by ordinary least squares (t-statistics between brackets).

$$hum_i = -0{,}05 - 1{,}76\ mig22_i + 11{,}42\ eduex_i + 0{,}78\ unemp_i \quad (12)$$
$$(-0{,}64) \quad (-5{,}24) \quad (9{,}35) \quad (3{,}39) \quad R^2=0{,}943$$

$$grw_i = 7{,}39 + 0{,}51\ hum_i - 0{,}2\ initi_i - 0{,}153\ internet_i \quad (13)$$
$$(6{,}95) \quad (3{,}22) \quad (-4{,}57) \quad (-3{,}31) \quad R^2=0{,}86$$

[7] Beine et al. in their estimation procedure (2001, 2003) used other index – the increase in proportion of the population with tertiary education attainment. This variable is not suitable for the transitional countries, especially for Poland – because it is strongly biased by the demographic structure of the population. In the analyzed period, there was an overrepresentation of young individuals in the population, which additionally increased the proportion of tertiary educated.

[8] Sample includes: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romenia, Slovakia and Ukraine.

All the coefficients of the parameters in equations 12 and 13 were significant at 5% level.

The human capital equation shows a strong and negative correlation between the investments in education at the tertiary level (hum_i) and the migration probability ($mig22_i$), confirming the predictions of the theoretical model[9]. The higher the brain waste (the skilled migration rate) was, the lower the investments in education were in transitional countries. Therefore, the existence of *ex ante* "negative brain effect" has been confirmed. Not surprisingly, public expenditures on education ($eduex_i$) were the most important factor, thus showing the effectiveness of the public system of education in transitional countries. The rate of unemployment also affected the dependent variable. This can be explained by the fact that the difficult situation on the labor market at home pushed young people to delay the market entering and to improve their qualifications meanwhile.

Table 1 Variables and their empirical counterparts

Variable	Definition	Empirical counterpart	Source
hum_i	investments in education at tertiary level	average tertiary enrollment rate, 1999-2003	World Bank, 2006
$mig22_i$	skiled migration rate	stock of skilled OECD foreign-born adults arrived in the destination country after age 22 as percent of skilled natives, 2000	Beine et al. (2006)
$eduex_i$	public expenditures on education	average public expenditures in education as percentage of GDP, 1999-2003	UNESCO (2006)
$unemp_i$	rate of unemployment	mean unemployment rate, 1999-2003	World Bank, 2006
grw_i	growth rate	average growth rate of GDP per capita (PPP), 1999-2003	World Bank, 2006
$initi_i$	initial GDP per capita	GDP per capita (PPP) level, 1999	World Bank, 2006
$internet_i$	indicator of physical capital	internet users per 1000 people, average 1999-2003	World Bank, 2006

In the growth equation, there is clearly visible a positive and significant correlation between the rate of GDP per capita growth (grw_i) and the investments in education at the tertiary level (hum_i). Also the relation between the initial income per capita and growth ($initi_i$) is in accordance with the economic theory: the negative sign of the coefficient confirms that the convergence in transitional countries is taking place. Surprisingly, the parameter ($internet_i$) - the internet users per 1000 people (proxy variable for the quantity of physical capital) is negative and strongly significant. One possible explanation is that in the transitional countries there is still a shortage of physical capital, which is detrimental to growth. Another plausible justification for the negative sign of ($internet_i$) is the convergence among transitional economies – the ones with the smaller amount of physical capital grow at a higher pace than

[9] The migration rates at the secondary and primary level, as well as the general migration rate were also negatively, but not significantly correlated with the (hum_i), so were dropped from the analysis.

the ones with advanced level of capital. However, there is no significant correlation between ($initi_i$) and ($internet_i$) variables.

5. Conclusion

The theoretical model presented above shows the potential outcomes of brain waste phenomenon in the transitional countries. It has been demonstrated that brain waste can induce two negative effects on the home country's economy. The first one is typical of brain drain outflow of skilled workforce – the *ex post* "drain effect", as described in the "new economics of brain drain" literature. However, due to the nature of brain waste (ie. the wrong and not fully used potential of immigrants skills) - arises the probability of the second detrimental, *ex ante* "negative brain effect". Some individuals, when considering whether to study or not at the tertiary level may decide to quit school in order to work abroad. Due to the brain waste they simply do not see gains in obtaining university diploma, as the skilled immigrants get the same menial jobs as the unskilled ones. The positive "brain effect" arises only when the migration probability for educated agents is very high, which in turn increases the magnitude of the *ex post* "drain effect".

The impact of migration on educational investments has been empirically researched. The estimation has shown very clear and significant negative relation between the skilled migration rate (ie. the empirical counterpart of migration probability) and the tertiary enrollment rate. Thus, the existence of the "negative brain effect" in the transitional countries has been empirically confirmed. It has been shown, that brain waste reduces the economic performance of transitional countries in two ways: by reducing the inclination to study at tertiary level among the young generation, and by lowering the number of graduates in the society.

Two other negative outcomes of the brain waste, not included in the theoretical model, must be mentioned. As the skilled immigrants work in menial jobs, where their qualifications are not properly used – their personal human capital stock depreciates very rapidly. For instance, a young after-graduate mining engineer working as a waiter in a London restaurant, after five years of emigration would lose a considerable amount of knowledge acquired at the university. As the brain waste is a massive and common phenomenon, the return migration will not be beneficial for the homelands, contrary to what has been presumed by the "new economics of brain drain" researchers. Also the benefits stemming from the remittances

would be smaller than expected, because the immigrants working in menial jobs earn less than native skilled workers.

The policy implications of the brain waste varies with the country's perspective. The receiving countries should pay more attention to regulations which ban the entrance of skilled immigrants on labor market. The situation, when the educated foreigners perform menial jobs is not truly beneficial for the countries of immigration, because the real potential embodied in these workers remains hidden. On the other hand, the transitional countries must analyze with greater attention the quality of tertiary schooling services. The boom of educational services in 1990s, especially visible in Poland, but also in other countries of CEE region implied the creation of new higher education institutions. The growing number of universities and students was not supported by the sufficiently high increase in the number of teaching staff. This in turn meant that the quality of schooling at the tertiary level has been reduced, especially in peripheral universities or private schools. The brain waste shows clearly, that the diplomas obtained at university are not evaluated positively by foreign labor markets. Thus, some reforms must be carried out, in order to increase the quality of education services at tertiary levels in transitional countries.

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