

EDUCATIONAL TRAJECTORIES OF RUSSIAN SCHOOL STUDENTS AFTER 9TH GRADES BETWEEN 2000-2014: TYPES OF REGIONAL SITUATIONS

Kseniia A. Adamovich

National Research University "Higher School of Economics" (RUSSIAN FEDERATION)

Abstract

This study examines territorial differences in Russian students' choice of educational trajectory after secondary school between 2000 – 2014, between regions in various socio-economic and cultural contexts. The Russian case might be interesting for the social and economic gap between Russian provinces, which is comparable to other countries differences: some regions, equal to Singapore or the Netherlands in GDP per capita, while others are similar to Honduras or Bolivia. These differences in economic development, among other things, are also associated with the gap in human capital, which is traditionally measured through the level of education of the population. In the Russian system of education, the actual choice of educational trajectory takes place at the end of secondary school, when children should choose between the academic track, which presumes admission to the high school and university after that, and the vocational track, which includes admission to vocational college.

Since 2000th, the proportion of secondary school graduates, who chose the academic trajectory, has declined in most of the Russian regions, despite growing access to higher education, thanks to the raise in the number of universities between 2000-2008 with simultaneous demographic decline. With the dynamic time warping algorithm and time series cluster analysis, six different types of regional situations were identified, in the dynamics of the percentage of students who chose the academic track after secondary school.

In general, in the most economically advantaged regions with a developed infrastructure of higher education, the popularity of the academic trajectory remains at the same high level. But also there were some decreases in 2009 and 2013, which could be a consequence of the world economic crises in those years. These crises became additional factors at the regional level, for the families in the more developed territories, to re-evaluate their children's chances for higher education and the associated costs.

At the same time, the proportion of students on the academic track in more economically disadvantaged regions, with lower access to higher education, has gradually decreased since 2000. These students faced a "double penalty" because they had to plan their education strategy, taking into account higher competition for places in universities, or moving to other regions to enter educational institutions there, which was also associated with growing costs. In this situation, the vocational track becomes a more affordable alternative for students from regions with a lower level of economic and social development.

As the result of the analysis, it is possible to determine short and long term prerequisites for further growth in the human capital gap between Russian regions and, consequently, the growing differences in economic development.

Keywords: Regional inequality, educational inequality, human capital, secondary education, higher education, educational trajectories, dynamic time warping.

1 INTRODUCTION

Territorial inequality is one of the most acute issues that is discussed in multi-unit and large countries. Interregional differences in economic development are connected with differentiation of employment of people with a tertiary education, as well as with differences in human capital, which, in turn, is usually measured by the educational level of the population [1], [2].

There are various theoretical approaches to interpreting students' choice of their educational trajectories, but there is still little known about the relationship of this choice and the regional context of these students. Most studies focus on individual levels in terms of families' socio-economic status, students' academic performance and their choice of trajectory [3], [4]. Theory of Reproduced Social Inequality in education [5] presumes that children from families with higher social and cultural capital

choose a more prestigious the academic trajectory more often. In the Rational Choice Theory framework [6], students make a trajectory choice, taking potential benefits and costs into account and avoiding risks, connected with growing social mobility. The same concept is also used in the Sociology of Rational Choice [7], where a number of individuals' actions is projected onto the behaviour of the whole system, that helps to explain such effects as panic on the stock exchange. Therefore, the choice of the academic trajectory at the regional level can be regarded as a variety of choices of individuals that take the same factors into account, including accessibility of higher education and vocational education in the region, the socio-economic welfare and the educational policy's signals related to chances of obtaining education.

Russia's case is particularly interesting due to the variety of regions with different social and economic backgrounds, where educational reforms and innovations are introduced gradually like in a natural experiment. The same signals of the educational policy may not be visible in regions simultaneously and may be interpreted differently in regions with a diverse socio-economic situation. One of these signals may be the national reform for the Unified State Exam (USE) implementation. USE is a subject-specific standardised test, which students have to pass after completing high school in order to enter a university. The reform for USE implementation started in 2001, but between 2001 and 2008, Russian regions joined it gradually on a voluntary basis. In 2009, the exam became mandatory throughout the country. Implementation of USE, as a high-stakes test, in a taken region also might become an additional negative factor for students when choosing the academic trajectory, with growing costs of preparing for the exam and admission to the university.

