MIGRATION OF RESEARCHERS IN THE BALTIC REGION: A FORECAST AND FACTORS

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The importance of this research relates to the need for increasing the human capital of Russian science and for assisting the spatial development of the country, particularly, its border areas. This study tests several hypotheses. The first one holds that the outflow of researchers will reduce over the next few years. Others concern factors affecting the number of researchers in the Russian Federation in general and its Baltic part in particular. These factors include salaries and workplace environment. Methodologically, the study draws on Russian and international sources on the migration of researchers and builds models of two types to trace connections and to produce forecasts, while calculating the emigration rate. The models of the first type describe how the amount of salary and workplace conditions affect the number of researchers. These are vector autoregression models built in the R software environment, using statistical time series. The models of the second type use Excel forecast function to carry out prospective evaluations of the number of researchers and migration rates. The study did not confirm the hypothesis that the reduction in the number of researchers was slowing down in Russia and St Petersburg in particular. Thus, the state measures aimed to preserve the human capital of national science will be insufficient to prevent either a decline in the number of researchers or their emigration in the near future. The article provides concrete recommendations for reforming the system of remuneration in research to reverse the negative trend.

Keywords:
emigration of researchers, salaries in research, academic workplace environment, Russia, Baltic region, vector autoregression model, research staff forecast, reforms

Attracting talented young people interested in scientific research while retaining mature scientists is becoming increasingly relevant for Russia. The National Project for Science is aimed at solving it. According to the National Project for Science approved in 2018 (NPS), the challenges of state policy in research and technology will be, among others, to establish in Russia favour-

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able conditions for prominent world-class scientists, including those from leading industrial countries, and to increase the effectiveness of Russian science. These aspects are highlighted as an independent federal program within the framework of the NPS.

The second issue gaining increasing attention is the spatial development of Russia. The regions near international borders have a special place in this context. From the viewpoint of scientific development, they have lower barriers to the cross-flow of talent and, therefore, in the absence of directed circulation, there is a risk of a relatively high outflow of professional researchers. The relevance of this study follows from the combination of these two aspects: consolidation of human resources and spatial development of territories.

Statement of the problem and hypotheses

In a broader context, the factors of interest for this study are those that influence the changing number of scientists in the Russian Federation, both on the national level and in Russian constituent entities in the Baltic Sea Region. The interest in the changing number of scientists in the Russian part of this region is due, among other things, to a contradiction between the general positive growth of population in the Baltic territories of Russia impacted by migration and the negative trend in the total number of scientists from 2014. For the national economy in general, 2014 was a turning point because of changes in geopolitical conditions which affected science as well. Besides, it was in that period that the implementation of Presidential Decree 597 setting target ratio of the average salary of researchers to the average wage in the economy [1] started taking effect. In practice, in some cases, these decisions led to the reduction in the number of scientists on the payrolls.

Experts describe two Russian Baltic regions, the Kaliningrad and the Leningrad ones, as the cross-border 'development corridors' and note a significant positive growth in population with migration as its main contributor [1].

Against the background of favourable demographic conditions in the Baltic region of Russia, there is an overall fall in the number of researchers, the most skilled category of those employed in the scientific sector (see Table 1).

[1] Decree of the President of the Russian Federation of 05.07.2012 No. 597 «On measures for the implementation of state social policy» // RLS «Consultant-plus.»

Table 1

Number of researchers in the Russian constituent entities of the Baltic region, thousand people [2]

Russian constituent entity	2010	2011	2012	2013	2014	2015	2016	2017	2018
Kaliningrad region	0.62	0.67	0.67	0.67	0.68	0.72	0.73	0.69	0.78
Leningrad region	2.54	2.59	2.61	2.44	2.87	2.84	2.81	2.80	2.22
St Petersburg	43.56	44.68	45.50	43.93	43.32	42.96	40.93	40.39	36.51
Total	46.72	47.94	48.79	47.05	46.87	46.52	44.46	43.88	39.51

The general decline in the number of researchers in the Russian part of the Baltic Sea Region does not mean that there are no relatively well-off areas. In the Kaliningrad region, the number of researchers in 2018 grew by almost 25% compared to 2010, and 15% compared to 2013. This is explained by the participation of the region's leading research organization, the Immanuel Kant Baltic Federal University (IKBFU), in the large-scale projects aimed at consolidating scientific potential, namely, the implementation of the IKBFU Development Program and the 5—100 Project.

