

BRAIN DRAIN FROM BULGARIA BEFORE AND AFTER THE TRANSITION TO DEMOCRACY¹

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ABSTRACT

Scientific outmigration or 'brain drain' from Bulgaria has increased considerably after the downfall of communism in 1989. The problem is exacerbated by the lack of reliable estimates of both the real extent of the phenomenon and the factors that contribute to it. The present study utilizes data sets from two large surveys of potential emigration of scientists and engineers in the capital Sofia. The first contains data collected shortly before the events of 1989 (n=1,017), and the second has comparable information four years after the transition (n=711). Disposition among scientists and engineers to leave Bulgaria and work abroad has not changed substantially between 1989 (10%) and 1993 (12%). What differs is that several waves of brain drain have altered the age structure of R&D manpower. Findings from several OLS multiple regression models using the 1993 data reveal that potential emigration is positively affected by being male, knowledge of English, and assessment of the 'Panov Law.' Among the predictors that have a negative effect on potential brain drain are utilization of scientific results, evaluation of the general perspectives for Bulgarian science, and standard of living. The slow speed of reforms and low salaries are the leading reasons for the decision to emigrate. U.S.A. is the preferred destination for long-term employment abroad.

INTRODUCTION

From the point of view of the future democratic development of Bulgaria as a modern European nation it is of great, if not vital, importance to preserve the creative research and development manpower potential. Limiting this capacity could have tragic long-term consequences for the country. Regrettably, scientific emigration has increased considerably after the democratic events in 1989 due to continued political instability, the slow pace of economic reform, cuts of funds and personnel in research institutes and universities (tightening of the labor market) and, of course, greater openness. The Minister of Science and Higher Education Prof. N. Vassiliyev said in interviews in a popular newspaper ('24 chasa') and in a popular science journal ('Nauka i obshtestvo') in February 1992 that in 1990, 7,000 people and in 1991, 5,000 Bulgarians (total of 12,000) with scientific degrees or holding scientific tenure emigrated. This is undoubtedly false because only 30,000 people have scientific degrees or position in the country. It however underlines two important things. First, the government is really worried by the brain drain which is obviously taking place. Second, there are no hard data to estimate the real extent of the phenomenon or the factors that determine it.

This research aims to overcome the lack of systematic study of this phenomenon by providing empirical description and analysis of emigration trends, changes in living and professional conditions in Bulgarian science after 1989, their perception on the part of researchers, and formation of readiness to emigrate, or potential emigration.

THEORETICAL FRAMEWORK AND PAST RESEARCH ON BRAIN DRAIN

Brain drain is usually a label used to describe the emigration of highly qualified and otherwise talented professionals from one country to another. It is a part of the broader process of international migration (emigration, or outmigration typically is the process viewed from the donor country's standpoint, while immigration is the reciprocal view from the recipient country's standpoint). There are two broadly conceived approaches to defining emigration - the legal and the statistical. The first classifies as emigrants persons who formally change their legal status (i.e., acquire new citizenship or at least permanent residency). The second uses the factual presence or absence of individuals as an indicator of emigration.

The UN definition of emigrants envisages persons who settle permanently in a foreign country or reside there for a period longer than one year. This is considered the best way to establish factual (or real) emigration especially in demography.

Potential emigration, although largely debatable as a concept, is often understood as related to a declared intention or desire to reside for a longer period outside the home country (Y. Kaltchev, S. Tsvetarsky, 1991:5).

It is justifiable from the point of view of the present study to regard as potential emigrants researchers who either express intention or desire to leave for a foreign country, or who are absent at the time of study, for a period longer than six months. The extreme case of this is when potential emigration is combined with horizontal mobility, i.e. when

someone looks for a job irrespective of his qualification or is concerned with getting permanent residence in a foreign country on any conditions (i.e. even without practicing his or her profession).

Emigration as a more general concept is treated in the literature (see H. Domozetov et al., 1990) as a process consisting of three phases:

1. Formation of disposition to emigrate.
2. Decision-making after assessment of the situation.
3. Execution of emigration behavior.

The last stage will not be considered in the analysis since it marks (either when formally applying for change of citizenship or when extending the stay over one year) the transition to actual emigration.

The broadest scheme to be employed is the "push-pull" theory, or the explanation of scientific emigration as being caused by both repelling factors in the country of origin and attracting factors in the more developed country of destination. More concretely A. Portes's conceptual framework, which incorporates "push" and "pull" determinants of brain drain and macro and micro levels of analysis, constitutes the theoretical basis of the present research. Portes distinguished three types of determinants of brain drain: 1/ primary (pull factors from the recipient country); 2/ secondary (push factors from the donor country); 3/ tertiary (individual decision factors - professional achievement, life situations, etc.). The first two operate on a macro, while the last - on a microlevel (Portes, 1979). Emphasis in this paper will be put on tertiary determinants, although descriptive statistics about primary and

secondary factors will be used as supplementary explanatory resource. The study focuses mainly on push factors (i.e. conditions within the donor country that facilitate emigration). The single "pull" indicator to receive closer scrutiny will be the orientation of potential emigrants to a particular country.

The phenomenon of brain drain has been extensively studied, especially in the 1960s and 1970s, mainly because of concern that the lag between developing countries (the typical 'donors') and industrialized nations (the usual 'recipients') might be widening. These studies have dealt with other than Eastern European migrant flows of professionals or students. The bulk of the research focuses on immigrant researchers and students in the U.S.