In this paper we examine the students' choice of the educational trajectory after the secondary school on regional data over a long period of time. We provide answers to the following complementary questions:

- 1 What are the types of regional situations, regarding the dynamic students' choice of the academic trajectory between 2000-2014?
- 2 How does the socio-economic context vary in regions with different types of this dynamic?

2 METHODOLOGY

The research is based on the empirical data of statistical digests "Russia's Regions. Economic Indicators" for 2000-2016, which are published annually by the Federal State Statistical Service. The overall sample for the research was 1,230 observations for 82 regions over 15 years (Table 1). The analysis was made at the regional level, which imposes certain limitations on the research design.

In Russia, the choice of the educational trajectory usually takes place at the end of secondary school, when students choose between the academic trajectory (moving on to 10th-11th grades of high school), with prospects of admission to a university, and the vocational trajectory (entering a vocational college). The academic trajectory is traditionally considered to be more beneficial for career growth [8] and students who opted for the vocational trajectory often face career ceilings and have to change the specialty [9]. Thus, we operationalise students' choice of the academic trajectory, as our dependent variable, through the proportion of 9-graders in the region, who graduated from high school two years later.

Table 1. Descriptive Statistics (pooled data).

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Min.</i>	<i>Max.</i>
% of 9 th -graders who graduated from high school two years later	57.10	7.64	23.03	88.46
Year of USE implementation	2003.68	1.60	2001	2008
Enrolment in state universities (thousands of people)	15.39	22.19	0.10	249.50
% of employed people with a higher education	24.78	5.97	11.90	50.00
GRP per capita (in the 2000 prices, adjusted for the CPI, thousands of roubles)	1169.70	2521.37	17.99	26158.79
% of urban population	69.42	13.27	25.90	100.00
Number of 9 th -graders in the region (thousands of people)	19.26	17.01	0.40	118.20

The analysis was done in three steps. Firstly, in order to determine types of regional situations in the dynamics of students' choice of the academic trajectory, we conducted time series analysis with the help of the Dynamic Time Warping algorithm (DTW) [10], [11], [12], [13]. For each region, we constructed a curve that stands for the dynamics of proportion of students on the academic track. Secondly, we estimated the shortest DTW-distance among these curves, to do hierarchical cluster analysis [14], which helps us to determine clusters with different types of regional dynamics of students' the academic trajectory choice. Thirdly, we analysed the socio-economic context and factors of regional educational policy in those clusters with the descriptive statistics methods.

3 RESULTS

The overall share of Russian students who chose the academic trajectory, after completing secondary school, gradually decreases from 62.72% in 2000 to 50.94% in 2014. There are several plateaus in 2002, 2006 and 2010 (Fig. 1). If we look at the dispersion measures which demonstrate regional inequality in accessing this level, then the regional variance for this indicator rises. If, in 2000, the coefficient of variation for students' choosing the academic trajectory was 0.097, then, by 2014, it almost doubled to 0.182.