The number of researchers in the Leningrad region varies considerably. By 2017, in comparison with 2010, the number rose by 10.2%, while by the end of 2018 it fell significantly. A steadily declining number of researchers has been observed in St Petersburg since 2013. This is the main contributor to the changing number of researchers in the Russian part of the Baltic Sea Region. Clearly, this trend is determined by factors which are typical of Russian academia in general.

Quantitative and structural changes in employment in Russian academia in the post-Soviet period are the subject of analyses by the Institute for Statistical Studies and Economics of Knowledge, which is a part of the Higher School of Economics — National Research University (HSE-NRU). According to their most recent reviews, in 1995—2017 the number of researchers in the Russian Federation fell from 518,690 in 1995 to 359,793 in 2017 [3]. It is estimated that the outflow of talent is mainly directed to other economic sectors although there is no accurate data concerning the scale of scientific emigration. At present, no Russian-wide governmental statistics covers those who relocate to permanently live or work abroad on a contract basis [2, p. 8]. The number of compatriot scientists leaving and returning is not monitored either [3, p. 135]. Thus, we can only draw

[2] Science and Innovation // Federal State Statistics Service. URL: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/science_and_innovations/science/# (access date: 21.06.2019).

[3] Indicators of science: 2019: statistical compilation / L. M. Gokhberg, K. A. Ditkovsky, E. L. Dyachenko *et al*; Nat Research University "Higher School of Economics". — M.: NRU HSE 2019. — pp. 42.

upon selective studies presenting a wide range of opinions. Nevertheless, the agreed position is that the main outflow of talent occurs within the country, and emigration accounts only for a small percentage [4]. Even in the mid-90s, at the time when the outflow of talent was high, and the employment conditions abroad were significantly more favourable, relocation overseas amounted to only about 5% of the total number of researchers leaving the academia [5]. Notably, the researchers studying this issue name St Petersburg and the Leningrad region among the leading regions in terms of intellectual emigration. Some authors point to Western Europe as the area absorbing the largest share of Russian researchers scientists (42.2%). At the same time, Scandinavian countries accept 5.2%, and 1.1% of scientists head for Eastern Europe [6]. However, alternative estimates mention the United States, Germany and France as the major destinations. According to the Center for Scientific Research and Statistics, these three countries account for more than half of the Russian researchers [7]. These data should be deemed most reliable as they were obtained during an all-Russian survey of the scale of outflow of research staff. Thus, for the Baltic region, it can be assumed that the bordering countries serve as an intermediate point en route. Although, as evidenced by international authors, in the early 2000s, scientists from Russia were actively seeking research positions in the institutes and universities of Eastern Europe and Germany [8].

There is an abundance of literature on the impact of scientific migration on the country of origin and destination. A review of theoretical approaches to the assessment of the consequences of migration for the recipient country was presented by A. V. Lyalina [9]. Some researchers agree that the impact of migration is not straightforward and can lead to problems for both origin and destination countries [10—13].

Raul Ramos [14] offered his explanation for the directions of migration flows in the Baltic region, specifically, the scientific ones. As follows from his findings, the main source of migration flows to the EU are the neighbouring European countries (including Russia). The assessment of the gravity model offered by Ramos demonstrates that the most statistically significant migration factors are distance, territorial adjacency of the countries of origin and destination, as well as differences in the GDP per capita.

In the context of declining natural population growth in the EU countries, as well as the outflow of scientific talent from the European Baltic countries to the United States and Great Britain mentioned by researchers [15, p. 31], research migration, including the flows from the neighbouring countries, is the source of expansion of this professional category. For the Baltic countries of the EU, this source also includes Russian Baltic regions.

According to Eurostat[4], the number of scientists in the EU countries was steadily increasing between 2008 and 2018. Figures for a subgroup of indicators

[4] See.: *Eurostat*. URL: https://ec.europa.eu/eurostat/data/database (access date: 21.06.2019).

describing the number of scientists in the EU countries of the Baltic Sea Region (Germany, Denmark, Poland, Lithuania, Latvia, Estonia, Sweden and Finland) is also in line with this trend.

Figure 1 shows the growth index calculated as a ratio of the number of scientists in the current year vs the previous year for the EU Baltic Sea countries and Russian Baltic regions between 2011 and 2017.

