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Russian Economy Model: Post-industrial Society without Industrial Sector

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ABSTRACT

The study's relevance is due to the gradual transition of different countries of the world to a post-industrial economy, in which the share of industrial employment is significantly reduced. However, this process is usually associated with high social costs and management mistakes. Russia is not a happy exception to this rule. The article aims to identify the pain points of the Russian labour market and the higher education system caused by the transition process. For this purpose, based on the data of Rosstat, we considered the phenomenon of the educational bubble in the university sphere in 1992–2008 and the reasons for its occurrence. By using Russian and international statistics, it was possible to justify the gap between the sphere of higher education in Russia and the real sector of the economy. The analysis of the macroeconomic (aggregated) sectoral structure of the Russian economy and the higher education system did not reveal the existing personnel imbalances in Russia. This task we achieved by combining an external view of the manufacturing industry (comparison with other countries) and an internal one (study of its human resources potential). The main conclusion is that Russia is rebuilding the employment structure in the direction of the post-industrial stage of development. Still, at the same time, it does not have adequate support in the form of effective agricultural and industrial sectors. Such a transitive model of economic evolution is extremely inefficient and is fraught with the transformation of the country into a kind of "civilized colony" of the world system. To prevent this negative scenario, it is necessary, on the one hand, the most aggressive borrowing by the Russian industry of new technologies (including robots), on the other — the restoration of extremely close ties between universities and enterprises of the real sector of the economy. The model of the reintegration of universities and enterprises is a promising direction for further research.

Keywords: post-industrial society; higher education; top-level specialists; labour productivity; technological unemployment

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INTRODUCTION: NEW CHALLENGES – NEW PROBLEMS

The university system worldwide is currently undergoing tectonic changes. The transition to a post-industrial society and global geopolitical turbulence are making it extremely difficult for universities to decide which specialists they should train and for whom. The problems of higher education training (hereinafter referred to as the professional of the highest category — PHC) are compounded by an inefficient economy that generates misleading signals in system of higher education (HE).

In order to understand the challenges facing modern Russian HE, at least the following is necessary: assess the degree to which the sectoral structure of graduates corresponds to the sectoral structure of demand from the domestic economy; determine the degree to which the sectoral structure of the Russian economy and the university system correspond to similar indicators from the world's leading countries; identify the scale and location of existing personnel imbalances in Russia. The purpose of the article — is to obtain answers to these three questions using available information resources. The novelty of the work consists in a combination of traditional and non-traditional statistics, as well as in the superimposition of the view on the Russian HE both from outside and from within. These points will be explained in detail below.

SOURCES OF IMBALANCE IN DEMAND AND SUPPLY ON THE RUSSIAN LABOUR MARKET

The problem of unbalanced labour market and HE originates in the very history of modern Russia. Its genesis began almost immediately after the collapse of the USSR. The disintegration of the State had led to unprecedented de-industrialization of the economy, with all its attendant consequences. First of all, this has led to a disconnect between the country's industrial enterprises and universities. The manufacturing sector shrank, including in high-technology and knowledge-intensive areas, while the university sector has begun to grow excessively, including through the entry of private institutions into the education market (*figures 1–3*).

The mentioned phenomenon has already been reflected in literature and received the corresponding name — "educational bubble". At the same time, if the emphasis in Western literature is mainly on the study of the financial "educational bubble" related to credit for education [1–3], then Russian authors are more focused on the study of personnel imbalances and devaluation of higher education due to formation of "educational bubbles" [4].

