

# The Migration of Researchers from Central Europe during the Transition Period

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The article deals with the analysis of specifics of researcher emigration from post-socialist Central European countries to the USA in the context of the discussion on different approaches to the “brain drain” phenomenon and its forms. The extent and structure of researcher migration from Central European countries to the USA are compared to migration from Western European countries using several data sets. The findings show among others that the intensity of researcher migration from Central European countries to the USA was higher than from Western European countries in the early 1990s but it decreased significantly afterwards. Brain waste of highly qualified migrants from Central Europe persists.  
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**Key words:** *brain drain; brain waste; researcher migration; highly qualified migrants; Central Europe; USA*

## Introduction and the Structure of the Article<sup>2</sup>

The aim of this article is to present the results of the analysis of researcher emigration from post-socialist Central European countries to the USA in the context of the discussion on different approaches to the “brain drain” phenomenon and its forms. The analysis is a part of a research project undertaken in the department of Local and Regional Studies of the Institute of Sociology, Academy of Sciences, Czech Republic.

On the basis of secondary data analysis we look in this article for the specifics of researcher emigration from post-socialist Central Europe. The extent, form, and development of migration flow of researchers from selected countries in Central and Eastern Europe – Czech Republic, Slovakia, Poland and Hungary – to the USA are thus analyzed and compared to the migration flow from Western European countries (old EU 15, Switzerland, and Norway).

The article outlines briefly the different approaches to the phenomenon of highly qualified migration, sketches the situation of research in the transition countries, describes the data sources and the methodology of the analysis, and outlines its results.

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# Migration of Researchers and Other Highly Qualified Professionals as an Important Topic of Social Research since the 1960's and the Different Approaches

After the collapse of the socialist block concerns appeared that there would be significant migration outflows of qualified workforce from Central and Eastern Europe (Straubhaar 2000, Gaillard – Gaillard 1998). Gaillard and Gaillard (1998) see the collapse of the Soviet block as a factor causing the rising interest in brain drain in the 1990's. The problem of brain drain is however not new and for a better understanding of the different approaches it must be seen within its historical context.

In the sixties the problem of international migration of qualified workforce, and in particular of researchers, became more visible for academic research and for public policy. The main focus of interest was directed to the emigration from developing countries. Therefore, the topic was seen as a part of the problem of modernization and development of the Third world (Bhagwati et al. 1982, for an actual debate on the problem of economic impact for developing countries see e.g. Straubhaar 2000, Chiswick 2005, Schiff 2005). Simultaneously, the increasing need of highly qualified workforce animated concerns for sufficient numbers of qualified workers in developed countries, mainly in Europe (Moguerou 2006, Mahroum 1998). The problem of highly qualified migration in general is not restricted on the migration of researchers. Researchers represent just a small part of the highly qualified workforce and their migration motives and routes are often specific (Mahroum 2001). Nevertheless they represent one of the central segments of the information society and their presence is therefore essential. The approaches to the problem of qualified migration presented here can be applied on the migration of researchers very well.

A relatively intense migration of researchers and scientists is a phenomenon that has been here for a long time (see e.g. Jalowiecki – Gorzelak 2004: 299f), but in the second half of the 20<sup>th</sup> century it gains important political implications. Two factors were conducive to that: First, the crucial importance of highly qualified experts has risen with the gradual development of knowledge economics. The quality of human capital has come to be one of the fundamental factors of economic prosperity. Second, due to the establishing of educational systems in developing countries human capital has formed there as well. Poor living and working conditions and the discrepancy between qualification and demands of the labour market constitute strong push factors contributing to the brain drain of qualified workforce. The “drain” can be seen as a loss for the country of the person's origin and one of the reasons of persisting global inequalities. The debate on brain drain in this context therefore has an expressive economic scope

(Chiswick 2005, Schiff 2005)<sup>3</sup>. The economic view of brain drain is however not the only possible perspective. Mahroum (2005) emphasizes that the complex problem of international migration of scientists can be better understood in the “sociology of knowledge” perspective. The analysis of the organization of knowledge production and knowledge transfer helps to understand the patterns of mobility (Mahroum 2005: 220).

There are a number of concepts used in the present academic and political debate on highly qualified migration issues which are not easy to distinguish. With unavoidable simplification three perspectives can be differentiated which can also be conceptually specified. In each perspective somewhat different aspects of migration are emphasized, each perspective is associated with specifically designed research purposes, and each perspective implicates specific political approaches to migration regulations. These perspectives can be entitled: “brain drain approach”; “brain circulation and brain exchange approach”; and “knowledge circulation approach”. Table 1 summarizes the main specifics of the individual approaches.

Table 1

	BRAIN DRAIN	BRAIN CIRCULATION, BRAIN EXCHANGE	KNOWLEDGE CIRCULATION
<b>Context:</b>	Strong one-directional, mainly permanent emigration, especially from developing countries	Complex migration patterns between developed countries as well, especially between Europe and the USA	Rising importance of the development of international research cooperation; expanding possibilities of electronic communication
<b>Dominant point of view:</b>	Dominant economic view of the problem	The problem is approached predominantly from the perspective of the quality of national innovation systems	The problem is approached from the perspective of building international research networks and relationships
<b>The role of the expatriate professionals</b>	The expatriate diaspora is understood predominantly as a financial source (remittances, taxes)	Building and evaluation of special policies for the return of expatriate researchers and attraction of foreign researchers	Diaspora and migrating researchers are understood as potential connectors and multipliers of the national research outcomes

The individual approaches can be described in greater detail as follows:

#### Brain Drain Approach

The brain drain approach stresses the one-directional permanent migration of highly qualified people from one region. This situation is typical for the migration

