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Does Talent Migration Increase the Gap between East and West?[1]

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1. Introduction

The number of skilled migrants - and their share in total world wide migration - has risen dramatically in recent decades. *Docquier* and *Rapoport* (2004) report that the number of migrants residing in OECD countries increased by 50 percent between 1990 and 2000, with the increase in the number of skilled migrants equal to 2.5 times that of unskilled (70 percent versus 28 percent). The figures for the period 2001-2007 suggest that the share of skilled migrants is further increasing (ILO 2008).

In order to quantify high skill migration, *Docquier* and *Marfouk* (2006) calculate a selection indicator, which is given by the proportion of skilled (defined as migrants with tertiary education) emigrants in the total emigration stock. Selection rates in 2000 among emigrants were the highest in Croatia (29.4%), Bosnia and Herzegovina (28.6%), Albania (20.0%), Serbia and Montenegro (17.4%), Slovakia (15.3%), Romania (14.1%), Estonia (13.9%), Poland (12.3%), Hungary (12.1%), Lithuania (11.8%) and Latvia (10.2%): Only in the Czech Republic it was below 10% of emigrants.

These figures suggest that migration of the best educated and most talented workers is an evident phenomenon cross-over the Europe. The vast majority of highly skilled flow from East to West, although the return migration is increasing, particularly in the fastest growing Eastern economies. Given that human capital is an important determinant of economic growth, high skill migration may increase the development gap between East and West. In this study we investigate if and how high skill migration may affect the economic growth in Eastern Europe.

2. Theoretical framework

Economic growth is one of the key policy priorities for most of the (democratic) transition countries in Eastern Europe. In this section we introduce the theoretical framework which will be used for analysing the impact of high skill emigration on long-run growth in the East. First, we present key findings of the recent growth theories with respect to human capital as the key driving force of economic development. Second, from the endogenous growth theory we derive an innovation production function for a closed economy. Next, drawing on findings from international labour migration and knowledge spillover literature, we augment the closed economy innovation production function to an open economy model. Finally, we decompose the open economy innovation accumulation function into four key components: worker education, international labour migration, national knowledge creation through research and development and international knowledge spillovers.

2.1 The framework of innovative capital

The main reason for choosing the innovative capital framework for our study is that to date there is no single, coherent theory of international labour migration available fully capturing high skill migration impacts on economic growth. Only a fragmented set of theories exist that have developed largely in isolation from one another segmented by disciplinary boundaries (*Lucas* 2004).

Differences between the East and West growth trends and patterns in high skill migration, however, suggest that a full understanding of the relationship between high skill migration and economic growth cannot be achieved by relying on the tools of one model alone, or by focusing

on selected aspects such as brain drain stressed by the neoclassical theory, brain gain/waste emphasised by the 'new migration theory', Diaspora's role in knowledge spillovers stressed by migration network theory. Instead, its complex, multifaceted nature requires an integrated approach that incorporates the variety of effects, forces, and assumptions into one single framework. By adopting the innovative capital framework we attempt to integrate all key effects and forces of high skill migration on economic development emphasised by different theories in one unified framework.

Innovative capital in general and human capital in particular takes a central role in most theories of economic growth and development. Both the augmented neo-classical growth model and most of the endogenous growth models stress the importance of innovative capital in economic development. However, different schools of growth theory propose different functional relationships between the growth rate of national income and innovative capital. With respect to the role of innovative capital, growth models can be regrouped into two strands of theoretical views.

According to the neo-classical growth theory, the accumulation of human capital as a factor of production drives economic growth, implying that differences in levels of human capital are related to differences in output levels across countries (*Solow* 1956, *Mankiw* et al. 1992).

According to the endogenous growth theory, a greater human capital stock affects economic growth mainly by facilitating innovation and adoption of new technologies, implying that differences in the levels of human capital cause differences in output growth across countries (*Nelson* and *Phelps* 1966, *Lucas* 1988, *Romer* 1990). In contrast to the neo-classical growth theory, in which the long run growth is exogenously determined by technological change, endogenous growth models explain the level of economic growth within the model.

The two most widely applied endogenous growth models are *Lucas* (1988) and *Romer* (1990). *Lucas* (1988) models human capital in a firm's production function in a manner analogous to the augmented *Solow* model (private margin of innovative capital). However, in addition, he introduces an 'external' (social margin of innovative capital), whereby the average level of human capital in the economy affects individual firms' output but is not taken account of in their profit-maximisation decisions. In the context of our study an important feature of *Lucas* (1988) model is that even if there is no positive knowledge spillover effect, long run growth is determined by investment in both physical and human capital.

The second major strand of endogenous growth theories was pioneered by *Romer* (1990). The growth model of *Romer* has three sectors: a technology producing sector, an intermediate goods producing sector where capital goods are produced, and a final output producing sector. In his model the steady state growth additionally depends on the human capital stock. The part of human capital that is not used for producing goods and services is used for creating new technologies. The level of human capital, L_H, has thus a positive effect on the growth of knowledge, K, the stock of which determines the number of differentiated intermediate goods, x. According to the *Romer*'s (1990) model, the innovation sector operates according to a national innovation production function:

$$\dot{I} = \delta L_{Ha}^{\theta_1} K^{\theta_2}$$

where $\dot{I}$ is a sustainable rate of innovation and α is a productivity parameter. The sustainable rate of innovation, $\dot{I}$, is an increasing function of the number of skilled workers, L_{Ha}, and the stock of knowledge available to these skilled workers, K. Thus, in the *Romer*'s (1990) model the rate of technological change is endogenous in two distinct ways. First, the share of the economy devoted to the innovation sector is a function of the skilled workforce (determining L_{Ha}), and the allocation of resources to innovative activities depends on the R&D productivity. Second, the productivity of innovation creation is sensitive to the stock of knowledge capital, K, created by past innovations.