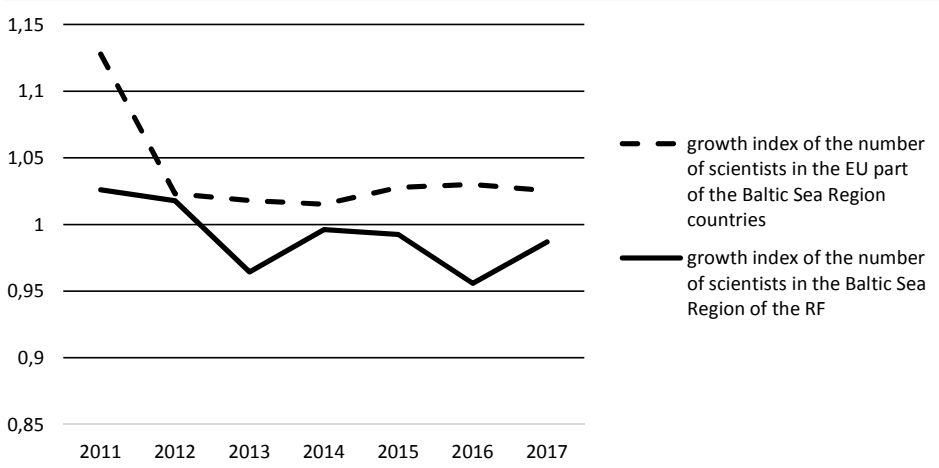

Fig. 1. Growth index of the number of scientists in the Baltic Sea Region

The graph shows a slowdown in growth rate for the EU Baltic Sea countries which corresponds to the fact that academia in these countries has been saturated with migrants. Thus, the migrant absorptive capacity of European science is reducing.

According to V. Yu. Ledeneva, the immediate cause of intellectual migration which comprises the migration of scientific talent is "the contradiction between the level of personal development, the individual's needs and capabilities on the one hand, and the conditions for their satisfaction on the other hand" [16, p. 108]. The researcher identifies two approaches to the identification of the main motives for the migration of scientific talent. The first stems from the prioritized pursuit of professional interests while the second is based on the desire for better living conditions, expansion and consolidation of personal economic security.

The opinions of international researchers on the causes of scientific migration differ. Some of them believe that currently the role of general professional and economic motives in the migration of scientists is greatly overestimated. For instance, S. Stern proves based on empirical evidence that 'dedicated' scientists would be willing to pay themselves for the opportunity to remain in the realm of science while working in commercial companies [17]. From the viewpoint of some authors, age-specific motives attract too much attention [18; 19]. The motives which come to the forefront are related to research activities. These are the need to overcome cognitive and resource limitations, to maintain close personal contact with colleagues on a project team, and to collaborate [20].

However, some authors adhere to a more traditional approach in explaining the reasons behind the migration of scientists. It turns out that the migration behaviour of 'stars of science' is significantly influenced by economic factors where the most important one is the level of taxes in the country of origin or destination [21]. The escalation of the economic downturn still has a significant impact on the direction of scientific migration flows [22—24]. The time of life of a researcher remains a significant factor in scientific migration as well [25].

Generally speaking, for the countries with catching-up development patterns, for instance, Russia, economic factors, including salary, are a major motive for emigration.

As can be concluded from the literature review, the increase in salary in the country of a potential migrant's origin might have both deterrent and stimulating effect. The latter holds true when finding a better environment and conditions for professional development is of primary importance. In this case, higher salary helps to offset the tangible costs accompanying migration. According to R. Ramos, the decision to migrate is based on cost-benefit analysis (with costs associated with the distance or unfavourable migration policy) [26] Other authors who share this approach use the same reasoning [27; 28].

This study pursued 2 major objectives: 1) finding the relation between the number of Russian researchers and the amount of remuneration as well as the working conditions; 2) making a forecast for the number of researchers highlighting migration outflow figures. These relations are reviewed in the context of three Russian constituent entities in the Baltic Sea Region: the Kaliningrad region, the Leningrad region and St Petersburg. The reason for choosing the study area is the fact that the migration behaviour of Russia scientists living in the Baltic Sea Region is determined by the factors which are both common to Russian academia in general and specific to the Baltic region. The latter include, among others, the geographical proximity to the EU countries and the use of these territories by Russian scientists as a transit point on the way to another country.

In this study, 'the Baltic Sea Region' is limited to European countries and Russian territories directly adjacent to the Baltic Sea. The reason is that, according to Russian researchers, the residents of bordering and coastal regions and countries having seaports are most actively involved in external migration [29].