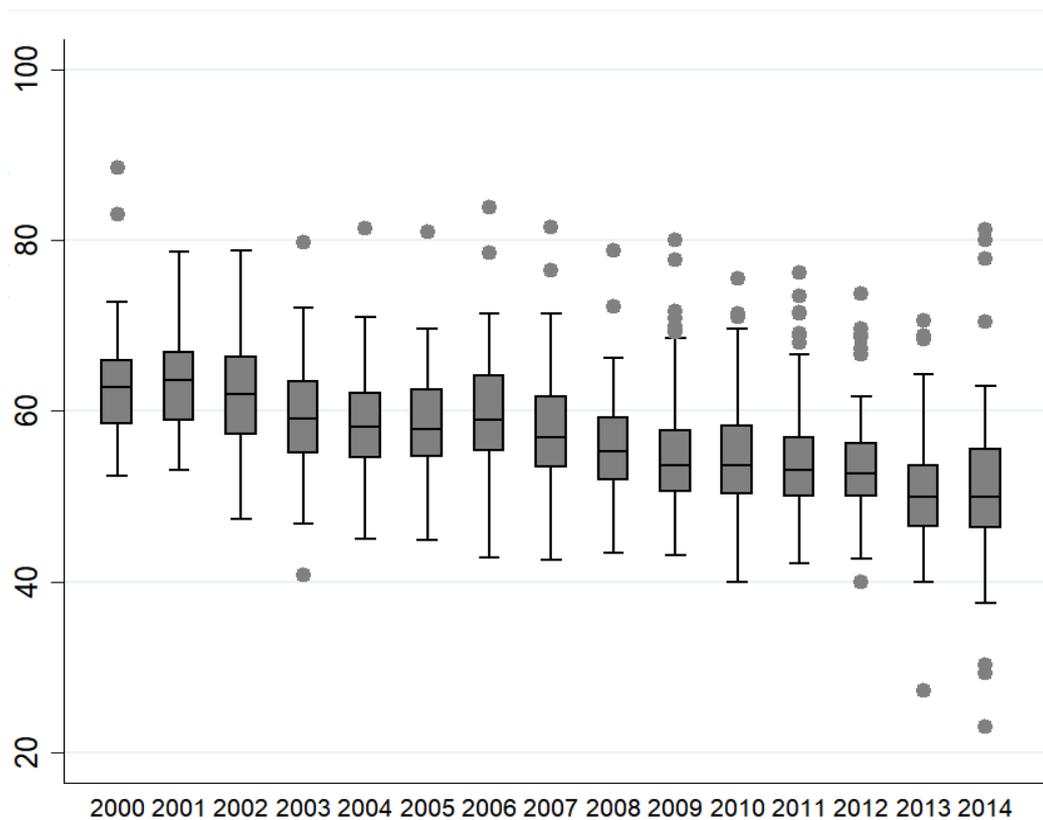


Figure 1. The dynamics of regional average proportion of Russian students on the academic track between 2000-2014 (%).

Besides, during the observed period, two groups of statistical outliers were formed. The first group includes regions with a consistently high proportion of students who have chosen the academic track, in contrast with the rest of the territories, where this indicator decreased. The second group presents regions with the most decline of this proportion (by almost a third). In general, the gap between regions, in the proportion of students on the academic track, accounts for 3.5 times.

We conducted time series cluster analysis to examine the dynamics of choosing the academic trajectory. This analysis allowed us to determine 6 types of regional situations. Clusters 1 and 2 turned out to be the largest. They included 26 and 33 regions, respectively. In contrast, the smallest clusters are 5 and 6 that showed atypical dynamics of students' choice of the academic trajectory (two and three regions, correspondingly).

3.1 Gradual Decline vs Delayed Fall

Cluster 1 consists of 26 regions, where the proportion of students, who opted for the academic trajectory, was declining gradually and consistently (except for a slight peak in 2006). The overall decline of this indicator, from 2000 to 2014, amounts to 3.5 standard deviation (Fig. 2).

Unlike the first group, in 32 regions of Cluster 2 the attractiveness of the academic trajectory started to decline later, in 2006. Up until then, between 2000 and 2006, the share of students who moved on to high school after completing 9 grades was rather high and stayed at +1 standard deviation. Despite the overall plateau, in 2003-2005 some regions saw an abrupt fall in the attractiveness of the academic trajectory, but later, this indicator returned to its initial level. Since 2006-2007, all Cluster 2 regions experienced a slide of this indicator with a slight rebound in 2011. On average, over 8 years (2006-2013), the share of students who moved on to high school after completing 9 grades in Cluster 2 regions fell by 3 SD. Since 2014, some regions show a sudden growing interest in the academic trajectory, which leads to a wide dispersion of the indicators (by 5 SD). In the end, the variation coefficient rose from 0.10 in 2000 to 0.16 in 2014.



Figure 2. Dynamics of the share of students who chose the academic trajectory between 2000-2014 (z-scores) in Cluster 1 vs Cluster 2 regions.

The key trends related to the change of the socio-demographic and economic context in the regions of this cluster are present in all groups to some extent. Overall, major changes in the social context of these clusters are connected with the demographic decline. The number of 9th-grade graduates for the observed period almost halved (from 29.37 thousand people in 2000 to 15.17 thousand people in 2014). It repeats the dynamics of the choice of the academic trajectory. However, enrolment in state universities starts falling only since 2008. As a result, accessibility of higher education rises: the ratio between enrolment in universities and the number of 9th-grade graduates two years earlier increases from 0.51 in 2002 to 0.64 in 2007 and 0.72 in 2014. In other words, universities in the regions of this cluster could provide government-funded places for 51% of 9th-grade graduates in 2002, 64% in 2007 and 72% in 2014. However, growing accessibility of higher education did not contribute to the academic trajectory becoming more attractive for students.

Further, the delayed fall of the proportion of students on the academic track in Cluster 2 may be related to later implementation USE reform (2005-2006), while Cluster 1 regions joined USE nearly at the beginning (in 2002-2003).