Fortney provides a comprehensive description of the historical inflow of outstanding professionals in USA up to the early 1970s. She delineates four distinct periods, out of which the most beneficial for the development of American science was the time span from 1930 to 1941 associated with the escape of many brilliant scientists from the excesses of Fascism (see Fortney, 1972:51-53). She also pays attention to an important factor for regulating immigrant flows of highly skilled persons - the changes in immigration legislation of the recipient country.

The studies of brain drain in the past demonstrate the diversity of factors and influences on the process, as well as the difficulties of trying to encompass separate migrant flows under a common theory. Despite this, some broad explanatory schemes have emerged. For example, it is widely accepted that there are two groups of stimuli - "push" and "pull", which interact on the decision to emigrate. As Lakshmana Rao points out, these refer to

differentials between the country of origin and the country of destination in terms of salary levels, wage structures, logistical support, political and institutional stability, opportunities for mobility and change (Lakshmana Rao, 1979:5).

What most of the empirical studies seem to converge on is the stronger effect of "push" factors, the main of which is the internal structural imbalance in the donor country - it educates more professionals than the economy or the job market can absorb. Thus Portes, citing several sources, concludes that the case of Argentinean doctors, scientists and engineers speaks of a tension, which amounts to training more professionals than the current development of the country can accommodate (Portes, 1976:497-499). Analyzing data from a UNITAR multi-national comparative study of students, stay-ons and returnees from a number of developing countries, educated in the U.S., Canada and France Glaser and Habers come to a similar conclusion about "...imbalances between the educational system and the economy, so that the number of professionals outstrips opportunities, will result in many departures"(Glaser and Habers, 1978:50). Interestingly enough, the same authors provide compelling statistical evidence of the erratic relationship between economic development (measured by GNP per capita and annual growth rate) and brain drain - the pattern is irregular and does not support previous views that the less developed the country the greater loss of professionals it will experience (Glaser and Habers, 1978:29-33). Of course, long-ranging inferences cannot be made only from a sample of countries, but these statistics show the complexity of explaining brain drain.

While the above mentioned determinants operate on a macrolevel, several empirical studies (chiefly surveys) have focused on reasons for emigration of scientists or students on an individual(micro) level. Grubel and Scott, for instance, report a study of 517 British scientists who stated that the most important reasons for them to migrate to America are greater professional opportunities, higher salaries and dissatisfaction with working conditions in the UK (Grubel and Scott, 1977:60). Tests of significance were not conducted, however, and since these were not weighted responses, the interpretation is limited. Despite this fact, Grubel and Scott point to an important specificity of scientific labor markets: they are more internationalized, comparatively small, well-informed, and permit relatively higher mobility as compared to other occupational labor markets (Grubel and Scott, 1977: 22-24). Going back to the individual level factors for brain drain, Lakshmana Rao, for instance, has discovered in a mail survey of foreign students in Australia that among the strongest predictors of intention to work abroad after graduation were working conditions(potential income, living standard, quality of jobs available, number of jobs) and professional needs - contact with eminent professionals, status of professionals, equipment (Lakshmana Rao, 1979:126-127). The same effects were found in the UNITAR multi-national survey, reported by Glaser and Habers (Glaser and Habers, 1978:91).

The discussion of trends of migration flows of qualified manpower in the research literature reveals two relevant for the present study descriptive characteristics of this group - the sources of brain drain, and the comparison of this to other subpopulations. As Lakshmana Rao has clarified, there are two groups of brain drain: 1/ trained professionals in

the donor country who join the work force of the recipient developed country immediately;
2/ students from developing to developed countries who decide to live and work in the latter
(Lakshmana Rao, 1979:3). I will be studying only the first group of potential emigrants.

Further, as the results of computations for eight countries demonstrate "scientists and engineers are on the average ten times as a likely to emigrate to the United States as are people from other occupations"(Grubel and Scott, 1977:80). Moreover, within the group of professionals potential emigrants represent an academically superior subgroup (Portes, 1976:502).

Despite the useful highlighting of significant determinants of international migration of highly qualified labor force, the classical empirical research on brain drain discussed so far, fails to adequately address the issue of how major industrial or political transformations reshape labor markets, which provides an impetus to increasing emigration of scientists and engineers - a very pertinent relationship from the point of view of what happened in Bulgaria after November 1989. One clue as to how to approach that problem can come from labor market research outside the "brain drain tradition" (for a comprehensive review see Kalleberg and Sorensen(1979); for a distinction between occupational internal and external labor markets see Bridges and Villemez(1991)). An insightful analysis by Noyelle(1987) of the recent trend in American economy towards decline in the role of the internal labor market and the increasing reliance on the external labor market could provide better understanding of the process, which occurred in the scientific labor market in Bulgaria during the post-transition period.