Although, there is neither a general agreement on the precise values of these parameters nor on the functional form linking innovation to economy-wide long-term productivity growth, there is a relatively broad agreement that these are the key factors in explaining the realised level of economy-wide innovation (*Furman*, *Porter* and *Stern* 2002).

2.2 Innovation accumulation function

The closed economy innovation production function can be derived straightforwardly from *Romer* (1990). Applying a logarithmic transformation and rewriting the growth rate in form of stock changes we obtain closed economy innovation production:

$$\ln I = \alpha + \lambda_1 \ln L_H + \lambda_2 \ln K$$

According to equation (), the national innovative output, I, is an increasing function of the size of skilled workforce, L_H, and the stock of knowledge available to workers, K. Given that the two innovative inputs are accumulable, their endowment is determined endogenously through equilibrium strategies of economic actors. The size of the human capital in the country is determined by the number of educated workers, L_H. The stock of country knowledge capital depends on national research and development activities, K. The two coefficients (λ_1 and λ_2) measure the relative contribution of the two innovative inputs: human capital and knowledge capital.[2] α is a productivity parameter, which captures all other factors affecting the creation of innovative capital but not captured by variables L_H and K.

Next, we consider the innovative capital accumulation in an open economy. Empirical evidence and previous studies suggest that in an open economy, when international flows of human capital and knowledge capital are possible, the national innovative capital depends not only on country's endowment with skilled workers and the level of technological knowledge, but also on the net migration of skilled labour (*Sjaastad* 1962; *Bhagwati* and *Rodriguez* 1975) and international knowledge spillovers (*Krugman* 1979). Therefore, we explicitly account for the net high skill migration which, depending on the sign, might augment or shrink locally educated workforce; and for international knowledge spillovers, which magnify the locally produced knowledge, by

[2]Parameter λ_1 determines whether the marginal product of an additional invention is increasing (the so-called 'standing on shoulders' effect, *Caballero* and *Jaffe* 1993) or decreasing (the so-called 'fishing out' hypothesis) in the stock of human capital, and parameter λ_2 determines the returns to scale with respect to the stock of existing knowledge.

including them in the innovative capital supply function.

In order to account for international movements of innovative inputs, we introduce two new variables: L_H^m denotes the net migration of skilled workers, and K^m denotes stock changes in technological knowledge due to cross-country knowledge spillovers.[3] According to the underlying endogenous growth theory of *Romer* (1990), at least part of the technological knowledge is a public good (i.e. non-excludable and non-rival). This implies that cross-country spillovers of technological knowledge can only increase the national innovative capital creating a no-loose situation for both sending and receiving countries ($\partial K^R \geq 0$, $\partial K^S \geq 0$).[4] In contrast, skilled labour is a rival input implying that international migration of skilled workers decreases its stock in the sending country and increases the stock of human capital in the receiving countries creating a win-lose situation for the receiving and sending countries, respectively ($\partial H^R \geq 0$, $\partial H^S \leq 0$). Substituting the two new variables - skilled labour migration and international knowledge spillovers - we obtain the aggregate supply of innovative capital, I^S, in open economy S:[5]

$$\ln I^S = \ln \alpha^S + \underbrace{\beta_1 \ln\left(L_H^S + L_H^m\right)}_{\substack{\text{worker} \\ \text{education}}} + \underbrace{\beta_2 \ln\left(K^S + K^m\right)}_{\substack{\text{high-skill} \\ \text{migration}}} \qquad \begin{array}{l} \text{domestic} \\ \text{innovation} \end{array} \quad \begin{array}{l} \text{knowledge} \\ \text{spillover} \end{array}$$

Open economy S's innovative output, I^S, depends on the number of workers who acquired skills through education, L_H^S, net migration of skilled workers, L_H^m, domestic knowledge creation through R&D, K^S, national and international knowledge spillovers, K^m, and parameters of the model.[6] The relative contribution of the four components to national innovative supply, I^S, depends on equilibrium strategies of economic actors.

The innovative capital function suggest that among other factors country growth prospects depend on worker education, high skill migration, domestic R&D activities and knowledge spillovers. However, all four growth determinants are mutually related to each other. In the following section we analyse how high skill migration affects the four determinants of growth and hence the gap between East and West.

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[3]Superscript ^{m} denotes migration.

[4]Sending country is denoted with superscript S and receiving country with superscript R. Similarly, skilled labour is denoted with subscript H (human capital) and unskilled with subscript U (unskilled).

[5]The innovative capital framework derived here is similar to the innovative capacity approach of *Furman*, *Porter* and *Stern* (2002).

[6]For the sake of simplicity, we assume that national knowledge spillovers, K^{SS}, are already accounted for in the domestic knowledge production function, K^S.

3. The impact of skilled migration on innovative capital in the East

In this section we investigate the impact of high skill migration on the four key drivers of economic growth derived above. Relying on the innovative capital framework, we show graphically and analyse theoretically how skilled labour migration affects the four determinants of national innovative capital: knowledge stock through worker education, long-run net migration of skilled workers, domestic knowledge creation activities and international knowledge spillovers. In line with empirical evidence, we assume that the Eastern sending countries are less developed than the Western receiving countries, and hence the skilled labour wage in East is lower than in West and the gap between Eastern and Western European countries exist. According to the traditional migration theory (*Harris and Todaro 1970*) wage differences trigger skilled migration - driven by higher expected earnings in receiving country, skilled workers migrate from East to West. Migration induces adjustments in the four growth determinants, which we analyse in the following sections.

3.1 Migration impact on worker education

Education is the most obvious way of augmenting human capital at home. Therefore, we start with open-economy education equilibrium, where we explicitly account for migration-induced adjustments through education.

If liquidity constraint for entering education is not binding, we can distinguish between three sources of adjustments: changes in skilled/unskilled wage ratio at home, skill downgrading effect in the destination country, and education cost heterogeneity effect of differently able workers. A fourth source of migration-induced adjustments in education equilibrium is remittances, if liquidity constraint in the Eastern sending country is binding.