3.2 Collapse in 2013 vs Declines in 2009 and 2013

The 6 regions of Cluster 3 also saw a sharp and early decrease in the attractiveness of the academic trajectory (Fig. 3). By 2003, the proportion of students, who moved on to high school, declined by 2 SD. After that, this indicator levelled off (with some fluctuations) at the country average. A special feature of this cluster is another fall in 2013. This trend is present in most regions, but it is most prominent in this

cluster: over one year, the share of students, who opted for the academic trajectory, decreased by 2 SD.

To some extent, the dynamics of the academic trajectory attractiveness in the 13 regions of Cluster 4 replicates the previous one. In 2001-2003, there is a sharp fall in the share of high-school students by 2 SD. After a slight plateau of 2003-2005, this indicator falls again by one standard deviation in 2009. The indicator shows a minor improvement for the next three years (by 0.5 standard deviation). However, in 2013, the regions experienced another decrease to -1 SD.

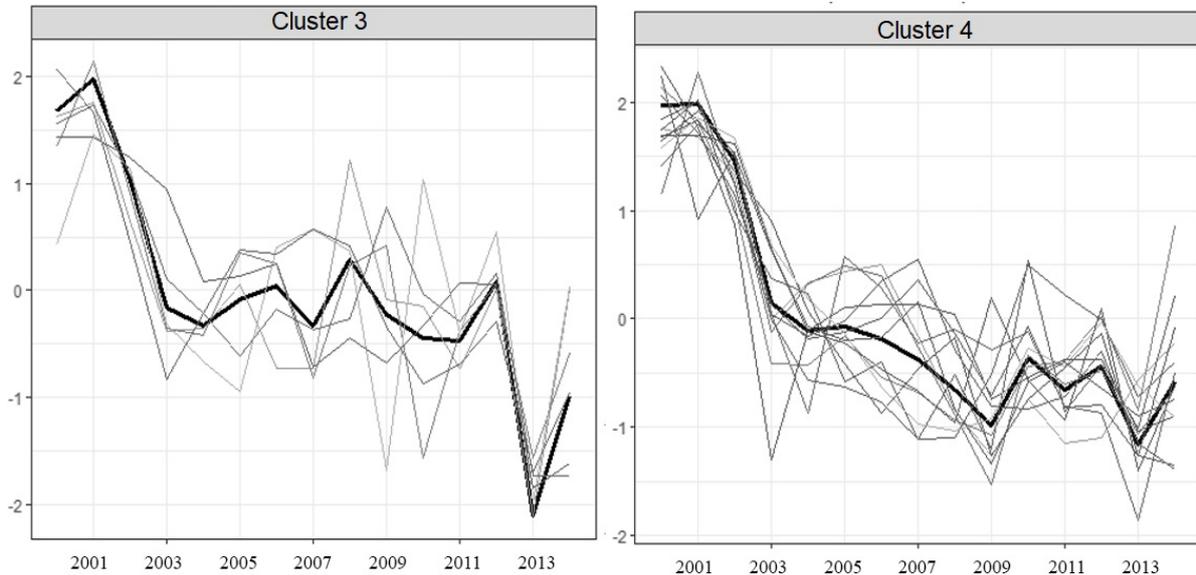


Figure 3. Dynamics of the share of students who chose the academic trajectory between 2000-2014 (z-scores) in Cluster 3 vs Cluster 4 regions.

The whole downward trend in these two clusters is also accompanied by the demographic decline. In addition, the dynamics of the mean and the coefficient of variation, for the university admission in these clusters, show a considerable decline in 2003, especially in regions with a high concentration of universities. This could have been a negative factor for enrolees and their parents. In other words, a relatively low accessibility of higher education and a sharp decrease in the number of places in the regions with this indicator at maximum could have impacted students' choice of the academic trajectory negatively.

The additional declines, in 2009 and 2013, seems to be the consequences of the world economic crises of the same years, which led to GRP falls and overall economic instability. Under these circumstances, students had to re-evaluate the costs associated with higher education. Moreover, the crises of 2009 influenced more economically developed regions of Cluster 4 more prominently.

3.3 The Privileged vs Regions at risk

Cluster 5 includes three regions (Fig. 4), however, one of them (the Chukotka Autonomous Region) is included mostly due to significant fluctuations of the share of students on the academic track. So, it would be more appropriate to examine only two regions which are presented by federal cities - Moscow and Saint-Petersburg. These two regions are the only ones where the popularity of the academic trajectory is on the rise over the observed period. Interestingly, initially in 2000-2001, the ratio of high-school students to the number of 9th-grade graduates was 2-3 SD lower than in other clusters. However, in terms of 'raw' percentages, it is more appropriate to acknowledge the stable attractiveness of the academic trajectory in these cluster regions against a considerable fall for this indicator in other regions. The peak is recorded in 2014 (up to 3 SD).