BULGARIAN BRAIN DRAIN IN THE CONTEXT OF THE TRANSITION TO DEMOCRACY IN EASTERN EUROPE

The problem of outmigration of highly qualified specialists is not only Bulgarian, to be sure. Other Eastern European countries have recognized the dangers of an increasing emigration wave among their researchers and engineers too, although studies are scarce. As witnessed by the report on Hungary at the UNESCO meeting on brain drain in Venice, Italy, in November 1991 (Brain Drain Issues in Europe, 1991), the first Eastern European country to introduce market reforms is experiencing a "fourth wave" (after 1930s, 1945-9, and 1956) of emigration of researchers, beginning as restraints on travel abroad were lifted, especially with Austria and Germany. Since 1979 the number of Hungarian researchers employed abroad has continually increased, especially the fourfold increase from 1982 (608) to 1986 (2,512). In 1991 the estimate was 4,500 or 15% of the Hungarian Academy of Sciences was employed abroad. The situation is a matter of similar concern in other former socialist countries. An article in "The New York Times" in July 1993 quotes figures of the Russian Academy of Sciences, which are startling - 80% of the country's top mathematicians have emigrated, and about 80% of the scientists firmly wish to work and live abroad (Leskov, 1993:A15). This information, however, is quite unreliable. A study of the "brain flight" in Polish science in 1991 revealed that about 10% of the researchers from the 8 largest centers had emigrated (Hryniewicz et al., 1992:45-46). The last is probably the only serious piece of research on brain drain in the region after the democratic events, but altogether the fact of

the matter is that there has been an insufficient number of published representative studies on scientific emigration from Eastern Europe after the radical transformations in 1989.

In order to understand the increase of brain drain from Eastern Europe after the events of 1989, we need to bear in mind the broader socio-economic context, as well as the structural factors within the R&D sector that contributed to it. Four years after the downfall of communism the vast majority of these newly independent states were experiencing severe economic and financial difficulties. For example, none of these countries has met the Maastricht criteria for incorporation in the European Union in 1993. The average inflation rate for the 10 transition economies that had a Europe Agreement (EA) was 105.6, well short of the criterion of 3.2. The average interest rate for the same states was 44.5, or well above the criterion of 9.1 (Andreff 1999). At the same time the attempted 'shock therapy' in Bulgaria led to a 16% unemployment. The situation was further exacerbated by the gridlock in the political environment (Spenner et al. 1998: 602-603).

Another reason why the conditions in 1993 were ripe for emigration of the most productive researchers was the mismatch between the high manpower potential and the low funding of research (low salaries, outdated equipment, inadequate capital investment, irregular funding for purchase of materials and substances). Especially glaring was the conscious effort by the communist party establishment on the eve of the 1989 events to "produce" a disproportionately large number of scientists and engineers by common world standards. The former socialist countries, for instance, occupied the top positions

in a ranking of countries according to the proportion of R&D personnel in the total population (Table 1).

Throughout the 1980s the R&D expenditures, although fairly high in relative terms—about 3 percent of GDP (Simeonova 1995), were nearly not enough in absolute terms and apparently insufficient to provide cutting-edge equipment, materials, and facilities, since the bulk of this support was spent on salaries. The funding situation markedly worsened in 1991, when the so-called ‘contract salary’ was introduced for institutes within BAS and the share of budget allocations for R&D went down. Concurrent with this trend was the decision to cut the staff of BAS as part of the ‘restructuring’ of the Academy. Thus, the total staff of BAS was reduced by about 34% for the period 1990-1994 (Simeonova 1995: 763).

Finally, the changing labor market situation for scientists and engineers created a favorable condition for increased mobility and migration, both internal and external. The democratization of the political system and the restructuring of the state-planned economy in Bulgaria led after 1989 to a destabilization of the national internal occupational labor markets and the exposure of those employed in R&D to the impact of the international (external) scientific labor market. This created prospects for greater mobility opportunities, and was accompanied by a better sense of the supply and demand mechanisms operating

TABLE 1: Number of R&D Personnel by Countries Compared to Total Population
(Source: UNESCO, Statistical Yearbook, 1991. Paris, 1991, Tables 1.1 and 5.16)

| Country | Population (in thousands) | R&D Personnel (in thousands) | % of Population |
|----------------|------------------------------|---------------------------------|-----------------|
| 1.GDR | 16630 | 127.449 | 0.77 |
| 2.USSR | 287630 | 1694.400 | 0.59 |
| 3.Bulgaria | 8989 | 50.585 | 0.56 |
| 4.Japan | 123116 | 636.817 | 0.52 |
| 5.Poland | 37854('89) | 181.000('85) | 0.48 |
| 6.Czechoslov. | 15650 | 65.475 | 0.42 |
| 7.USA | 247350 | 950.000 | 0.38 |
| 8.Yugoslavia | 23695 | 78.704 | 0.33 |
| 9.Israel | 4520 | 14.173 | 0.31 |
| 10.Norway | 4227 | 12.100 | 0.29 |
| 11.Sweden | 8500 | 22.725 | 0.27 |
| 12.Netherlands | 14835 | 37.520 | 0.25 |
| 13.Canada | 26220 | 61.130 | 0.23 |
| 14.Australia | 16830 | 38.570 | 0.23 |
| 15.Switzerland | 6647 | 14.910 | 0.22 |

Notes: Data are for 1988-89, except where indicated otherwise. The 15 countries are ranked by size of R&D personnel (scientists and engineers) as a percentage of the total population. Only a proportion of the total R&D personnel in the socialist countries works in the national academies.

on specialized labor markets. It also, however, meant stronger exposure to competitive processes both on the national and on the outside labor markets. The changed labor market situation - the opening up to the international market of scientific labor as a result of the newly acquired freedom to live and work abroad - proved most advantageous for the relatively younger researchers who were familiar with modern methods and technology, knew foreign languages, and were confident in their talents. Many of them decided to look

for opportunities abroad, where they could better achieve their professional and personal goals. The representatives of the old elite with minor exceptions were either not sufficiently qualified in terms of knowledge of foreign languages or in too later stages in their professional careers to take such a radical step. Therefore, the vast majority of this group preferred to cling to the well-established positions they already had in Bulgaria, especially in view of the instability and tightening of the national labor market as a result of the sharp drop in budget allocations for R&D and of the recurrent cuts in scientific personnel.