First, we consider changes in relative wages in home country. If only skilled workers migrate or, equivalently, if more skilled workers migrate than unskilled, then the ratio of skilled/unskilled workers will decrease in the sending country. A declining supply of skilled labour compared to unskilled labour supply will exert an upward pressure on wage rate for skilled labour (see also section 3.2). Increased skilled/unskilled wage gap will induce additional unskilled workers to obtain education. Thus, home wage adjustments will increase the long run education equilibrium in the sending country.

Second, we analyse the impact of receiving country's wage effect on worker education decision in the sending country. Several recent studies (*Docquier and Rapoport* 2004) find that migration prospects foster domestic enrolment in education as it increases expected return to the investment in education. The data presented in the table below confirms this hypothesis for the CEE countries. It has to be noted that in general enrolment in tertiary education is relatively high (and increasing) in most CEE countries. Though, there might be other reasons that influence the decision to invest in education than the prospect of emigration, particularly taking into account a phenomenon described below.

Table 1: Gross rates in higher education enrolment, as a percentage of 19-24 year old population

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Bulgaria	26	26	27	28	30	34	35	34	35	35	33	31	32	32	34
Croatia												30	32	33	35
Czech Rep.	17	16	17	18	19	20	21	22	24	26	28	31	35	40	44
Estonia	34	32	29	28	29	32	35	38	43	45	51	62	63		
Hungary	12	12	13	14	16	18	20	25	28	32	36	39	45	57	60
Latvia	21	21	19	18	18	22	31	36	42	47	53	60	63	65	64
Lithuania	27	23	21	21	21	23	26	31	34	39	44	54	58	62	66
Poland	17	17	19	21	24	27	31	35	39	43	46	51	52	54	56
Romania	9	11	13	14	14	18	19	19	21	23	27	30	33	34	36
Slovakia	14	14	15	15	17	18	20	20	22	23	23	31	32	33	36
Slovenia	23	26	26	28	30	31	34	44	51	53	58	67	70	74	80

Source: OECD, UNICEF.

According to empirical evidence from the Western European and North American destination countries (*Mattoo et al.* 2005, *Drinkwater et al.* 2006), only a small part of highly skilled immigrants are employed in skilled jobs. Usually, the majority of skilled migrants from East work in sectors requiring little qualification, such as agriculture, transport or construction.[7] For example, data from the US and Swiss censuses show that because of labour segmentation in destination countries only about one third of migrants from Balkan countries with tertiary education have obtained skilled jobs (*Lucas* 2004).

Table 2: Probability of Obtaining Skilled Jobs – Different Cohorts and Education Levels

Cohort Education Level	1990s Bachelor	1990s Masters	1990s Professional	1980s Bachelor	1970s Bachelor
Bulgaria	37%	56%	65%	27%	0%
Czech Republic and Slovakia	34%	52%	42%	32%	41%
Hungary	55%	68%	87%	37%	60%
Latvia	59%	73%	87%	50%	30%
Lithuania	31%	50%	40%	61%	80%
Moldova	49%	65%	56%	0%	17%
Poland	35%	55%	65%	25%	35%
Romania	40%	59%	70%	41%	40%
Russia	45%	63%	61%	41%	49%
Ukraine	39%	58%	62%	46%	29%
Yugoslavia (former)	29%	49%	59%	21%	31%

Source: Mattoo, Neagu and Özden, 2005, based on US Census 2000 data.

There might be several explanations why the majority of highly skilled East European migrants working abroad are occupied in low-skilled jobs where their professional qualifications are not appropriately employed. Firstly, the lack of harmonisation between the educational systems within Europe implies that university diplomas from CEE countries may not be recognised 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 there are too few engineers. Thirdly, the imperfections of labour 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. As a

[7]Given that the acquired knowledge of skilled workers is largely wasted, in the migration literature this effect is often referred to as a 'brain waste'.

result brain waste effect, skilled immigrants from transitional countries receive, to a large extent, very low returns on their human capital.

The migrant work skill downgrading in the destination countries affects the education decision of unskilled workers in home country. Because the majority of skilled migrants are employed in unskilled jobs abroad, a reduced skill premium creates disincentives for unskilled workers to enter education and acquire skills. Note that not only the potential migrants are affected, but through a lower international wage for labour also workers staying at home are affected in the source countries. As a result, less young people enter education and less unskilled workers want to become skilled. Thus, foreign wage signal will decrease the equilibrium education in the sending country.

Next, we look at the impact of worker ability heterogeneity. Workers are not equally talented; they are highly heterogeneous in their ability to acquire education. The utility maximisation of workers implies that, in the presence of positive costs of education, only the most talented obtain education. This in turn implies that, on average, those workers which were unskilled before migration started are less talented than skilled workers who have first obtained education, suggesting that acquiring skills through education will be more costly for the remaining unskilled workers. As a result, after emigration of the most talented workers, home country will have less skilled workers in equilibrium than before migration. Thus, in the presence of worker heterogeneity, the emigration of most talented has an additional negative impact on human capital creation through education.

The view that skilled migration will have a negative impact on human capital in sending countries is consistent with the theoretical models developed by *Haque* and *Kim* (1994) and *Wong* and *Yip* (1999). Each study also examines the impact of tax-financed education subsidies under high skill emigration and draws conclusions for education policy.