<sup>3</sup> In the nineties another trend of reasoning appeared in the debate on brain drain from the economic point of view called “new brain drain approach”. Its protagonists emphasize that not even high permanent emigration rate of highly qualified experts is necessarily an economic disadvantage, because the possibility of emigration encourages potential students to increase their human capital. In respect to the fact that not all graduates really emigrate can the increased motivation under some conditions balance or outweigh the losses associated with the emigration (Schiff 2005).

between countries with very strong differences in economic, working, living, and political conditions. Countries or regions which researchers emigrate from don’t dispose of effective instruments for keeping their brains at home. The permanent emigration is understood as an economic loss mainly if the public educational costs are taken into account. (Chiswick 2005: 6)

A classical proposal for policies responsive to this situation is the idea of taxing the outflow of human capital (Bhagwati et al. 1982, Wilson 2006). The point is that the earnings of emigrants are not taxed just in the country of their work, but that the country of their origin can cash in on them as well. Other possible gains for the countries of origin are voluntary financial flows from their diasporas, the remittances. In comparison with the state budget they can reach a significant amount<sup>4</sup>.

#### Brain Exchange and Brain Circulation Approach

The brain circulation and brain exchange approach also focuses on the movement of people, but the view is extended to a more complex analysis of migration patterns between individual countries. The movement of highly qualified workforce is not understood as a one-directional process. Individual countries are seen as knots in a global network which experience flood and ebb of human capital according to their attractiveness. The emigration of researchers and scientists doesn’t necessarily mean a definitive loss. Expatriate researchers can be compensated by experts from other countries (brain exchange) and their return with higher competencies gained abroad can be expected (brain circulation). Johnson and Regets (1998) offer the following definition of brain circulation: “a cycle of study and work abroad may be followed by a return to the home country to take advantage of high-level opportunities” (Johnson – Regets 1998: 1). Meyer summarizes the main changes in migration characteristics responsible for the changing approach to qualified migration as follows: “It may be temporary – with occasional returns to the country of origin – rather than permanent; it is multi-directional instead of unilateral; and, being a global movement, it affects developed as well as developing countries. Furthermore, the increased ability to interact at a distance helps maintain umbilical links with regions of origin, in contrast to the past when a break with such a region was often total“ (Meyer 2003:1). Thinking in the perspective of brain exchange and circulation is thus typical for the migration of researchers between developed countries, especially between Europe and the USA. It can be shown that the migration balance is skewed in favour of the USA (e.g. Mogueuou 2006). The situation is however not caused by differences in economic and political conditions. The quality of national

<sup>4</sup> For the economic approach in the research on brain drain issues in Central Europe see e.g. (Baláz et al. 2004)

innovation systems plays a very important role whether we speak about the organizational or intellectual quality or about the research milieu and equipment. Political implications of this approach focus on two main problems. The first is the aim to improve the quality of national innovation systems so that they can compete with excellence centres abroad in the contest for the best brains. The recent German discussion of reforms of its academic systems is very typical for this view (see e.g. Haberkamm – Dettling 2002). The building of the European Research Area as a “cornerstone for European knowledge society” (Commission of the European Communities 2007, p. 1) which shall become a sufficiently competitive and penetrable research environment is a step in the same direction. The second implication is the building of targeted programmes, grants and scholarships to attract the best researchers from abroad. Some of these programmes are focused primarily on the return of native researchers working abroad<sup>5</sup>.

Research activities in the brain circulation and brain exchange approach face several difficulties based on the accessibility of data. It is very difficult to gain reliable data for analyzing international migration of a specific population segment on a broader scale than between two countries. Nevertheless, for the assessment of migration flows in the perspective of brain circulation and brain exchange it is important to see the situation complexly. It is furthermore crucial to have the possibility to follow the movements of people for a longer period. The probability of the return of emigrating researchers could thus be estimated<sup>6</sup>.

### **Knowledge Circulation Approach**

The knowledge circulation approach differs from the others as it doesn't put principle accent on physical mobility of people. It is much more focused on international research cooperation and the reception of foreign research results. The physical presence of researchers is not crucial. The circulation of ideas between individual research institutes is therefore stressed more than the mobility of people between them. The rising importance of this approach is related to the development of electronic communication which makes an easy cooperation possible. It doesn't mean that the mobility of people comes to be unimportant, but its valuation and the perception of its impact are shifting. The mobility of people, permanent or temporary, is one of the most important criterions of the development of cooperation between research institutes and building of

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<sup>5</sup> See e.g. the European Marie Curie reintegration grants, the German project Gain ([www.gain-network.org](http://www.gain-network.org)), the Austrian project Brainpower Austria ([www.brainpower-austria.at](http://www.brainpower-austria.at)). The common aim of these projects is the creation of opportunities for the return and reintegration of native researchers.

<sup>6</sup> Recent survey on International Mobility of Doctorate Holders conducted in many OECD countries may offer some interesting internationally comparable data for this reason. The focus on doctorate holders means, however, that the population of researchers won't be involved sufficiently.

international teams. „Mobility is not an end in itself, but an instrument by which research results can be optimized” (EC 2001).

The diaspora of researchers living abroad also plays a new role in this approach. The focus is not on remittances anymore, but on the possibility to arrange international contacts. The members of the diaspora can become the connecting link between their country of origin and their current place of work (Meyer 2001). Political implications of the knowledge circulation approach include the effort to encourage cooperation with diaspora researchers through creating occasions for meeting (physical or electronic)<sup>7</sup>; the intensification of international cooperation of national research institutes; the building of connections between them and centres of excellence abroad; and the creation of an open organizational environment (Mahroum 2000: 375).

Social research in the perspective of knowledge circulation connects the analysis of physical migration of researchers with the analysis of the intensity of cooperation and information flows between individual institutes or firms, and searches for the influence of these connections on research performance (e.g. Mahroum 2000).