The collapse of the USSR led to the so-called transformational recession of the economy, which lasted until 1998. The HE also experienced a primary depressive shock manifested in a drop in student numbers, but its duration was incomparably shorter — the fall lasted only until 1993 inclusive. At the same time, even the short-term decrease of the flow of students went against the background of the "inflated" infrastructure of the university sector: number of State universities of higher education immediately increased after the collapse of the USSR, and since 1993 this process has been reinforced by the emergence of private institutions. It was during this period that the volume and structure of PHC demand, as determined by the real economy, and the supply of personnel, as determined by HE, began to diverge systematically. The inertia in blowing up the "educational bubble" stretched for 17 years, until 2008, after which it began to blow up faster. As a result of these processes, the HE and manufacturing sectors, as well as the entire national economy, have been

Fig. 1. **Dynamics of manufacturing and the number of universities in the Russian Federation, 1991–2019**

Source: Rosstat.

developing in different directions over the past seven years, which indicates that higher education institutions have become disconnected from the country's real problems.

The scale of the resulting disconnection of the personnel subsystems is best illustrated by the following figures. In relation to its peak in 2008, the number of higher education establishments in 1991 was only 45.7%. The growth rate was even higher for the number of students, who in 1993 represented only 34.8 per cent of the total in 2008. This strong growth was accompanied by a catastrophic drop in GDP and manufacturing output. Thus, in 1998 the level of GDP was 57.3% of the pre-crisis level of 1990, and subsequently — 45.7% of the level of 2019. The manufacturing sector experienced an even greater difference, with output in 1998 at 41.5% of the pre-crisis level in 1990, compared to the year of the global maximum (2019) — 39.0%. This amplitude of different movements of a priori interrelated indicators by all standards can be considered unprecedented.

From 1999 to 2008, all four parameters considered were simultaneously increasing, but the 2008–2009 crisis pushed them down. GDP and manufacturing after the short-term recession started to rise again, while the "education bubble" continued to blow. As a result of these disruptions, the UAS and the real economy of the country from 2010 to 2019 were back in phase control.

To the above can be added that during the period of blowing up "educational bubble" 1990–2008, when the number of professors-teaching increased by 90.8%, and number of students — 2.9 times, population decreased by 3.3%, number of employed — at 5.7%, number of students in secondary education — at 32.4%.[1] This personnel dissonance is further evidence of the complete dislocation and disorientation of HE from the real economy.

These changes led to the establishment of almost universal higher education in Russia, with its simultaneous devaluation, when the diploma of the higher education institution ceased to serve as a guarantee of the graduates' professionalism and

[1] Calculated from Rosstat data.