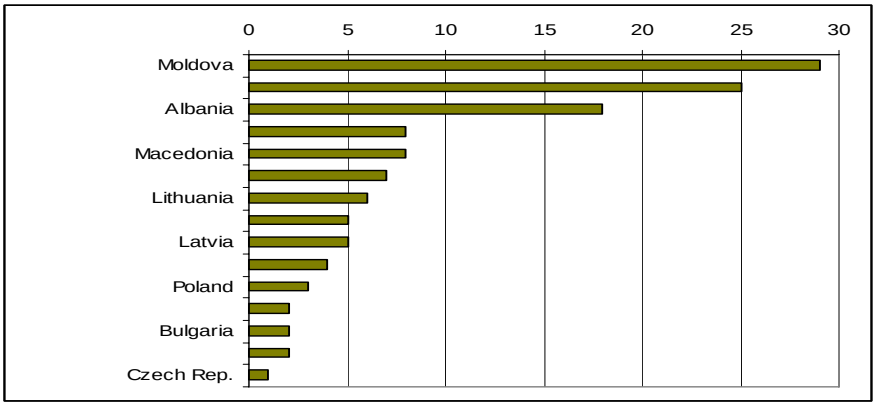
Finally, we consider how education decision of workers in the sending country is affected by worker emigration if liquidity constraint is binding. The key aspect here are rents which emigrants receive in the destination country, because highly skilled workers, as other groups of migrants, tend to remit part of their income received abroad to their families in home country. According to *Cox* (1987), skilled worker remittances differ from unskilled worker remittances in at least two respects: quality and quantity. On the one hand, highly-skilled migrants remit less than unskilled because skilled migrants are more likely to settle and to reunite with their family in the receiving country. On the other hand, in contrast to unskilled worker remittances, which mostly are spent for consumption goods, remittances of skilled migrants are more often directed towards investment in production, fixed assets and education (*World Bank* 2000).

These findings suggest that skilled worker remittances may move upward or completely remove the liquidity constraint of education. As a result, more workers, particularly those which were restrained from education by the liquidity constraint, are able to acquire skills through education.[8] Thus, in poor countries remittances may help overcome liquidity constraints which

[8]According to *World Bank* (2000), especially for poor families in less developed economies remittances often help to cope with liquidity constraints locking the access to formal education. For example, *World Bank* (2000) reports that about 80% of remittances in Albania go to poor households. In more developed economies educational remittances provide access to a better education and training either at home or abroad. In both cases the remittance investment in education leads to more educated workforce and/or a better (higher quality) education resulting in more human capital.

restrained worker access to education, increasing in such a way the equilibrium education in the sending country.

Figure 1: Remittances as a share in GDP, 2004



Source: IMF Balance of Payments Statistics.

The IMF estimates of income received from friends and relatives abroad as a proportion of the national income (GDP), suggest that they are particularly high in Moldova (30%), Bosnia and Herzegovina (25%) and Albania (15%). These countries are among the world's largest recipients of remittances as a portion of GDP. However, also other East European countries remittances are significant.

In addition, there is plenty evidence that official remittance figures tend to undercount the actual flows as part of the transfers between migrants and their families occurs through informal networks. A *World Bank* (2006) survey indicates that between one-third and two-thirds of migrants, depending on their country of origin, tend to use informal channels to transmit remittances. Significant empirical evidence indicates that remittances lead to positive effect on economic growth, whether through increased consumption, savings or investment and have important multiplier effects (*Lucas* 2004, *Ledesma* and *Piracha* 2001).

Summarising findings of this section we may conclude that, when accounting for induced effects triggered by skilled worker migration, the long-run education equilibrium will likely be different from the short-run education equilibrium. These differences stem from adjustments in relative wages, which do not take place in the short run but might be important in the long run. In this section we discussed four sources of induced adjustments in education equilibrium: changes in skilled/unskilled wage ratio in the sending country, skill downgrading effect in destination countries, education cost heterogeneity, and the impact of remittances on liquidity constraints. Given that two effects (the first and the fourth) have a positive impact on worker education, and two effects (the second and the third) work in opposite direction by decreasing the number of workers entering education, it is impossible to determine a priori the sign of the relationship between high skill emigration and the number of remaining workers acquiring skills through education.

3.2 Long-run high-skill migration

Next, we consider feed-back effects of high skill migration, which determine the long-run net migration of skilled labour. The equilibrium migration is determined by a trade-off between

expected increase in earnings and migration cost. In the long-run, adjustments in relative wages will affect the equilibrium migration through several channels, which we aim to analyse in this section: changes in relative wages in home and host countries and changes in migration costs.[9]

Before considering the induced effects, we shortly summarise the direct brain drain effect of high skill emigration on human capital stock in the sending country, because it is the departure point for determining the long-run impact of skilled labour migration on human capital stock (*Bhagwati* and *Hamada* 1974). As above, because of exogenous cross-country wage differences skilled workers migrate from low wage source country to high wage receiving country. The direct and most visible effect of skilled worker migration is transfer of human capital embodied in labour.[10] Assuming that skilled migrants can transfer neither more nor less human capital than embodied in their private productive skills, at the time of migration the stock of human capital in the sending country is monotonically declining in skilled worker emigration. This implies that the size of human capital diversion from source country to receiving country can be calculated by multiplying the number of skilled migrants by the average skill level of migrants.

In the long run, skilled worker migration affects wages in home and host countries and migration costs, which in turn affect the migration decision itself. In order to determine the long-run impact of skilled worker migration on human capital stock in the sending country, it is important to account also for these induced effects. As pointed out in previous section, the high skill emigration will reduce labour supply in the sending country. If the demand for labour does not change (which is more likely to hold in tradable goods sectors than in sectors producing non-tradable goods), a decreasing labour supply will exert an upward pressure on wages in home country. This implies that changes in home country's wages will narrow the migration-driving wage gap between source and destination countries, implying less migration in the long-run. Thus, wage flexibility has a positive impact on human capital stock in the source country.

Several studies point to the fact that wages were drawn up in the sending countries through emigration. However, in most CEE countries emigration first helped to reduce labour market pressures in the time of rapid economic changes and adjustments and to decrease high unemployment. Only in the very recent years, emigration to Western Europe countries after the EU enlargements in 2004 and 2007, emigration led to labour shortages in some fast growing CEE economies (such as the Baltic States, Romania and Bulgaria) which exert upward pressures on wages and wage increased by 20-30% annually exceeding productivity growth by far.