Most past research has not specifically dealt with emigration of researchers from Bulgaria since November 1989. Three studies - two by the Central Statistical Bureau in Sofia (Kaltchev and Tsvetarsky, 1991; Ochakvani promeni v migratsionno povedenie na naselenieto v Bulgaria(Expected Changes in Migration Behavior of the Population in Bulgaria, 1991), and one by the then National Institute for Youth Studies (Mladezhkata emigratsia:1990(Youth Emigration:1990), 1991) - provide figures on emigration as a whole and on youth emigration. The surveys by the Central Statistical Bureau supply a wealth of information on demographic characteristics, human capital and occupational variables, but do not deal with individual level reasons, which bear upon the disposition to emigrate, with the exception of purpose of travelling abroad. This was due to time limitations, since the short questionnaires were filled out by departing Bulgarian citizens at customs checkpoints at several ports of entry. The study of youth outmigration captures a variety of sociological and psychological factors, which influence individual migration decisions, but does not contain reliable criteria for distinguishing the group of young scientists and engineers, on the

one hand, and is narrowly focused on only one age group - those between 18 and 33 years of age, on the other.

The only other major study on potential emigration of "scientific workers" - a category still used in social sciences in Bulgaria, was a survey completed prior to November 1989 in the capital Sofia and the follow-up survey in 1993. The latter study titled "Emigration and Mobility among Scientists in Bulgaria at the Beginning of the 1990s" was designed as a longitudinal survey to repeat the 1989 representative study, and was completed by the Institute of Sociology in Sofia in May 1993.

Data for real emigration of research manpower potential have not been available. Figures provided by various sources differ considerably and are unreliable. Estimates of potential emigration of the envisaged universe also vary. This is largely due to the difficulties in doing such research, to the questionable nature of collected information (the issue is, after all, a sensitive one) and to the lack of good data bases.

Thus, there is a lack of sound knowledge about the effect of the opening up of Bulgarian society on outmigration of qualified manpower, which furthermore prevents investigation of trends. To fill in these gaps, the present study will try to answer the following research questions: Has the profound social change, which happened in 1989 (the downfall of communism and the transition to democracy) led to increased levels of emigration of scientists and engineers in the subsequent four-year period? What is the approximate extent of this brain drain, and is it differentiated among branches of science and research establishments? How is it related to the demographic and occupational

characteristics of the studied group? How are perceptions of labor market restructuring, of living conditions, of economic and political changes related to dispositions to emigrate? Has there been a significant shift in the impact of explanatory variables that account for potential brain drain from 1989 to 1993?

HYPOTHESES

The interrelationships among these variables are likely to be complex with no easily discernable patterns of interaction. Nevertheless, past research (see Hr. Domozetov et al., 1990; Tchalakov and Iolova-Iordanova 1993)) suggests that we should expect the following:

Hypothesis 1: Younger researchers (age group 31-40) will be more likely to fall into the category of " potential emigrants ". Researchers between 41 and 50 will be less likely to do so, while researchers 51 and above will be least likely. Outmigration of younger scientists has vital negative implications for the reproduction of R&D manpower.

Hypothesis 2: Never-married and divorced scientists will be more prone to consider emigrating.

Hypothesis 3: Men will be more likely than women to express a disposition to emigrate. Testing this hypothesis is important for finding out whether the present

favorable gender composition – as compared to some other countries – will be preserved in Bulgarian science.

Hypothesis 4: Publication activity will relate positively to dispositions to emigrate.

Higher professional self-assessment should positively affect potential emigration. The rationale behind this hypothesis is that it adds the qualitative dimension to brain drain (i.e. it is crucial to know not only how many, but whether the most talented scientists and engineers would leave).

Hypothesis 5: Knowledge of English will positively affect disposition to emigrate.

Several studies of brain drain in other countries have shown that knowledge of a foreign language (the language of the recipient country) is probably the strongest predictor of emigration behavior (Rao 1979).

Hypothesis 6: Representatives of the natural sciences and the applied sciences will exhibit

higher propensity to emigrate than social scientists, because expectations are that they have had more international contacts and that their knowledge is more readily convertible making it easier for them to specialize and find jobs. Furthermore, potential brain drain from the Bulgarian Academy of Sciences will be lower than that from Sofia University, The Higher Institute of Economics and The Technical University. This might have implications for science policy.

Hypothesis 7: Dissatisfaction with living conditions (low payment, lack of prospects

for material well-being) will likely increase potential emigration.

Hypothesis 8: Dissatisfaction with the state of the economy and with the general state of science within the country will be high. It will be related to disposition to emigrate. Overall neglect of science and technology during this period of social cataclysms has promoted a sense of frustration, "weightlessness", and futurelessness among scientists and hence a disposition to seek ways for individual affirmation and prosperity outside Bulgaria.

Hypothesis 9: Evaluation of the future perspectives of the employing scientific unit will be negatively related to disposition to emigrate.

Hypothesis 10: Orientations to particular countries and regions will vary. Nevertheless it is expected that the most attractive country for residence and work will be USA. Thus, disposition to emigrate is anticipated to be positively predicted by preference to work abroad in the United States.