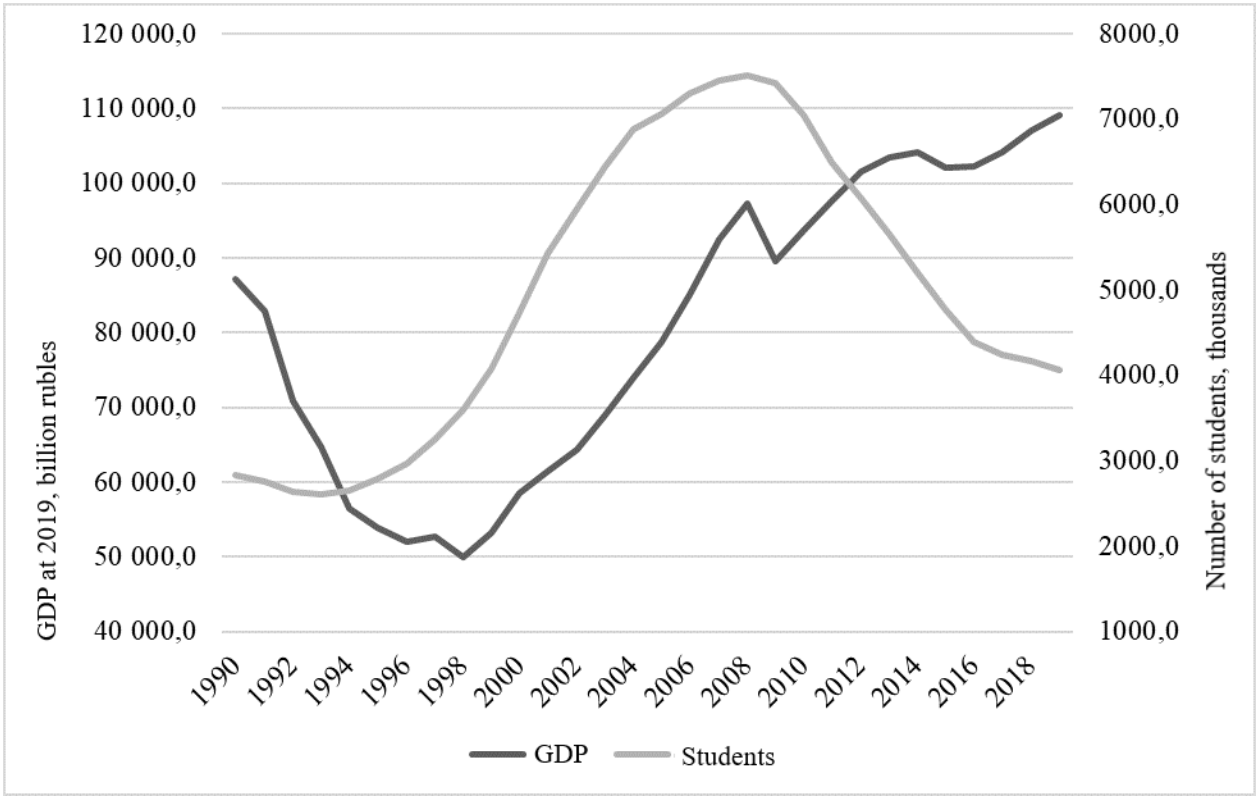

Fig. 2. **Dynamics of GDP and the number of students in the Russian Federation, 1990–2019**

Source: Rosstat.

competence and, consequently, as a reference for the employer. Market mechanisms were initially expected to give some signals to enterprises, universities and young people as to what skills were needed and promising. Gradually, however, the initial shortage in the labour market of certain professions was eliminated, while subsequent graduates no longer found adequate jobs. As a result, graduates have become randomly distributed among sectors of the economy, taking into account rapidly emerging vacancies, and work in the field of specialization has become a unique phenomenon. A survey carried out by Rabota.ru service together with portal Rambler in September 2020 showed that 64% of respondents did not work in this specialty, while 40% did not work in it for a day.[2] Thus, market expectations and market signals have not been realized: disorientation of the real economy prevented it from sending meaningful and sustained impulses to the education system, which in turn also had nothing to offer the real economy.[3]

Initially, the Government's misguided ideology led to the alternation of divergent regulatory trends in HE. For example, since 1991, the country has had a *deregulation regime* for higher education establishments, which has been characterized by a lack of management and monitoring by the Government of the Russian Federation and its agencies. This period was marked by a

[2] URL: https://news.rambler.ru/other/44834092-eksperty-vyyasnili-skolko-rossiyan-rabotayut-po-spetsialnosti/.

[3] A striking example of the complete disconnection of the education system from the needs of the market is the lawyers who, according to Rosobnadzor's estimates, produce 10 times more than the number needed by the domestic economy; this estimate is also confirmed by the statistics of the job search portal Career.ru, one lawyer vacancy for nine abstracts (URL: https://www.kommersant.ru/doc/3534212).