The following three main hypotheses were proposed:

the number of researchers in the Russian Federation can be significantly affected by the way the target ratio of the average researcher's salary to the average wage in the economy is to be achieved;

the second significant factor which influences the changing number of researchers is the productive work of scientific organizations and universities which is an indirect characteristic of the workplace environment of scientists;

the outflow of researchers from the academia will be moderate because for middle-aged and older scientists the situation is now quite stable; those who wanted to emigrate or leave the realm of science have already done so. As for

younger researchers, there have been efforts taken aimed to attract and retain young people in science which will further expand within the framework of NPS and other nationwide initiatives.

Data and tools

The researchers draw attention to the problems in establishing a statistical database to describe the total emigration from Russia and, specifically, the emigration of scientific talent [29; 30]. There is no systematic collection of data concerning the 'pushing' and 'pulling' factors in the migration of Russian scientific talent. As was noted above, there were some isolated studies of this issue based on limited sampling. The data obtained in the course of such selective studies cannot be used to build quantitative multi-factor models satisfying the criteria of statistical significance.

A review of international publications over the last decade demonstrates that there were scarcely any attempts to model migration based on the 'pushing' and 'pulling' factors. For example, in 2009 Iranian researchers designed a system dynamics model to characterize the long-term impact of the emigration of scientists on the economy and society of the country. However, the developers were forced to limit themselves to the structure of accumulators, flows and links, because, by as they admitted, it was impossible to populate the model with quantitative parameters due to the lack of key data [31]. In 2011, Romanian researchers built an econometric model using binary variables based on interviews with 589 Romanian migrants. The model studied the influence of individual factors, including, among others, employment, marital status and cultural preferences, on the decision to return home [32]. Gravitational migration models were developed as well [14].

As far as the modelling scenarios listed above are concerned, only the system dynamics approach could help in the identification of practical measures to influence the external migration processes, provided that the model worked.

At the same time, over a long period, the Russian statistical recording system has been accumulating data on the number of researchers, including broken down by region. A starting point of the corresponding time series is 1995. They can serve as a basis to build statistically significant trend models describing retrospective changes in the number of researchers and make it possible to obtain a valid forecast for the future. Combining the expert estimates of the share of emigrants in the reduction of the number of Russian scientists and the projected changes in the number of researchers derived from the trend models makes it possible to calculate the level of external migration. The level of external migration multiplied by the expert estimate of the share of migrant scientists from Russia received by the EU Baltic countries gives an estimate of the number of Russian migrant scientists who are heading to the countries of the Baltic Sea Region. This is the algorithm utilized in the study.

The factors which affect the number of scientists in the Russian Federation and can potentially act as 'pushers' leading to internal or external migration were analyzed with the use of a different method and over a shorter time interval. The set of factors which affect the number of researchers was limited to controllable conditions and parameters of the scientists' activities which can be directly regulated by public authorities because decisions at the governmental level are underpinned by regular relevant statistics. The choice of the time interval, in this case, was determined by the time when data collection started, which is 2012—2013. The number of researchers was defined according to Rosstat (the Russian Federal State Statistics Service) data for the period of 2012—2017. Current information about the growth rate of the average number of scientists in 2018 provided by the Institute for Statistical Studies and Economics of Knowledge of HSE-NRU was used for a preliminary estimate of the number of scientists in the Russian Federation in 2018. The Rosstat and HSE-NRU data are presented broken down by regions; thus, the figures of the Russian Baltic regions, the Kaliningrad and the Leningrad ones, as well as St Petersburg, were specifically selected from those described above. The number of researchers in the Russian Federation was unstable, with alternating periods of increase and decrease in the number of scientists. Since 2015 the number of researchers in the country has fallen. It should be noted that a steady reduction in the number of scientists in the Russian Baltic regions began after 2013.

The ratios between the average scientist's salary in Russia and the average wages established in the economy in 2012—2017 are presented in the collected works of the Institute for Statistical Studies and Economics of Knowledge of HSE-NRU [5]. The ratio for 2018 was obtained from the current information submitted by the Institute for Statistical Studies and Economics of Knowledge of HSE-NRU. Despite the divergent nature of changes in the ratios between the average scientist's salary and the average region-specific wages in individual years of the period, in general, they were increasing over the whole period.