Of the other countries Canada, Germany, England and France should figure as target countries, although the order of preference remains uncertain. It is reasonable to make such a prediction, since financial and job opportunities are greater in the U.S. Also respondents had much better information about immigration laws and regulations in 1993 than in 1989. The quota for green card holders in the U.S. is set at 25,000 for any individual country - much larger than the actual number of immigrants from Bulgaria (see 1992 Statistical Yearbook of the INS. Annual. October 1993(P), Fiches 1-3). Further, the U.S. immigration policy is classified as "open door" in comparison with the "closed door"(restricting legal immigration) policies of a number of Western and Northern

European states in the early 1990s (see Segal, 1993:135).

Finally, it is expected that the level of potential emigration will be about the same in 1993 and in 1989. This proposition will not be tested formally, because the two questions measuring potential emigration in the 1989 and the 1993 surveys respectively are not fully compatible. Nevertheless, these crude measures should give us an approximate indication of whether expressed desire to stay abroad for a longer period will be the same shortly before and four years after the transition.

DATA AND METHODOLOGY

Data

The data used in this research are drawn from two main sources - the study of potential emigration of Bulgarian scientists and engineers in 1989 and the representative survey "Emigration and Mobility among Scientists in Bulgaria at the Beginning of the 1990s". The first data source will be used only for background information and descriptive evaluation of emigration trends and patterns. It is a representative survey which collected information from 1,017 scientists and engineers in the greater Sofia area shortly before November, 1989 on a variety of questions concerning plans to travel abroad, living conditions, professional situation, attitudes to the eased passport regulations, satisfaction with the economy, satisfaction with the state of science, and several others.

The second and main data source permits the direct testing of the research hypotheses and limited comparisons with the pre-1989 situation. It was largely modeled as a

trend survey, repeating to a substantial degree the sampling procedure, the construction and the administration of the questionnaire of the survey in 1989. As in 1989, a one-stage stratified random sample was drawn from the same four scientific organizations (BAS, Sofia University, The Higher Institute of Economics, The Technical University). A slight difference was that money and time considerations in 1993 led to a reduction of the sample size, which somewhat affects the stochastic error (a bit higher in 1993). The actual size of the sample was approximately 8% (n=711) in 1993 as compared to the 10% sample (n=1,017) in 1989, when the same population was somewhat larger. The 1993 survey is representative of the mentioned universe.

The instrument was a self-administered questionnaire, consisting of 48 questions (45 closed-ended and 3 open-ended), most of which had multiple items, corresponding to separate variables of interest. It closely matches the 1989 questionnaire (except for some additional opinion elicitation questions about events after 1989), and includes all the indicators of the variables, specified in the hypotheses. The only missing variable is "decision to emigrate".

The validity of the 1993 survey is expected to be higher than that of the 1989 study, particularly with regard to intentions to emigrate. This may be due to the fact that back in September 1989 a lot of scientists were still afraid to tell the truth because of the possible negative consequences. The units of analysis are individuals, more specifically respondents, falling within the category of "scientific workers" - according to the still employed occupational description in Bulgaria.

Dependent Variable

The dependent(exogenous) variable is disposition to emigrate, or preferred stay abroad. It is measured on a 4-point ordinal scale, where values range from 1 "from one to six months" to 4 "for over 5 years" in response to question #15 from the 1993 survey "If you have an opportunity to go abroad and could choose for how long you could stay there, how long would you live and work abroad?(Please, choose only one answer)".

Independent variables

Independent(exogenous) variables used in the present analysis fall into four groups: human capital properties of subjects; structural-occupational characteristics; attitudinal measures or perceptions of changes; and controls.

The human capital group encompasses the standard variables gender, marital status, age, publications abroad, and knowledge of English. Gender is a dichotomous indicator coded as a dummy variable (1=male, 0=female). Marital status has been collapsed into two categories: "married" (coded 0) and "single" (coded as 1). Age was initially measured as continuous (number of years), but later grouped into five categories as ordinal (though collapsing data in general is an evil to be avoided, sometimes it is justified to do so depending on the special research goals): 1=30 years and below; 2=31-40; 3=41-50; 4=51-60; 5=over 60. Number of publications abroad was coded as ordinal ranging from 1=no publications to 5=more than 50. Knowledge of English was measured on an ordinal scale with the following categories: 1=don't know English; 2=fair; 3=good; 4=excellent.

The structural-occupational block of variables included two dummy-coded indicators: social sciences (1=social sciences; 0=natural and applied sciences) and institutional affiliation (labeled BAS) with 1 coding for BAS and 0 for other scientific establishment.

The attitudinal variables set consists of three subsets of variables. The first includes three assessment questions about information facilities, utilization of results, and funding of research. They are all measured on a three-point scale: 1=bad; 2=medium; 3=good. The second subgroup consists of four variables that elicit responses on a five-point Likert-type bipolar scale ranging from 1=completely agree to 5=completely disagree. The variables here are : evaluation of research funding; evaluation of the difficulties to do science; evaluation of decommunization (the Panov Law); and evaluations of the perspectives for Bulgarian science. An example of the two bipolar statements regarding the last variable is: “The situation of Bulgarian science is improving” versus “The situation of Bulgarian science is grave and the perspectives are even gloomier.” The third and final subgroup of attitudes concerns the factors for emigration of Bulgarian scientists and engineers. The three variables here are lack of opportunities for initiative; low wage; and the speed of reform. Respondents were asked to estimate the importance of each of those factors for emigration on a dichotomous scale: 0=unimportant; 1=important.