In contrast, the special feature in the two regions of Cluster 6 is a sharp and considerable decrease in the share of students who opted for the academic trajectory, at the beginning of the observed period, by 5 SD over two years. After that, this indicator fluctuated at the country average with a slight fall to -0.5 SD in 2014.

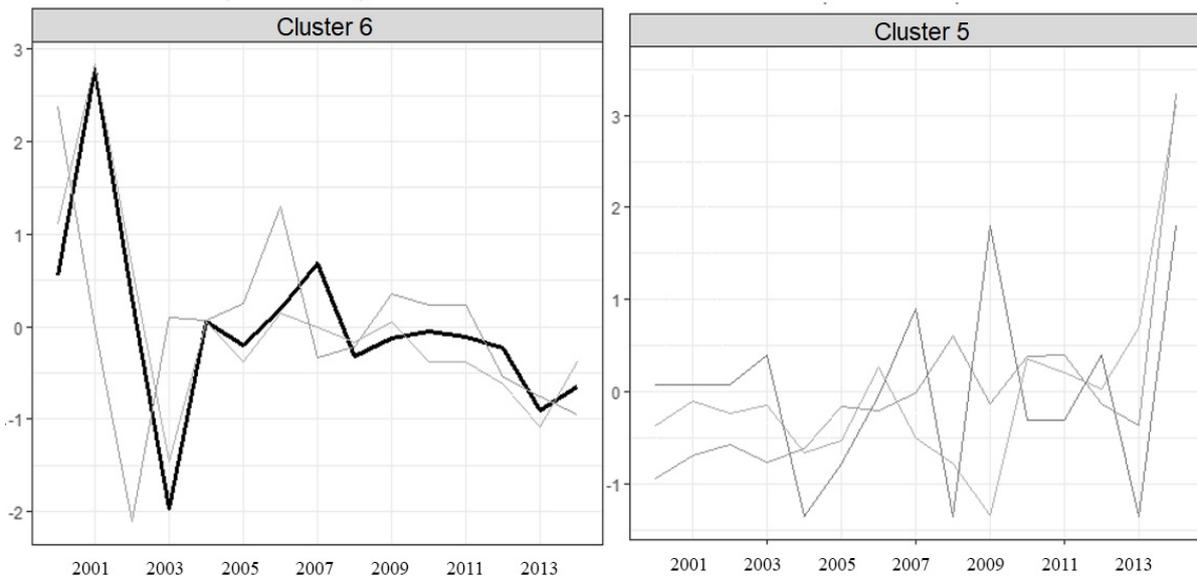


Figure 4. Dynamics of the share of students who chose the academic trajectory between 2000-2014 (z-scores) in Cluster 5 vs Cluster 6 regions.

The socio-economic context of these clusters differs greatly. The Cluster 5 regions provide a favourable environment for students' choosing the academic trajectory. Besides, the highest level of urbanisation and GRP per capita, and a high concentration of universities, a large share of the labour market is occupied by specialists with a tertiary education (from 43.4% in Moscow and 38.2% in Saint-Petersburg in 2000 to 48.2% and 41.1% in 2014, respectively). The 2009 and 2013 crises impacted both these regions' economic welfare and the academic trajectory attractiveness, but to a lesser extent than in regions of the Cluster 4.

On the contrary, Cluster 6 includes the least economically developed regions with low GRP, where most people live in rural areas. Unexpectedly, the share of students who opted for the academic trajectory in this cluster is higher than expected, despite lower enrolment in universities than in other regions of the Russian Federation.

4 CONCLUSIONS

The analysis showed that the gap concerning students' choice of the academic trajectory widens among the regions in Russia over the observed period. This happens because most regions of the Russian Federation see this indicator fall, while in more economically advanced regions it remains stable. Less economically developed regions are 'penalised' twice: their high-school graduates have to plan their education taking into account strong competition for university places, or they have to move to and enter universities of other regions, which also entails financial costs. In this situation, the vocational trajectory appears to be a more accessible alternative for students from regions with lower indicators for economic and social development. This situation contributes to lower human capital of the lagging regions not only now, but also in the long term.