Performance of the employees of Russian scientific organizations and universities was evaluated based on the number of publications indexed in the Russian and international scientific citation databases, Scopus and Web of Science, also presented in the above-mentioned collected works [6]. The estimate for 2018 was obtained with the use of a linear forecast function in Excel.

Similar indicators for the Russian Baltic regions were evaluated based on data from the federal performance monitoring system, for the scientific organizations engaged in research, development and engineering projects of non-military nature. The relevant statistics are available for 2013—2017. The estimate for 2018 was obtained with the use of a linear forecast function in Excel.

[5] Indicators of science: 2019: statistical compilation / L. M. Gokhberg, K. A. Ditkovsky, E. L. Dyachenko *et al*; Nat Research University "Higher School of Economics". — M.: NRU HSE 2019. — pp. 111.

[6] As above pp. 218—219.

The statistics recorded over the whole period under consideration show a steady increase in the performance indicators for the country in general and the Baltic regions of Russia in particular.

The distribution of the increase in the number of scientists was analyzed based on expert estimates: 1) the external migration outflow, as was noted earlier, is estimated at 5% of the reduction of the number of researchers; 2) according to estimates, the aggregate share of Russian emigrant scientists received by the EU countries belonging or adjacent to the Baltic Sea Region is 23.8% which is distributed as follows: a) Germany: 17.5%; Scandinavia: 5.2%; Eastern Europe: 1.1% [6, p. 333, 335].

Methodology

The influence of salary and working conditions on the number of researchers in Russia was characterized on the basis of the Vector AutoRegression model (VAR) built and implemented in the R software environment. The number of academic staff was projected with the use of Excel forecast functions.

VAR model describes the behaviour of several time series where current values depend on past values of the same time series. The following three time series were loaded in the system to model the dependence: a) the number of researchers; b) the number of publications by Russian authors indexed in Russian and international scientific citation databases; c) the ratio between the average researcher's salary and the average wage in the economy.

The results describe the dependence of the number of scientists (Y_t) on the previous value of this indicator (Y_{t-1}), as well as on the previous number of publications (X_{t-1}) and the ratio between the average scientist's salary and the average wage in the economy (Z_{t-1}). The nature of these dependencies is as follows:

1) in the Russian Federation:

$$Y_t = 1.4353Y_{t-1} - 0.2676X_{t-1} - 2484Z_{t-1} + 164508 \quad (1)$$

2) in the Russian part of the Baltic Sea Region:

$$Y_t = 0.7183Y_{t-1} - 0.0053X_{t-1} - 105Z_{t-1} + 28339 \quad (2)$$

The modelling framework included the model adequacy and accuracy tests specified in the R package documentation which serve to confirm the applicability of the model according to the testing criteria.

The dependencies obtained indicate that there is a negative relationship between the 'salary' indicator and the number of researchers. It appears that this might be an effect of the efforts aimed at achieving the target ratio between the average scientist's salary and the average wage in the economy. A review of the academic staff' payrolls in 2013—2017 performed by the Russian Research Institute of Economics, Politics and Law in Science and Technology (RIEPL) revealed the following. In 2017, the aggregate accrued payroll fund for academic staff amount-

ed to 54.8% of the level of 2013. At the same time, the calculations of the Institute for Statistical Studies and Economics of Knowledge of HSE-NRU show that in 2013—2017 the average monthly salary of staff engaged in research and development increased by 37% [7]. Clearly, the increase in average salary for academic staff along with the decrease in total payroll stems from a reduction in staff.

As follows from formulas (1) and (2), the number of academic staff over the time interval under review has a positive dependence on its previous value, but the effect of the remaining two factors is negative. This is typical both for the country in general and for the Baltic region in particular. The models presented only serve to record the practice of managing the remunerations and numbers of Russian researchers and, thus, they are not utilized to produce forecasts.

The Excel functions used for forecasting make it possible to flexibly take in consideration upward and downward fluctuations of the time series indicators, obtain statistically accurate trend characteristics and build forecasts on their basis. The future number of researchers for the next three years was modelled with this tool. The type of forecast function was individually chosen in each specific case based on the criterion of the adequacy of the time series description.