According to *Borjas* (1994), international labour migration affects not only wage rate in the sending country but also in the destination country. The immigration of workers increases labour supply in the destination country which, in turn, will exert a downward pressure on wages. Lower wages in the destination country will narrow the migration-driving wage gap between the sending and receiving countries. Smaller wage differences will in turn attract fewer migrants. Less emigrating skilled workers imply higher human capital stock in the sending country. Thus, we may conclude that wage flexibility in the destination country has a positive impact on human

[9]In reality, there much more forces at work. For example, the economic geography and urban systems literature stress that because of agglomeration economies, firms in the larger region will be able to pay higher wages attracting in such a way even more workers. However, for the purpose of the present study, we abstract from these effects, as we think that at international scale they are less pronounced.

[10]Given that the human capital embodied in skilled workers is draining out of country, in the migration literature this effect is often referred to as a 'brain drain'.

capital stock in the sending country. The wage effect depends on the sending country's size - the larger the sending country, the bigger is the wage effect in the destination country. Some recent studies (*Blanchflower* et al. 2007, *Gilpin* et al. 2006, *Wadensjö* 2006) found out that no wage pressure can be observed in UK, Ireland or Sweden, after the latest EU enlargement as large inflows of CEE workers went to these countries.

Workers care not only about the wage they may receive in the destination country but also about costs related to migration (*Sjaastad* 1962). Thus, workers trade the expected income increase off these costs. Workers migrate if the expected benefits arising from migration are higher than migration costs. Migration costs include not only the physical relocation costs but also employment uncertainty (which is higher abroad than at home), social costs of leaving family and/or friends behind, cultural adjustment costs etc. According to previous literature (*Carrington*, *Detriagiache* and *Vishwanath* 1996), migration costs are decreasing in source country's migrant stock in the receiving country. Declining migration costs in turn widen the net wage gap between source and destination countries attracting, in such a way, more migrants. Thus, through declining migration costs past migration has a positive impact on the next period's migration and, hence, a negative impact on human capital stock in the sending country. The major countries of destination with significant *diasporas* in EU countries are Germany and France for Serbia and Montenegro, Italy and Greece for Albania. More recently, after Ireland, the United Kingdom and Sweden allowed free movement of workers from CEE countries after the 2004 EU enlargement. As a result, large communities of CEE migrants are building in these countries and creating migration networks for migrants from Poland, Lithuania, Slovakia and Latvia.

Summarising the potential impacts of high skill migration on long run net migration and hence development gap between East and West we may conclude that our theoretical findings are in line with empirical literature, where brain drain is found to be strictly negative for human capital stock in the sending country, at least in the short-run (*Beine*, *Docquier* and *Rapoport* 2001; *Lowell* and *Findlay* 2001; *Lucas* 2004; *Katseli*, *Lucas* and *Xenogiani* 2006). The size of the direct brain drain effect is proportional to the product of emigrating skilled workers and the average level of skills embodied in the migrating labour. The long-run migration impact on the human capital stock, however, is determined by three additional drivers of economic migration which are not present in the short run: the sending country's wage effect, the destination country's wage effect, and changes in migration costs.[11] Adjustments in the sending country's wage rate and destination country's wage rate have a negative impact on migration and, hence, a positive impact on human capital stock in the sending country. In contrast, declining migration costs magnify the direct brain drain effect which, as discussed above, is negative for human capital stock in the sending country.

3.3 Migration impact on domestic innovation

This section analyses the impact of high skill migration on long-run innovation equilibrium which determines how much knowledge is created domestically. The two key determinants of national R&D activities is size of budget (government revenue) and budget share spent on R&D.

[11] Other, non-economic drivers such as lacking infrastructure, political instability, distrust in domestic institutions, also affect migration decisions of individuals.

We show that skilled labour migration affects both size and structure of government budget which in turn implies that, at least indirectly, the emigration of skilled workers affects the long-run innovation equilibrium. In addition, the high skill emigration affects the R&D efficiency of remaining workers.

We start with migration impact on size of government budget by considering the impact of highly skilled labour migration on government revenue. All workers contribute to government budget through tax payments. After emigrating, skilled workers do no contribute to the sending country's tax revenue anymore. Given that, on average, skilled workers are higher net contributors than unskilled workers, government revenue decreases due to fewer taxpayers in the origin country.[12] *Desai*, *Kapur* and *McHale* (2004) found that net fiscal loss from high-skill emigrants from India to the US ranged from 0.24% to 0.58% of GDP per year depending on the estimation method. Lower tax revenue reduces government budget allowing for less expenditure on science, research and development, which in turn slows down the accumulation of knowledge capital under the assumption that the share of R&D expenditure in the budget remains constant. In contrast, higher tax revenue and larger budget in the destination country imply that more expenditure can be devoted towards knowledge creation resulting in higher knowledge capital in the long-run; however, this revenue might also be used to increase social spending (see also the discussion below).

A further argument for high skill drain widened development gap is the loss of public spending in the education of emigrants. Considering that in CEE countries education is mainly publicly funded (see Table 3) and that this publicly subsidised higher education often serves as a vehicle to leave the country, then the merits of the publicly subsidised tertiary education may well be doubted (*Lucas* 2004).

Table 3: Public expenditure on education as percentage of GDP

	1991	2001	2004
Belarus	5.7	6.0	5.7
Bulgaria	5.4	3.5	4.2
Croatia	5.5	4.5	4.5
Czech Rep.	4.0	4.1	4.4
Estonia	6.9	5.3	5.1
Hungary	6.1	5.0	5.4
Latvia	4.1	5.5	5.1
Lithuania	5.5	5.9	5.2
Poland	5.2	5.3	5.4
Moldova	5.3	4.3	4.2
Romania	3.5	3.3	3.4
Russia	3.6	3.1	3.5
Serbia	4.2	3.3	
Slovakia	5.6	4.0	4.2
Slovenia	4.8	6.1	6.0
Macedonia	4.1	3.5	
Turkey	2.4	3.7	4.0
Ukraine	6.2	4.7	5.3

[12]Because on average the wage rate for skilled work is higher than for unskilled and the unemployment rate among skilled workers is lower, per capita, skilled workers contribute more to tax revenue than unskilled workers.