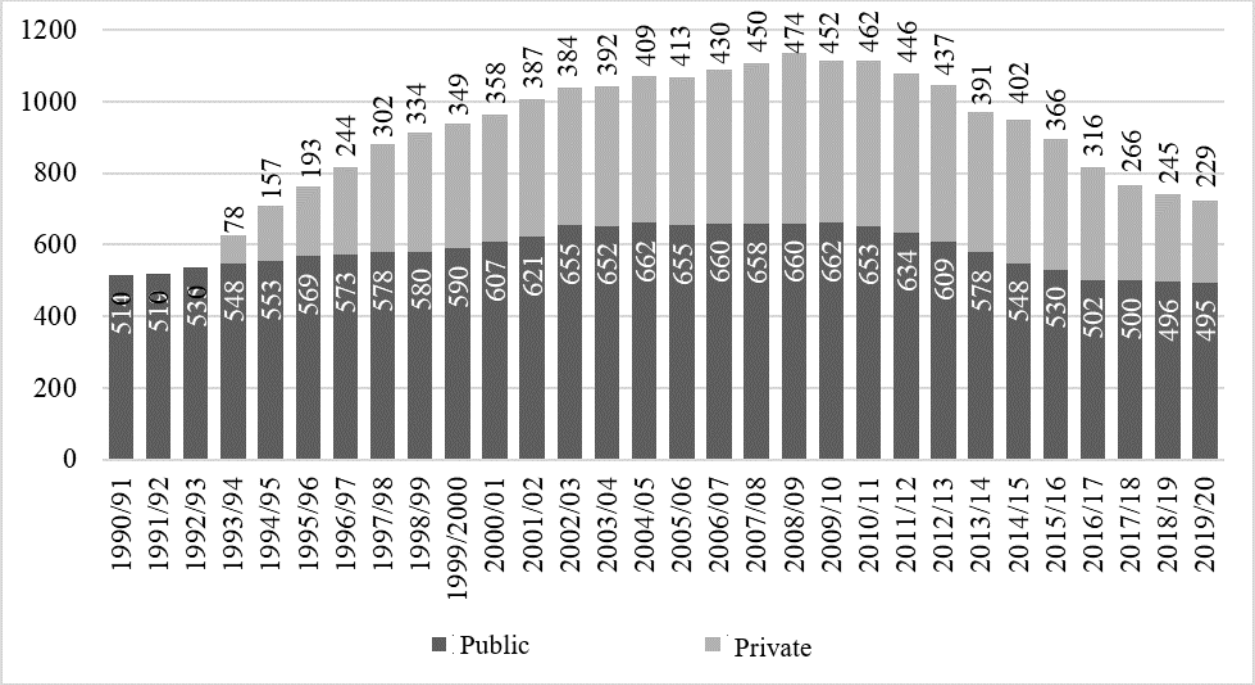

Fig. 3. **Number of public and private universities in the Russian Federation, 1990–2020**

Source: Rosstat.

quantitative increase in HE, with a parallel decline in the quality of training. Since 2010, this policy has been complemented by the wrong stratagem for the construction of a *university model of science* in Russia, which assumed the scientific priority of higher education institutions over other organizational forms of science — academic and sectoral (departmental) institutions. Such an arrangement led to the restructuring of state financing and supported by budget injections inflated "educational bubble". At the same time, a merger and takeover campaign is under way. However, by 2012, the country's budget was no longer able to adequately fund the bloated university sector. As a result, since 2014, the *hyperregulation* regime has been implemented with a characteristic of excessive activity of the public administration. From that point onwards, the total State monitoring of institutions of higher education for their effectiveness begins. *Control indicators* (targets) were used as tools for implementing such policies and were mandatory. As a result of the introduction of the evaluation system in 2014, 45.8% of all higher education institutions in the country were found to be ineffective (by the Ministry of Education). The policy of increasing the requirements for higher education is still being pursued through the introduction of new target indicators, which contribute to the compression of the HE.

The processes considered in Russia have coincided with a global paradigm shift in higher education. This involves a transition from the *career model* of the professorship to the home country with a corresponding high academic rent (including its intangible part) and individual contact with the student to a *business-model* with the annulment of the academic rent, focus on high-income universities and focused economies of scale [6, 7]. In recent years, the development of the HE business model has also been accelerated by new technological trends related to the widespread introduction of digitization and reformatting of educational standards (video

recordings of lectures, online lectures in remote access, complete abandonment of the traditional form of lectures, etc.) [8, 9].