Results

The estimated change of the countrywide number of researchers was obtained with the use of an exponential forecast function in Excel. In order to get a more authentic picture, an extended time series starting in 1995 was taken as a basis for the forecast model. This series was reconstructed according to the data of the Institute for Statistical Studies and Economics of Knowledge of HSE-NRU [8]. However, the estimated figure for 2018 presented as a part of current information was removed from this series, because it is preliminary and needs to be refined. The forecast contains a retrospective indicator for 2018, also calculated with the use of an exponential function, and three perspective indicators for the next three years. The nationwide number of researchers and absolute changes in their quantity in Russia are presented in Table 2. The same table contains the estimate numbers of annual external migration obtained as a product of the negative increase in the number of researchers multiplied by the share of external migration outflow (5%). The estimated figure of Russian researchers migrating to the EU countries of the Baltic Sea Region was obtained as a product of the indicator of external migration of Russian researchers multiplied by the total share of the incoming flow of Russian migrant scientists received by Germany, Scandinavia and Eastern Europe (23.8%).

[7] Indicators of science: 2019: statistical compilation / L. M. Gokhberg, K. A. Ditkovsky, E. L. Dyachenko *et al*; Nat Research University «Higher School of Economics». — M.: NRU HSE 2019. — pp. 111.

[8] Indicators of science: 2019: statistical compilation / L. M. Gokhberg, K. A. Ditkovsky, E. L. Dyachenko *et al*; Nat Research University «Higher School of Economics». — M.: NRU HSE 2019. — pp. 42.

Table 2

Forecast of the number and migration of Russian researchers in 2019—2021, number of people

Years	Number of researchers obtained with the use of an exponential forecast function	Change in the number of Russian researchers	Forecast for external migration of researchers from the Russian Federation	Migration of Russian researchers to the EU Baltic Sea countries
2017	359,800	—	—	—
2018*	358,678	– 1,122	– 56	– 13
2019	356,824	– 1,855	– 93	– 22
2020	355,051	– 1,773	– 89	– 21
2021	353,353	– 1,698	– 85	– 20

* A retrospective forecast indicator

In designing the forecasts of the number of researchers broken down by the Baltic constituent entities of the Russian Federation, preliminary assessments were made concerning the adequacy of description of the time series indicators in various combinations (for three regions and for two regions out of three) and with the use of different types of regressions. It was discovered that the most adequate description of the changing number of researchers is achieved in the case of separate examination of the time series for St Petersburg, on the one hand, and the time series of aggregated figures for the Kaliningrad region and the Leningrad region. The forecast of the number of researchers and its absolute change for the Kaliningrad region and the Leningrad region is presented in Table 3. The same table contains the estimates of annual external migration.

Table 3

Forecast of the number and migration of researchers in the Kaliningrad region and the Leningrad region in 2019—2021, number of people

Years	Number of researchers obtained with the use of a polynomial forecast function	Change in the number of researchers in the two Baltic constituent entities of the Russian Federation	Forecast of external migration of researchers from the two Baltic constituent entities of the Russian Federation	Migration of researchers from the two Baltic constituent entities of the Russian Federation to the EU Baltic Sea countries
2018	3,003	—	—	—
2019	2,502	– 502	– 25	– 6
2020	2,275	– 227	– 11	– 3
2021	3,007	732	—	—

Thus, the forecast shows a trend towards wave-shaped changes in the quantity and reduced rate of migration of the most qualified scientists from the two Russian constituent entities of the Baltic Sea Region to its foreign segment.

Table 4 shows the forecast for the number of researchers and its absolute change for St Petersburg. The same table contains the estimates of annual external migration.

Table 4

Forecast for the number and migration of researchers in St Petersburg in 2019—2021, number of people

Years	Number of researchers obtained with the use of a polynomial forecast function	Change in the number of researchers in St Petersburg	Forecast for external migration of researchers from St Petersburg	Migration of researchers from St Petersburg to the EU Baltic Sea countries
2018	36,508	—	—	—
2019	34,229	– 2,279	– 114	– 27
2020	31,022	– 3,207	– 160	– 38
2021	27,388	– 3,635	– 182	– 43

The forecast shows a trend towards a greater reduction in the number of researchers in St Petersburg, as well as greater migration from the city.

Of course, these calculations serve as a warning rather than a firm prediction. They describe the possible consequences of past trends continuing in the future.

Discussion and conclusions

The research hypotheses were confirmed only partially.

Hypothesis 1 was confirmed with the use of the VAR model, both at the level of the Russian Federation and at the level of the Russian part of the Baltic Sea Region. Indeed, as follows from formula (1), each per cent of the increase of ratio between the average scientist's salary and the average wage in the economy over the previous period (provided that the target level is achieved with the use of above-described methods) would reduce the number of researchers in the current period by 2484 people. A similar figure obtained from formula (2) for the Baltic region equals 105 people. It should be noted that the optimization of staffing which is currently underway in scientific organizations and universities forcibly pushes researchers out of science.