Source: UNESCO Education database.

Next, we show how skilled worker emigration affects the structure of government budget. More precisely, we analyse the impact of migration on the share of R&D expenditure. Skilled worker migration affects the share of R&D expenditure through changed ratio of skilled/unskilled workers in the source country: skilled worker share in the total workforce (and population) decreases whereas the share of unskilled workers increases.[13] Given that workers are also voters, the voting power of unskilled workers increases relative to that of skilled workers in the case of high-skill emigration. Usually, the political interests of the two worker groups are different. For example, the demand for social redistribution policies is higher by low-paid unskilled workers, whereas the demand for government investment in research and development is higher by skilled workers. Shifts in the relative voting power between the two worker groups will change the demand for specific policies which in turn may affect the structure of government expenditure in the sending country. In the case of skilled worker emigration, a shift in relative voting power towards unskilled workers would result in a higher demand for social redistribution policies and less future-oriented investment (e.g. R&D expenditure). Lower government expenditure share on research and development would in turn slow down the accumulation of knowledge capital in the sending country. The adverse impact of skilled migration on public spending in source countries was first mentioned in *Kancs* and *Ciaian* (2008). For a broader discussion for reasons driving the emergence of neo-socialism in Central and Eastern Europe see *Cook et al* (1999).

Table 4 provides an overview on how much different CEE countries spend on R&D. Whereas the Czech Republic, Croatia, Slovenia and Serbia spend over 1% of their GDP on R&D, other countries devote much smaller share of their national budget.

Table 4: Total gross domestic expenditure on R&D as percentage of GDP

Source: UNESCO Research and development database.

Finally, we consider the scale effect of national R&D activities. According to the knowledge production function of *Romer* (1990), new knowledge is produced using existing ideas and human capital resources seeking out new ideas at a point in time as inputs. The progression from tinkers to R&D labs with trained scientists and engineers is usually attributed to a 'fishing out' effect in innovation creation (*Furman*, *Porter* and *Stern* 2002). The earliest discoveries are those

[13]The increasing share of unskilled workers results from the assumption that the ratio of skilled/unskilled migrants is higher than the ratio of skilled/unskilled domestic workforce (positive selection, *Borjas* 1987).

ideas that require the least amount of scientific knowledge. Subsequent discoveries are harder and require a more complete understanding of scientific principles. The fishing out hypothesis is consistent with the observation made by *Jones* (1995) that although the number of research scientists and engineers has increased significantly over the post-war period there has been no accompanying increase in the rate of economic growth in the U.S. economy. According to *Abdih* and *Joutz* (2006), the larger the number of people searching for ideas is, the more likely it is that duplication or overlap in innovation would occur. As a result, doubling the number of researchers, the number of unique ideas or discoveries is less than double, and halving are more than double. This notion of duplication in research or the 'stepping on toes' effect has been found to be empirically significant (*Furman*, *Porter* and *Stern* 2002). The decreasing returns of innovation output with respect to the number of people seeking out new ideas suggest that the emigration of skilled workforce might increase the innovative output per researcher.

The third effect - decreasing returns to scale of knowledge - has the opposite sign to the changes in political support effect. Because of decreasing returns of knowledge to human capital, a lower stock of skilled labour in sending country implies that the efficiency of public spending on knowledge increases. There are important reallocation effects between policy transfers on knowledge creation and redistributive transfers. Because of higher relative political benefits from knowledge than from redistribution policies, the equilibrium redistributive transfers decrease, while growth related transfers increase.

Findings from this section suggest that skilled worker emigration affects size and structure of government budget, as well as the efficiency of national R&D activities. This in turn implies that, at least indirectly, the emigration of skilled workers affects the long-run innovation equilibrium. If the share of skilled worker in migrant population is higher than in home population, and political preferences are different between skilled and unskilled workers, then both fiscal effects (size and structure) decrease the domestically created knowledge capital. In contrast, if the 'fishing out' effect dominates the 'standing on shoulders' effect (*Caballero* and *Jaffe* 1993), then the R&D efficiency effect has a positive impact on knowledge capital in the sending country. These findings allow us to conclude that in the long-run skilled labour migration will likely reduce the total creation of knowledge capital but increase the innovative capital output per worker in the sending country.

3.4 Migration impact on knowledge spillover

This section analyses the impact of skilled labour migration on knowledge spillovers between migrant source and destination countries, as it co-determines how much knowledge capital is available domestically. The equilibrium level of knowledge spillover is determined by two opposite forces: the advantage of country backwardness and country's absorptive capacity. Skilled worker migration affects the absorptive capacity through three channels: human capital capability and 'adaptive' research capacity, and the cost of international knowledge transmission.

We start with human capital absorptive capability which, together with 'adaptive' research capacity, limits the upper bound of knowledge convergence between countries. New ideas and knowledge generated in other countries can only be adopted in home country if the necessary 'adoptive' technologies and human capital resources are available. Therefore, the availability of highly skilled workers largely determines country's capability to adopt foreign technology and to use imported ideas in own knowledge capital creation. For example, even if an innovative information technology developed in a frontier economy is available at no user cost in the

transition country, the transition country can only benefit from it if the necessary human resources are available for applying the imported technology. *Eaton* and *Kortum* (1996) identify knowledge flows through cross country patenting and find that a country's level of education plays a significant role in the ability to absorb foreign ideas. These results suggest that emigration of highly skilled workers decreases country's ability to benefit from technological spillovers.