### **The Specifics of Central European Context**

The migration extent and structure are influenced by a number of factors. Political and economic factors belong to the most important. Recently two important events have shaped the international migration of researchers from central Europe. The most important one is the EU enlargement which has removed some administrative barriers of migration from Central to Western European countries. The tightening of security measures for migration to the USA has changed the migration patterns to the USA.

In the second half of the 20<sup>th</sup> century the conditions of totalitarian states in Central Europe has caused specific patterns of migration of human capital and especially of researchers from Central Europe, because of specific migration motives and opportunities under the conditions of the totalitarian states. In addition to economic motives and work-related motives the political migration appears as an important factor even though for the majority of migrants it cannot be considered as predominant. An explicit differentiation between these two motives is not possible, because in individual cases both motives are mixed. (For the Czechoslovak context see Nešpor 2002: 46f.)

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<sup>7</sup> Creating networks among the diaspora researchers and researchers at home and providing the diaspora with information on the situation of research at home is a common practice. See e.g. the different national networks of researchers working abroad or the ERA-link – a network of European researchers working in the USA (<http://cordis.europa.eu/eralink>). Some complex national policies, such as the project Brainpower Austria stress the creation of contacts as a second aim besides the return of researchers from abroad.

Institutionalized migration opportunities were marginal in Central Europe and in some cases the emigration itself was an illegal act. It's not the aim of this text to analyse the individual migration waves, but it is extremely important to concentrate on the turning point in 1989. With regard to the political conditions migration of researchers from Central Europe necessarily has a two-stage character. The form of the migration in the nineties differs strongly from the earlier migration (e.g. change of destinations, expansion of short-term stays, development of student mobility, development of international intra-company mobility). It is, however, uncertain how the political changes influenced the total volume of migration in a short-term and long-term view. The fade-out of political motives for emigration could mean the reduction of motivation for migration, but at the same time migration opportunities developed very strongly.

There are several push/pull factors often mentioned as being responsible for the intensification of qualified migration flows. They can be divided according to economic factors (expected income differences, labour market conditions); political factors (political stability/instability, security, individual rights); and factors resulting from the structure of national innovation system (working conditions, endowment, existence of research centres, publication possibilities, educational system etc.) (see e.g. Mogueurou 2006: 4). It can be shown that Central European countries score on average worse than Western European countries (the old EU fifteen) in many of the factors mentioned above, so fears of brain drain of researchers from these regions could seem well-reasoned (see Gill 2003).

There is yet another factor which could intensify the brain drain – the existence of an established and relatively well-funded research sector in many countries of the socialist bloc in the eighties followed by a decline in funding and personnel at the beginning of the nineties. The people released from the shrinking research sector constitute an important group of potential emigrants who are highly qualified.

Massive emigration (long-term or permanent stays) of highly qualified people could influence negatively the transformation process and worsen the competitiveness of the region. (For an overview of the discussion on the impacts of qualified migration on sending and receiving countries see (Regets 2001).) It is however difficult to assess the critical extent and form of emigration which can cause important problems. The migration of researchers cannot be understood as a definite loss for the country of origin. Only in case the extent of emigration is significantly higher than the extent of immigration and the return rate is low, is the situation problematic.

Of course, it is difficult to generalize and to speak about post-socialist Central European countries altogether, because there have been important differences in their various research situations (Gill 2003). In spite of that, the countries of this

region face a number of similar conditions today – relatively low economic conditions in relation to Western Europe and the USA, relatively low funding of research, and the lack of centres of excellence. For that reason and because of some methodological reasons we have decided not to distinguish between individual countries in the analysis, and to focus on the region as a whole.<sup>8</sup>

Unfortunately, the hypothesis on migration outflows of highly qualified professionals from Central Europe and on the possible risks can not be firmly documented by empirical works due to limited data sources. There are not many empirical studies concerning the migration of researchers and professionals from Central Europe (see e.g. Gerold (ed.). 1997, Gill 2003, Jalowiecki – Gorzelak 2004, Williams – Baláž 2005, Vavrečková 2006). In some studies this migration is analyzed as a part of total European migration (e.g. Ackers 2005, 1999, Mogueurou 2006).

Some studies stress that the major part of personnel losses in the research sector in the transition period consists of the “internal brain drain” – leaving for other types of jobs not for another country (Marešová et al. 1997, Vavrečková 2006).

The studies mentioned above use different methods for analyzing the highly skilled migration, but they don't offer the possibility to analyze the development of migration extent and its structure, because the findings are based mostly on unrepeated surveys.

### Design of the Analysis

The aim of our analysis is to uncover the development and the structure of the migration of researchers from the post-socialist Central Europe to the USA. It was however not our goal just to analyze the absolute extent of migration, but to assess whether the significant conditions of Central Europe evoke specific migration patterns. For this reason we adopted a comparative approach and compared the extent and structure of migration from Central Europe to the extent and structure of migration from Western Europe. Without this comparison specifics and potential difficulties for the Central European region can not be evaluated firmly.

Due to the lack of data sources making a reliable comparison of total migration outflows impossible we focused on migration to the USA. According to (Gerold (ed.) 1997) the USA represents the main destination for researchers from Central

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<sup>8</sup> As an anonymous reviewer remarked, the summing of the Central European countries together could result in loss of details, because migration patterns perhaps differ among these countries. This remark is highly legitimate because the used data show really somewhat different migration extent for individual CE countries. The highest share of researchers living in the USA is for Poland and the lowest for the Czech Republic and for Slovakia. It is unfortunately impossible to distinguish between the Czech Republic and Slovakia, because these two countries are counted together in the data set. The number of researchers from individual CE countries is however not sufficient enough for more detailed reliable analysis. On this account we have summed these countries together in our analysis.