Hypothesis 2 was also confirmed in the VAR model. As follows from formula (1), on an average, every 3—4 additional publications which appeared during the previous period resulted in a loss of one researcher for Russian science in the current period. A similar figure obtained from formula (2) for the Baltic region is

189 publications. Thus, the pressure to publish proves to be a significant factor pushing people out of the realm of science in the Russian Federation; however, it is much less important in the Baltic region.

As demonstrated by the forecast models, hypothesis 3 on the reduced rate of outflow of scientific human resources was not justified at the level of the Russian Federation and St Petersburg. However, we should pay attention to moderately optimistic estimates of changes in the number of researchers presented in the forecast for the Kaliningrad and the Leningrad regions.

In order to maintain the number of Russian researchers, it is required to review their salary in a broader context, taking in consideration both the specific features of remuneration mechanisms in Russian science and alternative employment options for scientists in the commercial sector.

Studies show a positive correlation between the level of scientists' remuneration and their performance in the country where they get paid. For example, the examination of data concerning 145 Korean universities and colleges revealed a positive relationship between the number of scientific publications in international magazines and the level of scientists' salary [33]. However, evidence exists to the contrary as well. For example, the examination of data from one of the major Norwegian universities revealed a weak correlation between high-profile scientific publications of academic staff and the level of their remuneration [34]. Nevertheless, this might demonstrate that at the Norwegian university incentive payments for publications do contribute much to the researchers' salaries in comparison to the basic salary. By contrast to this, a low level of academic staff's basic salaries is still a problem for Russia. Despite the abolition of the Russian Federal Agency for Scientific Organizations (FANO) by Presidential Decree No. 215 of 15.05.2018 [9], many leading research organizations and universities still use the scale of minimum salaries for academic staff recommended by the FANO order of 15 April 2016 No. 16n [10] which is currently in force. The minimum salary can be viewed as the basic guaranteed salary; its size does not seem attractive for potential researchers compared to the average level of remuneration for skilled work in the commercial sector. Following the Decree of the President of the Russian Federation No. 597 of 7.05.2012 [11], the level of remuneration for scientists has increased significantly. According to Rosstat data, in 2017 through-

[9] Decree of the President of the Russian Federation of 05.15.2018 N 215 (as amended on 26.02.2019) "On the structure of federal executive bodies" // "Collection of the legislation of the Russian Federation 21.05.2018, N 21, Art. 2981.

[10] Order of the FASO of Russia dated 15.04.2016 N 16n "On approval of the Provisional Regulation on the remuneration of employees of federal state budgetary and autonomous institutions of scientific research and development, subordinate to the Federal Agency for Scientific Organizations" Registered in the Ministry of Justice of Russia on 09.06.2016 N 42495).

[11] Decree of the President of the Russian Federation of 07.05.2012 No. 597 "On measures for the implementation of state social policy" // "Compilation of the legislation of the Russian Federation", 07.05.2012, N 19, Art. 2334.

out the Russian Federation, it amounted to 183.5% of the average wage in the relevant region. Nevertheless, in many organizations a researcher's salary is still largely made up by incentives, that is, a non-guaranteed part of the remuneration, which does not help to attract young talents to science or maintain the number of researchers at the proper level.

The attractiveness of the commercial sector for the Russian researchers is supported by the persistent salary gap between scientists in research organizations and similar positions (like analysts or managers) in commercial organizations. According to expert estimates, in 2017 the average monthly salary in the commercial sector was between 60,000 and 200,000 rubles for analysts and between 90,000 and 600,000 rubles for managers [35]. The average monthly remuneration in research and development in 2017 was 48,833.6 rubles [12].

An upward trend in migration of high-potential Russian researchers caused by the occupation-specific motives for migration is also highly probable. As noted by P. Børing et al. (2015), the pull factors like reasonable salaries are important in explaining the labour mobility in general, but not relevant as researchers' motives for migration. The research environment, remuneration structure and competitive access to funding programs and equipment might be more important for individual scientists [36].

In general, the results obtained confirm the importance of a broader and more comprehensive approach to the determination of ways to achieve the goals set by the NPS to maintain and increase the number of researchers in the Russian Federation, including the border regions.

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