Two control variables are also included in the model. The first is an item that measures the respondents perceived standard of life by asking them to describe their material well-being by selecting one of four answers: 1= I hardly make ends meet; 2=My

life is difficult; 3=My life is normal; and 4=I live very well. The second control variable is destination country preference where the respondents were given a list of 16 countries or regions and were asked to give a 'yes'(=1) or 'no'(=0) answer for each one. I will use only the answers for the United States as a preferred country to work abroad.

Model

The model for analysis will be multiple OLS regression which allows the examination of effects of the explanatory variables on the independent variable of interest (preferable stay abroad). A series of nested models will systematically expand the blocks of regressors and estimate their contribution to the prediction of potential emigration. The sample regression equation to estimate the general population regression model will be:

$$Y = a + b_1 * X_1 + b_2 * X_2 + b_3 * X_3 + \dots + b_k * X_k + e,$$

where "Y" is "disposition to emigrate", "a" is the intercept, the "b's" are the regression(slope) coefficients, the "Xs" are the explanatory variables, "k" is the number of explanatory variables, and "e" - the random error term.

RESULTS

The 1989 survey on potential emigration of Bulgarian scientists showed that approximately 10% of the studied population has a strong disposition to emigrate. This is consistent with the earlier report from the same study, which classified 9.8% of the respondents as likely emigrants, using a slightly more restrictive measurement (see Hr.

Domozetov et al., 1990:79-82). The bulk of this group were comparatively younger researchers, who were predominantly single. They further expressed a high level of dissatisfaction with the existing conditions, higher than the average self-assessment of own abilities, and predominantly came from the natural sciences. They were classified as "high risk for emigration" group. Though the label was value-laden and inappropriate, the finding constituted a foundation to seek for a typical group of potential emigrants in the 1993 survey. In 1989 (before the events of November) indirect indicators had to be utilized, because respondents would not readily reveal their plans.

Although the issue is a sensitive one, it was deemed possible to formulate direct questions to measure disposition to emigrate, decision to do so, and destination country in 1993. Despite a problem of comparability, the estimate for 1993 is roughly 12%. This is the estimate that was obtained from the question that asked about certainty that the respondent will leave Bulgaria for more than six months within one year. Thus, it seems that there has not been a substantial change in potential emigration in 1993 as compared to 1989. The reason is probably that the Bulgarian R&D establishment had already experienced several waves of emigration between 1989 and 1993. Another reason for this steady rate of potential emigration is the aging of the R&D manpower, due partly to administrative measures (e.g. the decision of scientific institutes within BAS not to support graduate students and not to admit new postdocs) and partly to brain drain (Simeonova 1995). The comparison of the age distribution of respondents in the two samples (1989 and 1993) shows that in 1989 55.1% of the scientists were younger than 40 years as compared to only 38.8% for 1993. At

the same time the proportion of researchers over 50 years old increased from 13.7% in 1989 to 25.1% in 1993 (the sampling error in both cases is less than 2.5%).

The descriptive statistics displayed in Table 2 show that in 1993 only about one-fifth of the researchers from the Sofia area were single which correlates negatively with age. The mean for age is almost 3, or the 41 to 50 years old age group represents the central tendency in the sample. The male to female ratio is roughly 3/2, which is quite favorable as compared to most other European countries. Bulgarian scientists are not very productive in terms of publications abroad (the average here is closest to the 'between one and five' category), which is probably a reflection of the comparative disadvantage of being part of a fairly closed system for more than 40 years. Knowledge of English is between fair and good, on average. The majority of researchers in our sample come from the natural and applied sciences within the Bulgarian Academy of Sciences (BAS).

The attitudinal measures demonstrate a general degree of dissatisfaction with the conditions for research and the scientists' living situation. The most negative assessment of the factors for scientific work is given to funding ('bad'), followed by information facilities and utilization of results. The evaluation variables show a clear pattern of most responses tilted towards the negative end of the five-point scale. The lone exception here is the evaluation of the law for decommunization of the Bulgarian Academy of Sciences, where responses are almost equally split between positive and negative. This shows that the Panov Law is somewhat controversial with some scientists (mainly the members of the Union of

Democratic Forces) expecting a positive influence, while others (mainly the members of the Bulgarian Socialist Party) being convinced that it will do more harm than good.

Among the factors that respondents consider important for brain drain from Bulgaria low salaries and wages stands out as the most important, followed by the speed of reform. Most Bulgarian scientists and engineers have a fairly low opinion about their own standard of living (2 codes for the category 'my life is difficult'), which is consistent with the results for 1989. In short, there has been no change in the material being of Bulgarian researchers four years after the transition to democracy. Finally, most respondents view U.S.A. as the destination country of choice to work abroad.