In addition, country's absorptive capacity depends on investment in R&D activities which, as partly shown in section 3.3, depends on the size of domestic workforce (taxpayers). According to *Geroski* (1995), the size of national R&D expenditure is important not only for own innovation production but also for 'adaptive' research activities, because in order to be able to adopt or improve the knowledge generated by other countries, a country has to invest in 'imitative' or 'adaptive' research activities. Indeed, *Geroski*'s argument has sample empirical validation. At firm level the econometric studies of *Cohen* and *Levinthal* (1989) illustrate that the firm's own R&D activity enhances its absorptive capacity of innovations generated by other firms. Furthermore, the survey results of *Mansfield* (1981) show that imitation costs on average are about 65 percent of the original innovation costs. At country level *Guellec* and *van Pottelsberghe* (2001) tested this hypothesis by interacting foreign R&D with business R&D intensity for each country. Their results show that the impact of domestic R&D intensity on the elasticity of foreign R&D is positive and significant. Thus, in order to take a full advantage of international spillovers, a lagging behind country has to invest in 'adaptive' research activities. These findings suggest that national absorptive capacity is increasing in 'adaptive' research activities and decreasing in skilled labour migration, which reduces tax revenue for such activities.[14]

Next, we consider how skilled labour migration affects knowledge transmission costs. The effect of natural barriers, such as distance, on knowledge spillovers has been investigated both nationally and internationally. Many studies (e.g. *Jaffe et al* 1993, *Acs et al* 1994, and *Audretsch* and *Feldman* 1996) have argued that knowledge spillovers are rather localised. *Jaffe et al* (1993) find that a patent is typically 30 to 80 percent more likely to cite other patents whose inventors reside in the same country, than patents from other countries. This suggests that cross-border mobility of knowledge is limited and that knowledge spillovers are spatially localised. *Maurseth* and *Verspagen* (2002) use citations between European regions to estimate the effect of distance on knowledge flows. Their results indicate that distance has a negative impact on knowledge flows and that this impact is substantial. They find knowledge flows to be larger within countries than between regions located in separate countries, as well as within regions sharing the same language (but not necessarily belonging to the same country). Findings from *Peri* (2003) and other studies suggest that knowledge flows locally more easily than at a distance. This in turn implies that personal contacts of migrants may represent a significant knowledge transmission mechanism. Indeed, *Kapur* (2001) argues that skilled worker migration facilitates the spillover of knowledge, technology and business contacts from destination countries, by interacting as a carrier between knowledge producing country and knowledge absorbing country. In migration literature this effect is known as diaspora effect. Based on these findings we may conclude that skilled worker migration increases knowledge spillover from migrant destination countries to home countries.

[14] 'Adaptive' research activities may also be funded by private companies.

In addition, labour migration may also affect the ratio of national/international knowledge spillovers. Generally, the number of researchers is lower the smaller a country is. Hence the probability that the peers with whom skilled workers interact are located abroad is higher when skilled workers are from a small country. Proxying the economic size of a country by its labour force, the emigration of skilled workers will decrease country size and increase the probability of international (as opposite to national) exchange of ideas. *Guellec* and *van Pottelsberghe* (2001) test this 'size effect' hypothesis by interacting foreign R&D with an indicator of size for each country and confirm that smaller countries do benefit more from foreign R&D than larger ones. However, the increasing international knowledge spillovers are offset by decreasing national knowledge spillovers. Therefore, the net effect of the changed national/internation knowledge flows will unlikely be significant and, in the presence of positive knowledge transmission costs between countries, might be even negative.

Summarising findings from this section we may conclude that skilled labour migration affects knowledge spillover between migrant source and destination countries at least through three channels. We identify two effects which might restrict international knowledge spillovers: human capital capability to adopt imported technologies and national R&D expenditure for 'adaptive' research activities in the sending country. The third effect, which rather facilitates international knowledge infusion: knowledge transmission cost effect. The presence of two knowledge diffusion limiting forces and one augmenting force does not allow us to make general predictions about sign of the relationship between high skill migration, international knowledge spillovers and development gap between East and West.

Conclusions

Adopting the innovative capital framework of *Kancs* and *Ciaian* (2008), the present study analysis the potential impacts of high skill labour migration in general on innovative capital in the sending countries. In line with previous studies (e.g. *Beine et al.* 2001; *Lowell* and *Findlay* 2001; *Katseli et al.* 2006), we find that in the short- to medium-term high skill migration decreases national innovative capital and hence growth perspectives in the Eastern Europen sending countries.

Summarising our findings we may conclude that high skill migration affects economic growth in source and destination countries through a variety of channels: knowledge stock through worker education, long-run net migration of skilled workers, domestic knowledge creation activities and international knowledge spillovers. Given that the emigration of highly skilled workforce has both positive and negative impacts on key drivers of economic growth, the net impact of high skill migration depends on many factors and will likely be different from country to country and cannot be generalised based on theoretical predictions. Moreover, we found that the impact of high skill migration is likely to by different in the short run from the long run perspective, if centripetal forces of Diaspora high skill are strong enough. These results are in line with previous studies on high skill migration. The negative short-term effects are likely to be overturned by more positive long-term effects. Furthermore, there are important factors which are rather specific to Eastern Europe transition countries, they are small and open catching-up economies, where interaction and networking with more developed countries is of underlying significance and therefore diaspora effects might be very important. In the long run, there is also a possibility of return migration which is also associated with positive knowledge transmission to the sending country but not discussed in this paper.