Europe. It is nevertheless obvious, that the ignorance of other mainly Western European destinations limits the results.<sup>9</sup>

Our analysis of migration outflows of researchers from Central Europe corresponds mostly with the brain drain approach. The basis of the analysis is formed by the emigration of researchers from one region to another. The alternative perspective of brain exchange and brain circulation is just marginally implemented. This fact (caused mainly by the lack of accessible data) partly limits the results. On the other hand, the analysis builds a solid base for further research.

There are two basic problems in analyzing international migration of researchers and scientists. The first problem consists in the lack of available and reliable data sources. The other difficulty is the conceptual problem of defining and operationalising research activities. Our solution of these two challenges will be shortly described below.

### Data sources

There are several data sources used by migration researchers for analysing the patterns of highly qualified migration. All of them have important deficiencies:

#### 1. National censuses or micro-censuses

Not all censuses contain information necessary for analysing the migration precisely. But if the detailed education and occupation, nationality, country of birth, and the date of entry to the country for foreigners are included, reliable data can be gained. The low frequency of censuses (usually 10 years) makes the creation of a more detailed time series difficult.

#### 2. Statistics of research workers

Annual censuses of people employed in research and development sector according to the Frascati Manual<sup>10</sup> of OECD are a part of the agenda of statistical institutes in most EU countries. Unfortunately, these censuses don't include the information on the nationality of the researchers and other necessary information. For that reason they can only play a marginal role in assessing the extent and form of migration.

#### 3. Immigration and visa statistics

<sup>9</sup> The problem would be serious if it emerged that while WE researchers have only one meaningful destination – the USA (or perhaps two if Japan is considered); the CE researchers have more potentially interesting destinations – the Western Europe. If it is true, our comparative analysis of migration outflows to the USA cannot be generalized on migration outflows in general. On the other hand it seems probably that even for WE native researchers migration in another WE country is very often attractive. By means of the Database on immigrants and expatriates (OECD 2005) we can show that if we observe CE native highly qualified migrants (with tertiary education) who live in the USA or in WE, we can see that about 50% of them live in the USA. For WE native highly qualified migrants this share is usually about 30%-50%. It seems therefore rather improbable that the USA is a more dominant destination for qualified migrants from CE than from WE. In spite of that our findings shouldn't be overgeneralised.

<sup>10</sup> The Frascati Manual (OECD 2002) proposes standard practices for surveys on research and experimental development in the OECD countries and builds a common base for their statistical institutes.

Immigration and visa statistics are usable where visa requirements exist or where other immigration statistics are collected. This is the case of work related stays between Europe and the USA. Mobility among European countries can not be analyzed in this way. Immigration statistics have a great advantage in comparison to censuses, because they cover the annual number of entries to a country, not the whole foreign residing population. Nevertheless, these statistics suffer from the lack of data on exact occupation and education (see Office for Immigration Statistics 2005).

#### 4. Databases of foreign diasporas

Databases of foreign diasporas exist in a few countries (e.g. Italy – Database of Italian Residents Abroad – AIRE). Unfortunately, they don't cover the emigrated population sufficiently (Becker et al. 2003).

#### 5. Statistics of grant and scholarship organizations

Data sources of this kind only cover a small part of migrating researchers<sup>11</sup>.

#### 6. Sample surveys

Surveys can not serve as a data source for the estimation of the extent of international migration, they can nevertheless grant detailed information on motives and behaviour of migrating researchers. See e.g. (Jalowiecki – Gorzelak 2004, Backhaus et al. 2002, Fontes 2006).

The analysis of the migration of researchers always challenges a conceptual problem. It is very difficult to find a definition of research activity, because it is not simple to distinguish research from related activities with a scientific and technological base. It is furthermore not easy to operationalise the definition for research purposes.

There are two fundamental ways of defining research activity. The first way is subjective and it is based on the assessment of individuals themselves, whether they conduct research work in their job. The National Survey of College Graduates (NSCG) in the USA contains information of this character. The respondents are asked about work activities which occupy at least 10 percent of their time during a typical work week, and about work activities which occupy most hours of their typical work week. Basic research, applied research, and experimental development are included in the list of possible activities. Researchers can be defined as people indicating that research activities are either a part or the main part of their work.

The other definition – objective – is based on the evidence of research institutes, organisations, and their personnel by an external evaluator (research

<sup>11</sup> For an attempt to use these data sources for analyzing the migration of researchers from Germany to the USA see Wissenschaft Weltoffen (www.wissenschaft-weltoffen.de).

personnel surveys according to the Frascati Manual) or on the evidence of research outputs. Publications in professional journals or patent applications are considered as indicators of active research work (Fontes 2006). Another possibility is the predefining of research occupations and educational levels. Using occupation and education as indicators of research work is not easy, because the International Standard Classification of Occupations (ISCO) and related classifications which are used in most censuses don't contain a specific category for researchers. Nevertheless, a careful combination of information on occupational and educational characteristics can bring important results. Occupation and education are variables included in most census data, so their combination offers a relatively wide usable indicator<sup>12</sup>.

With regard to the difficulties mentioned above we decided for the following approach:

The aim is to compare the population of European researchers living in the USA to the population of European researchers at home and the development of these two populations. This comparison is the base for the analysis of researcher migration.

There are no fully comparable data on these two populations; we had to use data from several different sources. This factor limits the reliability of our analysis.

The analysis is based on the following data sources:

Data sources for the population of European researchers living in the USA:

- USA Census 2000, microdata, 5% data file
- National Survey of College Graduates, 2003 – An extensive survey of college graduates in the USA containing information on career and research activities. This is a unique data source for studying the population of researchers in the USA, but due to the limited extent of the sample (100 402 respondents) the absolute numbers of respondents from individual European countries are small. Furthermore, the sample includes only people settled in the USA for at least three years, so short term visitors are excluded from the analysis.