At present, the real sector of the Russian economy is slowly but still growing, so there is a demand for certain groups of specialists. However, the situation is complicated by the world economy's entry into a global turbulence, with old professions dying and prospects for new ones — very uncertain. The gradual emergence of so-called *robotomics*, an economy based on the broadest introduction of robots to replace human labour, on the one hand contributes to technological unemployment and the exclusion of a number of occupations from the labour market [10], on the other hand, revealing the shortage of highly skilled professionals for the digital economy [11]. As a possible solution to this problem, researchers have proposed the introduction of a universal basic income [12, 13], the replacement of the classical consumption model by a business model of sharing economy [14], the development of creative activities [15] and other options [16]. However, without the re-establishment and strengthening of linkages between production and higher education, the problem could not be effectively addressed.

In summary, several sources of the current imbalance between labour market needs and the PHC supply can be identified.

1. *The historical factor* — is the destruction of the USSR and its socialist system, the formation of a new State in the shape of the Russian Federation on the basis of capitalism, the de-industrialization of the former economy and the destruction of the scientific sector, breaking the relationship between HE and the real economy.

2. *The ideological factor* — is the unsuccessful reliance on the self-regulation of the market system, to strike a balance between the demand for higher education and its supply by expanding the latter's status and earnings and disqualifying university workers.

3. *Inconsistency of the policy* — of regulation in the higher education sector — change of course from complete acquiescence and great freedom of higher education institutions with the emergence of "factories for the sale of diplomas" and the quality of education to the ultimate "tightening the screw" and the total control of all aspects of the activities of HE participants by the State, the growth of bureaucracy and formalism in creative spheres of activity.

4. *Change of paradigm* of higher education — from rent "service model" of professors — to business model of service delivery, from production of "one-piece commodity" in the form of elite specialists — to mass education in remote format with parallel collapse of the model of mass education from-for the death of mass professions.

5. *The change in the format* of higher education — large-scale digitization and epidemic threats (COVID-19) led to a shift away from off-line learning and traditional sermons in favour of a remote format, online-learning, new digital learning technologies and devaluation of university teachers.

6. *Global turbulence* in the global economic system — a failed political transition, rising geopolitical tensions, the development of new technologies with robotics creates disorientation of economic agents and HE with respect to future staffing needs.

METHODOLOGY FOR THE STUDY OF HUMAN RESOURCES IMBALANCES

In order to understand the extent of the current human resource imbalances in two of Russia's adjacent markets — labor and graduates — authors will consider several cross-cutting issues at the macro level. The proposed approach relates to the fact that, at the micro level, the problems are evident (school leavers do not know what professions will be needed or where to go; universities

Table 1

Percentage of university graduates by field of study, 2005, %

Economic sector	Countries of the world				Industrial dispersion
	Germany	USA	Korea	Russia	
Education	11.9	25.2	24.2	12.8	51.1
Arts and humanities	20.7	7.4	13.6	3.7	55.5
Social sciences, journalism and information	9.1	7.2	6.3	10.7	3.9
Business, administration and law	20.5	30.6	13.6	40.0	133.7
Science, mathematics and statistics	11.4	3.1	5.9	2.8	15.9
Information and communication technology	4.5	2.8	1.1	3.4	2.0
Design, production and construction	10.1	6.2	19.9	16.1	37.3
Agriculture, forestry, fisheries and veterinary science	1.4	0.8	1.2	3.5	1.5
Health and social security	9.4	14.8	11.9	3.4	23.5
Services	1.0	1.9	2.3	3.6	1.2
Correlation coefficient with Russia	0.56	0.77	0.44	–	–

Source: compiled by the authors according to OECD data.

do not know who and for whom to train; university administrators do not understand how to recruit teachers who meet modern requirements; enterprises do not know, where to find skilled workers and where to look for them, etc.), at the macro level, the extent of human resource imbalances is not well understood. Further research should therefore result in a portrait of existing personnel distortions in the HE. To this end, a consistent analysis of several problem areas is feasible.

1. Author's shall determine the degree of conformity of the sectoral structure of the Russian PHC and that of other countries with advanced economies; and the conformity of the sectoral structure of employment with that of the Russian economy and other developed countries; education of the Russian labour force in various branches of the economy and the level of sectoral requirements for the HE.