Relying on the sociology of rational choice, we can assume that there are other factors at the regional level that determine sharp fluctuations of the academic trajectory attractiveness among 9th-grade graduates. For example, due to regional institutional differences, economic crises can have an impact on regions' welfare more than on others'. As a result, families in industrially developed regions suffer from financial instability more and have to re-assess their children's prospects of getting a degree because of costs it involves. This correlates with the negative dynamics of the share of students who chose the academic trajectory in these regions in 2009 and 2013-2014. Other researchers come to similar conclusions: public demand for higher education declines because of a demographic decrease and a financial crisis [15].

Another regional factors could be the changes in the educational policy. Educational reforms that are piloted in several regions, and are implemented in the country gradually, can be an incentive for students to change their decision regarding their prospective educational trajectory. One of the examples of such educational reforms could be a stage-by-stage implementation of the Unified State Exam in 2001-2009.

9th-grade graduates in various regions could assess their chances to successfully complete high school and their prospects of entering a university, based on the fact whether the regions participated in conducting USE, or not. This could explain a delayed fall in the academic trajectory attractiveness in Cluster 2 regions which joined the USE piloting the last. An alternative signal could be the restructuring of universities that started in 2003 and continued in 2012, which influenced the accessibility of higher educational institutions in regions differently. Despite the fact that the overall ratio of enrolment in universities to the size of the population did not change, it led to uncertainty and additional risks for students who were assessing their chances of getting a higher education.

ACKNOWLEDGEMENTS

The article chapter was prepared within the framework of the HSE University Basic Research Program.

REFERENCES

- [1] J. Benhabib, M. M. Spiegel, "The role of human capital in economic development evidence from aggregate cross-country data", *Journal of Monetary economics*, vol. 34, no. 2, pp. 143-173, 1994.
- [2] G. S. Becker, K. M. Murphy, R. Tamura, "Human capital, fertility, and economic growth", *Journal of political economy*, vol. 98, no. 5, pp.12-37, 1990.
- [3] D. H. Caro, "Socio-economic status and academic achievement trajectories from childhood to adolescence", *Canadian Journal of Education*, vol. 32, no.3, pp. 558-590, 2009.
- [4] A. R. Bessudnov, V. M. Malik, "Socio-economic and gender inequalities in educational trajectories upon completion of lower secondary education in Russia", *Educational Studies*, vol. 1, pp. 135-167, 2016.
- [5] R. Boudon, *Education, opportunity, and social inequality: Changing prospects in western society*. New York: ERIC, 1974.
- [6] R. Breen, J. H. Goldthorpe, "Explaining educational differentials: Towards a formal rational action theory", *Rationality and society*, vol. 9, no. 3, pp. 275-305, 1997.
- [7] J. S. Coleman, T. J. Fararo, *Rational choice theory*. Nueva York: Sage, 1992.
- [8] G. A. Cherednichenko, *Educational and professional trajectories of Russian youth (based on case studies)*. Moscow: Center for Social Forecasting and Marketing, 2014. (In Russ.)
- [9] D. L. Konstantinovskiy, Ye. D.Voznesenskaya, G. A.Cherednichenko, F. A. Khokhlushkina, *Education and life trajectories of youth: 1998-2008*. Moscow: Center for Social Forecasting and Marketing, 2011. (In Russ.)
- [10] J. M. Wooldridge, "Fixed-effects and related estimators for correlated random-coefficient and treatment-effect panel data models", *Review of Economics and Statistics*, vol. 87, no. 2, pp. 385-390, 2005.
- [11] J. Paparrizos, L.Gravano, "Fast and accurate time-series clustering", *ACM Transactions on Database Systems (TODS)*, vol. 42, no. 2, pp. 8-49, 2017.
- [12] M. Müller, *Dynamic time warping. Information retrieval for music and motion*. Berlin: Springer, 2007.
- [13] H. Sakoe, S. Chiba, "Dynamic programming algorithm optimization for spoken word recognition", *IEEE transactions on acoustics, speech, and signal processing*, vol. 26, no. 1, pp. 43-49, 1978.
- [14] S. Aghabozorgi, A. S.Shirchorshidi, T. Y. Wah, "Time-series clustering – A decade review", *Information Systems*, vol. 53, pp. 16-38, 2015.
- [15] I. V. Abankina, T. V.Abankina, L. M. Filatova, Ye. A. Nikolayenko, "Trends in changes in public demand for higher education in modern Russia", *Educational Studies*, vol. 3, pp. 88-111, 2012. (In Russ.)