Table 2: Means, Standard Deviations, and Zero-Order Correlations among Independent variables Used in the Analysis

| Variable | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
|---|------|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|--|
| 1. Marital status (single=1) | .22 | .41 | | | | | | | | | | | | | | | | | | | | |
| 2. Gender(male=1) | .58 | .49 | | | | | | | | | | | | | | | | | | | | |
| 3. Age | 2.80 | .99 | | | | | | | | | | | | | | | | | | | | |
| 4. Publications abroad | 2.30 | 1.08 | | | | | | | | | | | | | | | | | | | | |
| 5. English | 2.64 | .93 | | | | | | | | | | | | | | | | | | | | |
| 6. Social sciences | .23 | .42 | | | | | | | | | | | | | | | | | | | | |
| 7. BAS | .68 | .47 | | | | | | | | | | | | | | | | | | | | |
| 8. Information facilities | 1.54 | .63 | | | | | | | | | | | | | | | | | | | | |
| 9. Utilization of results | 1.81 | .68 | | | | | | | | | | | | | | | | | | | | |
| 10. Funding of research | 1.18 | .44 | | | | | | | | | | | | | | | | | | | | |
| 11. Evaluation of research funding | 1.68 | 1.00 | | | | | | | | | | | | | | | | | | | | |
| 12. Evaluation of difficulties | 1.75 | 1.07 | | | | | | | | | | | | | | | | | | | | |
| 13. Evaluation of decommunization | 2.53 | 1.35 | | | | | | | | | | | | | | | | | | | | |
| 14. Evaluation of perspectives | 1.90 | .96 | | | | | | | | | | | | | | | | | | | | |
| 15. No opportunities for initiative as factor | .65 | .48 | | | | | | | | | | | | | | | | | | | | |
| 16. Low wage as factor | .94 | .25 | | | | | | | | | | | | | | | | | | | | |
| 17. Speed of reform as factor | .70 | .46 | | | | | | | | | | | | | | | | | | | | |
| 18. Standard of life | 2.15 | .60 | | | | | | | | | | | | | | | | | | | | |
| 19. USA | .61 | .49 | | | | | | | | | | | | | | | | | | | | |

+p<.05

*p<.01 (two-tailed tests)

Table 3 presents the results from multivariate regression analysis involving several nested models. Model 1 introduces the human capital variables. Models 2 through 4 progressively add blocks of variables to this base model: structural factors; attitudinal variables; and controls. The only significant increase in explained variance is observed when we compare Model 3 to Model 2. R^2 increases from 6 percent to almost 16 percent when we include the attitudinal measures. This leads to the overall conclusion of the relevance of attitudinal and motivational factors for explaining potential emigration from Bulgaria in 1993.

From the human capital characteristics gender clearly stands out as the strongest predictor of preferred stay abroad (potential emigration). Thus, in Model 4 being male leads to a .31 increase in the disposition to emigrate (from ‘between 6 months and 2 years’ to the midpoint of this category and the next ‘from 2 to 5 years’). It also has the largest relative contribution to explaining the variance in potential emigration (the standardized coefficient, not shown here has the largest magnitude of all beta coefficients—almost .16 standard deviations change net of other effects). Thus, hypothesis 3 is confirmed, which is not the case for hypotheses 1 and 2, although the signs are in the predicted directions. The explanation for lack of significant relationship between potential emigration and age probably lies in the already discussed changes in the age structure of Bulgarian scientists and engineers—a large proportion of younger researchers have either left the country or moved out of science into the commercial sector. Surprisingly, publications in foreign scientific journals did not bear any

relationship to preferred stay abroad, which leads to rejection of hypothesis 4. Knowledge of English exhibited the predicted positive effect, controlling for other explanatory variables, on disposition to emigrate in all four models, which corroborates past research findings, notably Rao (1979).

From the structural predictors only affiliation with the social sciences has a negative relationship with disposition to emigrate, which leads to partial confirmation of hypothesis 6. Scientists from the Bulgarian Academy of Sciences are not more likely than those from Sofia University, The Higher Institute of Economics, and The Technical University to express a preference for a longer stay abroad.

Hypotheses 7 through 10 were largely supported by the findings. It merits attention that at least half of the attitudinal measures turned out to be significant predictors of disposition to outmigrate. Generally, dissatisfaction with conditions for work and pessimism about the future of Bulgarian science translate into greater readiness to leave the country for extended periods of time, even at the risk of leaving science altogether. Low salaries and the slow speed of economic and social reforms are considered as the most important determinants of potential emigration.

The two control variables showed the expected significant effects on potential emigration. Holding the other exogenous variables constant, a one-unit increase in respondent's assessment of his/her standard of living predicts a .224 decrease in preferred

Table 3. Coefficients from the OLS Regression of Bulgarian Scientists' Preferred Stay Abroad on Selected Independent Variables

| Independent Variable | Model 1 | Model 2 | Model 3 | Model 4 |
|---|-------------------|--------------------|--------------------|-------------------|
| <i>Human Capital</i> | | | | |
| Marital Status (single=1) | .041 (.098) | .059 (.097) | .023 (.101) | .022 (.100) |
| Gender (male=1) | .337*** (.080) | .312*** (.080) | .343*** (.083) | .309*** (.083) |
| Age | -.097* (.046) | -.083 (.046) | -.070 (.049) | -.042 (.049) |
| Publications abroad | -.054 (.043) | -.089* (.044) | -.063 (.046) | -.060 (.046) |
| English | .126** (.045) | .126** (.045) | .123** (.046) | .111* (.048) |
| <i>Structural Factors</i> | | | | |
| Social sciences | — | -.324*** (.094) | -.209* (.099) | -.197* (.099) |
| BAS | — | .008 (.085) | -.128 (.089) | -.167 (.088) |
| <i>Attitudinal Variables</i> | | | | |
| Information facilities | — | — | .088 (.066) | .177 (.065) |
| Utilization of results | — | — | -.133* (.062) | -.126* (.062) |
| Funding of research | — | — | .062 (.096) | .055 (.095) |
| Evaluation of research funding | — | — | .044 (.043) | .063 (.043) |
| Evaluation of difficulties | — | — | -.078 (.045) | -.072 (.045) |
| Evaluation of decommunization | — | — | .072* (.031) | .070* (.031) |
| Evaluation of perspectives | — | — | -.163*** (.049) | -.148** (.049) |
| No opportunities for initiative as factor | — | — | .136 (.084) | .123 (.083) |
| Low wage as factor | — | — | .455** (.156) | .345* (.159) |
| Speed of reform as factor | — | — | .282** (.092) | .260** (.091) |
| <i>Controls</i> | | | | |
| Standard of life | — | — | — | -.224** (.070) |
| USA | — | — | — | .202* (.087) |
| Intercept | 2.253 | 2.380 | 1.882 | 2.236 |
| Adjusted R ² | .045 | .061 | .156 | .178 |