Data sources for the population of researchers in European countries:

- The results of research institutes and research personnel surveys in European countries according predominantly to the Frascati Manual

<sup>12</sup> The definition of Human resources in science and technology (HRST) according to OECD is a typical indicator combining educational and occupational characteristics. However, its definition is very extensive. Graduates and/or people employed in the ISCO occupational category 2 and 3 are included. The indicator for researchers must be more specific.

Accessible data sources for the USA (Census 2000 data files and NSCG 2003) contain detailed information on the occupation and education of the respondents. Therefore, we decided to use a definition based on these two variables. It was necessary to specify “researcher occupations” and the role of education. Typical “researcher occupations” according to the Frascati manual (OECD 2002) are occupations of the ISCO<sup>13</sup> category 2 – professionals; and category 1237 – research and development managers. Certainly not all people in these occupations are researchers. The ISCO category 2 contains several types of occupations. It can be divided in the following way: Scientists in the narrow sense of the word (chemists, physicists, sociologists etc.), engineers, health professionals, teaching professionals, and other professionals (architects, legal professionals etc.). We regard the following people as researchers: Scientists in the narrow sense of the word with at least a master's degree<sup>14</sup> (ISCED 5)<sup>15</sup>, postsecondary teaching professionals with at least a master's degree, selected other professionals (historians etc.) with at least a master's degree, engineers and health professionals with a PhD degree (ISCED 6).

The data sources for European countries are based on surveys of research institutes and their personnel.

The comparability of the two different data sources and definitions was controlled in the following way. We have compared the total number of researchers in the USA according to our definition with the official number of USA researchers according to the OECD Frascati manual outlined in Eurostat. The results of this comparison are shown in Table 2.

**Table 2: Stock of researchers in the USA according to OECD and the definition combining occupation and education**

USA researchers FTE <sup>16</sup> according to OECD, 1999	1261226
USA researchers (combination of occupation and education), 2003	1557691

Sources: NSCG 2003; Eurostat

The OECD figure for the USA is only available for 1999 and in FTE. The total number (head count) of researchers in 2003 should therefore probably be slightly

<sup>13</sup> Neither the USA Census 2000 nor the survey NSCG classify the occupations according to ISCO, but the transformation of their occupational classifications to ISCO was relatively well possible.

<sup>14</sup> With the exception of some types of computer and information scientists (database administrators, support specialists etc.) who usually don't conduct research work.

<sup>15</sup> ISCED – International Standard Classification of Education. ISCED 5 (Master's level) and ISCED 6 (PhD level) are important for our purposes.

<sup>16</sup> FTE – Full Time Equivalent. The total number of employees carrying out research and development activities is recalculated in the equivalent of full-time jobs.

higher. The figures show that the number of researchers according to our definition doesn't differ dramatically from the OECD number.

It is obvious that the comparison must be made very carefully and that the results will be rather estimative. There are nevertheless no other usable exact data on international research migration.

Not all people in the category "researcher" born in Europe and working in the USA were included into the analysis – only people who entered the USA at the age of 20 or older. It means that people who came to the USA as children are not part of this group, because their migration can not be considered as migration of researchers.

### Results of the Analysis

Table 3: The dynamics of the population of European researchers in the USA

Region of origin	Number of researchers in the USA in 2000	Number of researchers at home in 2000	The population in the USA in relation to the population at home
Central Europe	9225	161977	5,7 %
Western Europe	61520	1486660	4,1 %

Source: USA Census 2000, 5% sample; Eurostat; our own calculations

According to Table 3 the share of expatriated researchers from Central Europe is higher than the number of expatriated researchers from Western Europe. The table doesn't show, if the difference arose in the 1990's or earlier. Moreover, the table doesn't contain information on the development of the population of researchers in the countries of origin which can be very important. We therefore include Figures 1 and 2 which show the development of the number of researchers in Europe.

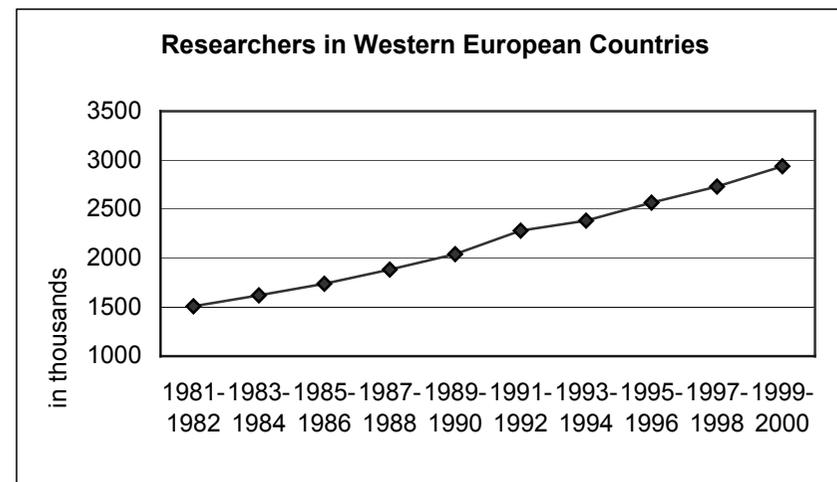
Figures 1 and 2 show the development of the population of researchers in Central and Western European countries since the 1980's. The shrinking number of researchers in Central Europe during the 1980's and in the first half of the 1990's contrasts with the gradual growth in Western Europe. This contrast is very important for the interpretation of Table 3. It seems probable that the higher share of researchers from Central Europe in the USA is not the result of a more intensive emigration, but of the fact that the researcher population in Central Europe in 2000 was smaller than in the past.