In contrast to previous studies we examine the impact of high skill migration not only on the formation of human capital, but we also consider the migration's impact on knowledge capital in the sending countries. Indeed, we find that the emigration of highly skilled affect both the production and the attracting of knowledge capital. Several impact channels are new in the literature and have not been mentioned before. These findings suggest that in the long-run the adverse implications of high skill emigration on Eastern country growth perspectives might be even larger through reduced knowledge capital than through reduced human capital. If the return migration policies are attractive enough, the migrants can be attracted back to home in a relatively short period of time. In contrast, the creation of knowledge capital requires a considerably longer time period. Hence, our key policy conclusion is while focusing on reducing the flow of leaving highly skilled, not to loose the attention from other important general equilibrium aspects co-determining long term growth prospects of Eastern Europe.

References

Abdih, Y. and Joutz, F. (2006), Relating the Knowledge Production Function to Total Factor Productivity: An Endogenous Growth Puzzle, IMF Staff Papers, International Monetary Fund, 53 (2).

Beine, M., Docquier, F. and Rapoport, H. (2001), Brain Drain and Economic Growth: Theory and Evidence, Journal of Development Economics, 64, 275-289.

Bhagwati, J. N. and Hamada, K. (1974), The Brain Drain, International Integration of Markets for Professionals and Unemployment: A Theoretical Analysis, Journal of Development Economics, 1, 19-42.

Bhagwati, J. N. and Rodriguez, C. (1975), Welfare Theoretic Analyses of the Brain Drain, Journal of Development Economics, 2, 195-221.

Blanchflower, D., Saleheen, J., and Shadforth, C. (2007), The impact of recent migration from Eastern Europe on the UK economy, Bank of England.

Borjas, G. J. (1987), Self-selection and the Earnings of Immigrants, American Economic Review, 77, 531-553.

Borjas, G. J. (1994), The Economics of Immigration, Journal of Economic Literature, 32, 1667-1717.

Caballero, R. and Jaffe, A. B. (1993), How High are the Giant's Shoulders, NBER Working Paper, 4370.

Carrington, W. J., Detriagiache, E. and Vishwanath, T. (1996), Migration with Endogenous Moving Costs, American Economic Review, 86 (4), 909-930.

Cohen, W. M. and Levinthal, D. A. (1989), Innovation and Learning: The Two Faces of R&D: Implications for the Analysis of R&D Investment, Economic Journal, 99 (397), 569-596.

Cook, L., Orenstein, M. & Rueschemeyer, M. (1999), Left parties and social policy in postcommunist Europe. Boulder, CO, itd.: Westview Press

Cox, D. (1987), Motives for Private Income Transfers, Journal of Political Economy, 95, 508-546.

Docquier, F. and Marfouk, A. (2004), Measuring the International Mobility of Skilled Workers

(1990–2000), Washington, D.C, World Bank Policy Research.

Eaton, J. and Kortum, S. (1996), Measuring Technology Diffusion and the International Sources of Growth, Eastern Economic Journal, 22, 401-410.

Furman, J. L., Porter, M. E. and Stern, S. (2002), The Determinants of National Innovative Capacity, Research Policy, 31 (6), 899-933(35).

Geroski P. A. (1995), Do Spillovers Undermine the Incentive to Innovate?, in Dowrick, S. (ed.), Economic Approaches to Innovation, Aldershot, 76-97.

Gilpin, N., Henty, M., Lemos, S., Portes, J. and Bullen, C. (2006), The impact of free movement of workers from Central and Eastern Europe on the UK labour market, DWP Working Paper 29.

Guellec, D. and van Pottelsberghe de la Potterie, B. (2001), The Internationalisation of Technology Analysed with Patent Data, Research Policy, 30 (8), 1253-1266.

Jaffe, A. B., Tratjenberg, M. and Henderson, R. (1993), Geographic Localisation of Knowledge Spillovers as Evidenced by Patent Citations, Quarterly Journal of Economics, 108, 577-598.

Kancs, D., Ciaian, P. (2008), Blue Cards, Blue Prospects? International Migration Papers No. 91. International Labour Organization, Geneva.

Kapur, D. (2001), Diasporas and Technology Transfer, Journal of Human Development, 2, 265-286.

Krugman, P. (1979), A Model of Innovation, Technology Transfer, and the World Distribution of Income, Journal of Political Economy, 87, 253-266.

Lowell, B. L. and Findlay, A. (2001), Migration of Highly Skilled Persons from Developing Countries: Impact and Policy Responses, International Migration Papers, 44, International Labour Office, Geneva.

Lucas, R. E. B. (1988), On the Mechanics of Economic Development, Journal of Monetary Economics, 22, 3-42.

Lucas, R. E. B. (2004), International Migration and Economic Development: Lessons from Low-Income Countries, Expert Group on Development Issues (EGDI), Stockholm, Swedish Ministry for Foreign Affairs.

Mankiw, N. G., Romer, D. and Weil, D. N. (1992), A Contribution to the Empirics of Economic Growth, Quarterly Journal of Economics, 107, 407-437.

Mansfield, E. (1981), Imitation Costs and Patents: An Empirical Study, Economic Journal, 91, 907-918.

Mattoo, A., Neagu, I.C. and Özden, C. (2005), Brain Waste? Educated Immigrants in the U.S. Labour Market, World Bank Policy Research Paper, 3581.

Nelson, R. R. and Phelps, E. S. (1966), Investments in Humans, Technological Diffusion, and Economic Growth, American Economic Review, 56, 69-75.

Romer, P. M. (1990), Endogenous Technological Change, Journal of Political Economy, 98 (5), 71-102.

Sjaastad, L. A. (1962), The Costs and Returns of Human Migration, Journal of Political

Economy, 70, 80-93.

Solow, R. M. (1956), A Contribution to the Theory of Economic Growth, Quarterly Journal of Economics, 70, 65-94.

Wadensjö, E. (2006), Migration to Sweden from the New EU Member States, IZA Discussion Paper, 3190.

World Bank (2000), Higher Education in Developing Countries: Peril and Promise, Report of the Task Force on Higher Education and Society, World Bank, Washington DC.

World Bank (2006), Migration and Remittances: Eastern Europe and the Former Soviet Union, World Bank, Washington DC.