Note: Numbers in parentheses are standard errors; N = 535

*p<.05 **p<.01 ***p<.001 (two-tailed tests)

stay abroad. Also as expected, choice of U.S.A. as a destination country to work abroad is a significant determinant of disposition to emigrate.

DISCUSSION AND CONCLUSIONS

The findings generally provide support for a “push-pull” theoretical explanation of Bulgarian brain drain, although some modifications are necessary. The most important negative result is that age was not a significant predictor of potential emigration at the individual level. Neither was number of publications abroad or marital status. Thus, we need to be alerted to the negative demographic changes that have occurred in the Bulgarian R&D establishment (aging, loss of the most promising and productive scientists) during the four-year period from 1989 to 1993. Overall, with these qualifications, the "push-pull" theory, which most predicted effects were based upon, can account fairly well for the major determinants of brain drain in Bulgaria. More specifically, the findings indicate that the theory is quite useful in explaining how gender, foreign language knowledge, disciplinary affiliations, dissatisfaction with the economy, the state of science, the political situation, and living conditions affect individual dispositions of scientists and engineers to live and work abroad.

Of much greater importance, however, is the implication that maybe a reformulation of the theory is in order in the sense that the "push-pull" paradigm should be modified to

include major social, economic and political upheavals, which unleash unprecedented explosive push forces, leading to increased wave-like brain drain processes. Therefore, the theory should try to incorporate such "natural social experiments", a key part in which perhaps plays the restructuring of the national scientific labor market, whose assessment becomes a strong motivating factor for emigration of "scientific workers".

The findings of this study have some important policy implications both for the donor and for the recipient countries. In the case of the home country this will mean that Bulgarian policy makers and research planners should be alerted to the possible detrimental consequences for the development of the national scientific community and for the socio-economic progress of the nation as a whole. These are, among other things, losing competitive edge on the international market, diminished ability to produce intellectual capital, deepening reliance on expensive foreign technology as an aftereffect of exporting qualified human capital, incurred financial losses (because of investments in qualifying researchers, who do not bring the expected returns), loss of possibilities to attract new industries, lowering of the quality of life (like for example the decline of health care services as a result of - among other factors - the brain drain of doctors and biologists), as well as some others.

Since forceful measures to curtail outmigration do not work, or rather incite a reverse reaction—the pre-1989 limitations to travel abroad, the legal restrictions and the false moral stand to condemn emigrants as "traitors" led to unleashing an extreme syndrome of "running

away from the cursed place" and severing most ties with the country of origin , as soon as the barriers were lifted—the overall strategy in dealing with brain drain on a national level should be to create a "force field", which will produce a backward "pull" effect. The best solution from that point of view is a long-term one - improvement of living and working conditions as a result of socio-economic development and stabilization. Nevertheless, some viable measures of a more short-term nature towards achieving this goal could be: steady increase in the budget allocations for R&D, more efficient organization of science, opportunities for more contacts with the international scientific community.

So far as the policy implications for the recipient countries are concerned, on average they could experience more gains than losses - acquiring highly-skilled specialists, making financial savings (since the training of these professionals was paid for by the donor country), maintaining a competitive advantage in the advancement of science and technology. However, from the point of view of their labor markets, there are some possible negative trends that should be a matter of concern. The main of these is that immigrating scientists and engineers create a surplus in R&D personnel in the host nations and enhance the competition for jobs in the scientific labor markets in these nations.

The present paper deals almost exclusively with potential emigration of Bulgarian researchers and with push factors, which influence individual plans to outmigrate. It does not plan to answer at this point questions, which, as the preceding discussion and the implications of the study suggest, are worth tackling for a fuller description and explanation of the brain

drain phenomenon. They constitute an agenda for subsequent research, which will hopefully enrich our understanding of this complex process.

The first line of future study concerns the "other side of the coin", or the immigration phase of brain drain (settlement and adaptation in the recipient country). Collecting data from the main target states for migration - the U.S., Canada, Germany, England, France - is facilitated by the existence of good data bases on immigration. In the case of USA these are chiefly the public-use data from INS. Other sources are statistics from NSF, the Department of Labor, and the Department of Education. These could be supplemented by survey data about immigrant and would-be immigrant (exchange visitors, transferees, graduate students) highly-skilled Bulgarians to examine adaptation processes, disciplinary differences, social status changes, influences exercised upon the employment of American researchers, etc.

A second avenue to be pursued in future research is the brain drain from other former communist European countries. Although, as I have argued previously, reliable empirical analyses are unavailable for most of these nations, it may well be that the massive outflow of R&D personnel is rather a regional Eastern European phenomenon, spurred by economic decline and political liberalization, than a country-specific process.

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