Figure 1



Source: Eurostat; Statistical yearbooks of the individual countries; our own calculations<sup>17</sup>

Figure 2

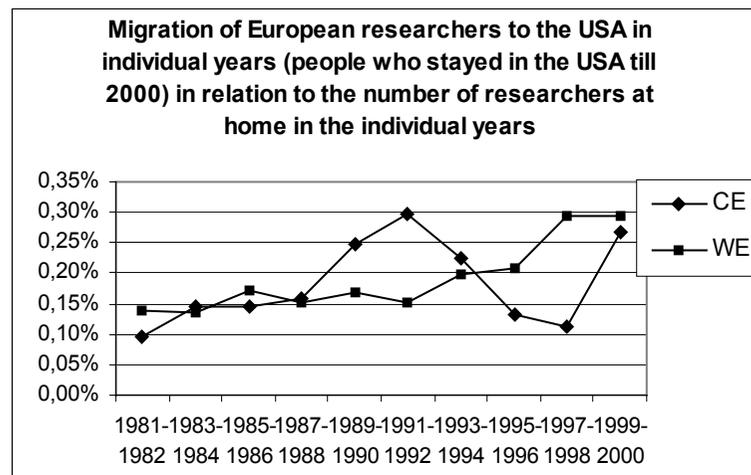


Source: Eurostat; our own calculations

<sup>17</sup> The national methodologies for statistical surveys on research personnel differ slightly and many European countries adopted the unified Frascati methodology during the 1990s. The former data (1980's and the first half of the 1990's) are therefore based on our estimates and calculations with the use of National Statistical Yearbooks and Eurostat tables.

Figure 3 contains more detailed information which relate the number of people who went to the USA in individual years to the number of researchers at home in those years.<sup>18</sup>

Figure 3



Source: USA Census 2000, 5% sample; Eurostat; Statistical yearbooks of individual countries; our own calculations

Figure 3 shows the development of migration intensity from Europe to the USA. The figure doesn't show the total number of entries to the USA in individual years, just the number of people who came to the USA and have stayed there till 2000 (the census year). The increasing numbers of entries don't therefore necessarily mean rising migration, because people leaving the USA before 2000 are invisible for the analysis. Nevertheless, it seems obvious that despite the migration barriers in the 1980's rate of permanent or long term migration of researchers to the USA was almost the same from Central Europe as from Western Europe. In the first transformation period (1989-1994) after the fall of the Iron Curtain the emigration of researchers from Central Europe increased, reached its peak in 1991-1992, and was significantly higher (3% from Central Europe vs. 1,5% from Western Europe) than emigration from Western Europe. In the second period, the emigration from Central Europe descended rapidly and was even lower

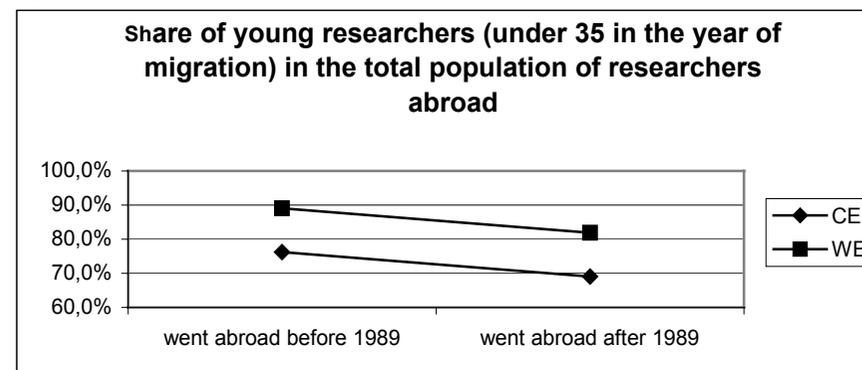
<sup>18</sup> The comparison of number of people who went to the USA in individual years with the number of researchers at home in those years is more appropriate than to compare the number of people who went to the USA with the number of researchers at home in a later fixed year (e.g. in the year 2000) as we did in the initial stage of the analysis (Kostecká – Bernard – Kostecký 2007). The problem is however, that it is necessary to rely on estimates because there are no reliable and comparable data available on researchers in European countries in more remote years.

than the migration from Western Europe. A possible explanation of this effect could be the sudden elimination of migration barriers after the fall of the communist regime and fast catch-up of formerly restricted migration possibilities. After some years of extended migration, the situation calmed down.

Available data makes the analysis of the structure of the population of expatriate researchers possible. For our purposes the career stage and especially the research productivity of European researchers abroad are essential.

The career stage of researchers going abroad is an important aspect of brain drain. Massive emigration of established scientists has other reasons and consequences than the emigration of young scientists. We have thus analyzed the portion of researchers who in the year of their first entry into the USA were younger than 35 years.

Figure 4



Source: USA Census 2000, 5 % sample

Figure 4 outlines the share of young researchers in the total emigration of researchers to the USA. It is obvious that the USA is an attractive destination mainly for younger researchers. The share of them is about 70-90 percent. The decline of this share in the 1990's (statistically significant,  $p < 0,05$ ) can hypothetically be explained by the invisibility of short-term stays in the earlier migration. The decision for a long term stay is more probable for young migrants, therefore the share of young migrants (age of migration) is higher for migration before 1989. It is nevertheless obvious, that in the Central European region, the share of young researchers is not as dominant as in Western European countries (statistically significant,  $p < 0,05$ ). The difference made about 12% in the 1990's.

The productivity of researchers is a crucial aspect of brain drain. The migration of researchers is probably a highly selective process. Among others the criteria of

funding organizations play an important role in the process of selection. The impact of brain drain on the countries of origin would be deeper if the population of expatriates consisted of the brightest professionals.

It is extremely difficult to measure the productivity of research work as there are no reliable indicators for that. One possibility would be to use bibliographical data from international citation databases or patent applications (see Fontes 2006), but this information cannot be connected to anonymous data in the survey samples. We must therefore rely on information about the number of published articles, papers, and patent applications acquired from the researchers in the NSCG 2003 survey.

For the purpose of our analysis we compared the average number of articles published in the years 1998-2003 by researchers born in Central Europe (CE) and Western Europe (WE), and the portion of researchers who in the same five years proposed a U.S. patent. The results are summarized in Tables 4 and 5.

**Table 4: Number of articles in reviewed professional journals in 1998-2003**

	WE		CE	
	Entry to the USA before 1989	Entry to the USA after 1989	Entry to the USA before 1989	Entry to the USA after 1989
0	42%	24%	37%	20%
1-5	28%	40%	23%	46%
6-20	22%	28%	30%	34%
21+	8%	8%	10%	0%

Source: NSCG 2003

**Table 5: Share of researchers with US patent proposals in 1998-2003**

	WE		CE	
	Entry to the USA before 1989	Entry to the USA after 1989	Entry to the USA before 1989	Entry to the USA after 1989
NO	88%	79%	72%	79%
YES	12%	21%	28%	21%

Source: NSCG 2003

The differences in numbers of articles show an interesting tendency. Researchers who emigrated before 1989 are significantly ( $p < 0.05$ ) less productive than their colleagues who emigrated later. The main difference lies between the categories “0 articles” and “1-5 articles”. The portion of researchers who didn’t publish any articles is about twice as high among emigrants who came to the USA

before 1989 than among emigrants who came after 1989. A possible explanation for this fact offers the age and the career stage of the emigrants. Later emigrants were younger in the year of the survey and more often in an early stage of their career. Early career stages are considered to belong to the most productive phases in many fields. The differences between researchers from CE and WE are not statistically significant.

Table 5 offers another picture. The share of patent proposals of WE researchers is almost twice as high for researchers who emigrated after 1989 than for earlier emigrants. The case is contrary for CE researchers. The share of patent proposals is smaller for later migrants. The situation of WE migrants is thus similar to the case of published articles. The specific situation of CE migrants can have two explanations: First, the earlier migration was dominated by technically oriented researchers who have had more patent proposals. Second, the earlier migrants who left CE before 1989 are generally more productive than their younger colleagues. Reasons for this fact could be found in the specific critical situation of first rate researchers under the communist regime and the high share of them in the expatriate population.<sup>19</sup>

In general it seems that there are no important differences between the productivity of expatriate researchers from Western and Central Europe. This doesn’t mean that brain drain is not a selective process. But it is probably not more selective in Central European post-socialist countries than in the countries in Western Europe.<sup>20</sup>

The lack of data makes the analysis of the probability of return in the migration of researchers very complicated. In some papers return intentions of expatriate researchers are highlighted (e.g. Backhaus et al. 2002). The main deficiency of this approach is that there is no certainty whether the intention really will be followed by a return. Return decisions (and migration decisions in general) depend on a complex set of factors. Some of them are situational. The relationship between a general intention to return and the return act is therefore complicated.

In our paper we have chosen another way of analysis. The data on US visa recipients offer some interesting and surprising insights into this problem. We have compared data about the number of recipients of US H1B visa<sup>21</sup> with the

<sup>19</sup> One more argument considering the more patents from CE researches entering US before 1989 issue was proposed by an anonymous reviewer: Due to the restrictions under the communist regime it was much more favourable to apply for a patent in the West (i.e. a very restricted or nonexistent profit for the proposer of the patent under the communist law could pose an explicit motivation for migrating and proposing the patent in the West.)

<sup>20</sup> Problems with the vague definition and problematic operationalisation of research work are unfortunately very influential here. As publications in professional journals are very typical for researchers and rather unlikely for other similar occupations, the results may be distorted through an inappropriate definition.

<sup>21</sup> For the purposes of our analysis data from Statistical Yearbooks of the Immigration and Naturalization Service were analyzed. H1B visa are assigned to workers with specialty occupations. Researchers are a small part of them. Certainly not all H1B visa

data of the total number of entries of these visa holders to the US in a year. As a result we can compare the average number of entries of individual visa recipients from different regions to the USA in one year. In Table 6 the results for individual visa recipients from CE and WE are summarized.

Table 6: H1B Visa holders

	2000	2001	2002
	Number of H1B visa recipients		
CE	1736	2037	1767
WE	22478	27462	21028
	Entries of H1B visa recipients to the USA		
CE	2870	3244	3481
WE	94065	96203	96569
	Average number of entries pro person		
CE	1,7	1,6	2,0
WE	4,2	3,5	4,6

Source: Statistical Yearbooks of the Immigration and Naturalization Service, 2000, 2001, 2002

The average number of admissions to the USA of H1B visa recipients from WE is more than twice as high as that of CE visa recipients. WE visa recipients more often leave the USA temporarily and come back again. The data doesn't contain the information saying which country the people visit, but it is very probable that most of them visit their country of origin. If our premise is true it would mean that the personal contact with the country of origin is more intensive for WE visa recipients. They have more opportunities to visit their country of origin. A regular contact with the situation at home is however an important factor of decision to return permanently. The low rate of home visits, caused possibly by financial reasons, can be potentially dangerous and can result in low return rates of CE expatriate researchers.<sup>22</sup>

The last part of the analysis focuses on the problem of "brain waste". The problem of brain waste is closely linked to the migration of researchers. It is not unusual when highly qualified people work in less qualified occupations after the

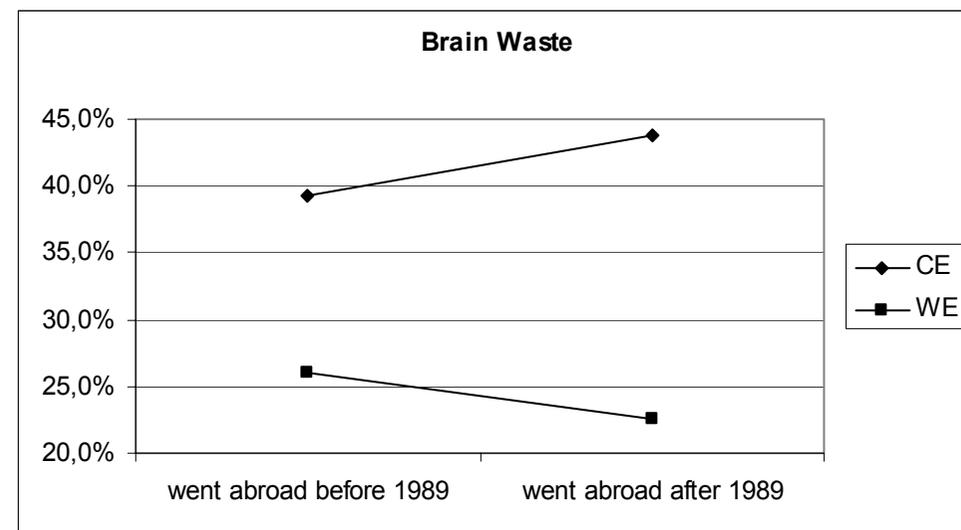
recipients are researchers and there are many foreign researchers in the US with other types of visas. For a comparison of the number of entries to the US these data are nevertheless instructive.

<sup>22</sup> An alternative explanation would offer the network approach to migration which emphasizes social relations and social networks as factors explaining migration patterns. The lower frequency of home visits for CE researchers can be caused by the fact that they tend to migrate more often with their families or that they integrate more easily in emigrant social networks abroad. These hypotheses cannot however be verified on the base of the accessible data.

migration. This situation is more common for migrants from developing countries. Unfortunately, it is very difficult to assess the extent of "brain waste", because for a reliable evaluation information about the situation of a person before and after the migration is necessary. This information is not included in the data we have worked with. For an estimation of the extent of brain waste, we had to use another indicator. We have analyzed the number of emigrants with tertiary education working in occupations that don't require this level of qualification<sup>23</sup>. Of course, the extent of brain waste according to this indicator is not the extent of brain waste of researchers. We suppose however, that these two types of brain waste are correlated<sup>24</sup>.

The results of the brain waste analysis are outlined in Figure 5. It is obvious that the problem of brain waste is more important for qualified migrants from the CE region and that this problem increased slightly during the 1990's.

Figure 5



Source: USA Census 2000, 5% sample

Almost one half of qualified migrants from CE work in less qualified occupations in the USA. It is almost a double portion in comparison with

<sup>23</sup> SOC classification of occupation used by the US Census, categories 400 and more.

<sup>24</sup> This measure of brain waste is more reliable for long term stays. Williams and Baláz (2005) show in their study, that the apparent brain waste for short term stays of young Slovaks in the UK is very often rather "brain training" and means the acquisition of new competences.

emigrants from WE. It seems difficult to find reasons for this important difference between CE and WE. In our view, the income differences between CE and WE are a probable explanation. The income gap between the USA and CE is much higher than between the USA and WE. Migration driven by income expectations is therefore much more important for migrants from CE than from WE. A big part of these migrants is ready to accept less qualified occupations, because the income conditions are still better than in their country of origin<sup>25</sup>.

What does it mean for the migration of researchers? If the general brain waste is so high, we suppose that the brain waste of researchers should be of considerable extent as well. It means that there are many researchers who have emigrated to the USA and who do not work in research occupations after the migration. These researchers are invisible for all previous analysis. We can suppose the analyzed extent of brain drain to be underestimated. Unfortunately, the size of the underestimation is unknown. It is probably significantly higher for CE than for WE. The extent of researcher brain waste could be estimated by means of an extensive survey among emigrants, it would be nevertheless very complicated to get an appropriate sample of them.

### Conclusions

- The relative number of Central European native researchers in the USA is slightly higher than of Western European native researchers.
- The development of the migration proceeded in two stages in the 1990's. In the first five years, the relative emigration from Central Europe was higher than emigration from Western Europe; in the second stage it was lower.
- The structure of the population of emigrated researchers differs in several aspects. The main difference concerns the age of the emigrated researchers. The portion of researchers who emigrated between the age of 20 and 35 is lower for Central European countries.
- Differences in research productivity between researchers from Central and Western Europe are only hypothetical and the quality of our data doesn't allow a reliable comparison.
- The problem of brain waste seems more serious for CE countries, although it occurs in the population of WE emigrants as well. This finding partly questions the other results of the analysis, because the number of

<sup>25</sup> The same can be true for researchers who have found qualified occupation outside of research environment in the USA. The share of them is unknown. It seems probably that the share of them could be higher for researchers from CE, because the shrinking research sector in the 90s caused an extensive "internal brain drain" – many researchers searched for other type of job in the Czech Republic. It is probably that a number of them moved abroad afterwards.

former researchers working after the migration in other occupations couldn't be analyzed.

In general, although the push factors in Central Europe are relatively strong, the emigration of researchers to the USA was in the second half of the 1990's not higher than emigration of researchers from Western Europe. Alternative theoretical approaches for explaining migration (institutional approach, network approach) could be of greater relevance for this phenomenon. As stated in the chapter "Design of the analysis", these findings shouldn't be overgeneralised to the overall migration outflows, because we don't know a lot about the migration to other destinations. It is not clear (and it cannot be found out reliably on the base of accessible data) if migration patterns to WE countries differ significantly from migration patterns to the USA.

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