2. Let's find out the "quality" of the PHC of the manufacturing sector and the graduates prepared for it from the point of view of international standards.

CROSS-COUNTRY ANALYSIS OF GRADUATE'S STRUCTURE IN HE

For our purposes, it is necessary to compare the structure of graduates in the larger areas of training over the last decade and a half for several countries. The representative composition of the latter is minimal — the USA (the technological leader of the world economy), South Korea (the technological leader of Asia), and Germany (the technological leader of continental Europe).

Table 2

Percentage of university graduates by field of study, 2018, %

Economic sector	Countries of the world				Industrial dispersion
	Германия	США	Корея	Россия	
Education	9.2	16.0	17.2	5.9	29.4
Arts and humanities	16.5	6.5	12.8	5.8	26.4
Social sciences, journalism and information	7.9	6.8	9.0	8.4	0.9
Business, administration and law	20.6	27.0	18.8	20.5	13.0
Science, mathematics and statistics	11.3	4.2	5.1	6.0	10.2
Information and communication technology	4.5	5.1	3.0	4.4	0.8
Design, production and construction	19.5	7.1	15.0	22.5	44.9
Agriculture, forestry, fisheries and veterinary science	1.5	0.7	1.3	2.7	0.7
Health and social security	7.9	23.2	14.2	16.1	39.7
Services	1.1	3.4	3.4	7.7	7.6
Correlation coefficient with Russia	0.69	0.62	0.68	–	–

Source: compiled by the authors according to OECD data.

Cross-country comparisons will show how far the Russian HE model is moving out of the world trends in PHC preparation. Estimated data for four countries, presented to draw in the *table 1, 2*, following conclusions.

First, the model of PHC reproduction has changed in Russia over the years. For example, in 2005, the structure of student output was the most similar to that of the United States system of education [the correlation between Russian and United States employment structures was the highest compared to two other countries (*table. 1*)], in 2018, this gained more similarities to the Germany model (*table 2*). It is hardly a mistake to say that in the early 21st century Russian government tried to copy the American model of training, perceiving the United States as a model and reference for the university system. However, during the first two decades of the 21st century, American universities slowly but surely lost ground on the top of global university rankings [17]. This, along with the complications of Russian-United States political relations, led to the reorientation of the domestic HE towards a more conservative European continental model towards the end of the second century. At the same time, this development took place against the background of a global convergence of training models from different countries — the differences between the personnel structures of the four States considered in 14 years became much smaller. In this way, Russia was following the trend of unifying national models for the preparation of PHC, with a slight shift from Anglo-Saxon to Euro-continental formats.

Second, the Russian industry structure

Table 3

Industry distribution of employed in the world economy in 2008, %

Economic sector	Countries of the world		
	Germany	South Korea	Russia
Agriculture, forestry and fisheries	1.2	5.0	5.9
Mining and quarrying	0.2	0.1	2.3
Manufacturing	19.1	16.8	14.1
Electricity, gas, steam and air conditioning	0.8	0.3	2.7
Water supply, sewerage, waste management and environmental remediation	0.6	0.5	0.7
Construction	6.7	7.6	7.1
Wholesale and retail trade, repair of motor vehicles and motorcycles	13.9	13.9	15.9
Transport and storage	5.1	5.2	8.6
Accommodation and catering	3.8	8.4	2.6
Information and communication	3.2	3.1	1.8
Financial activities and insurance	3.0	3.1	2.3
Real estate	0.5	2.0	1.7
Professional, scientific and technical activities	5.7	4.1	3.2
Activities in administrative and support services	5.0	4.9	2.4
Public administration and defence; compulsory social insurance	6.9	4.1	7.1
Education	6.7	6.9	9.5
Activities in health and social services	13.0	7.6	8.0
Art, entertainment and leisure	1.3	1.7	1.8
Other activities in services	3.4	4.8	2.4

Source: compiled by the authors according to OECD data.

of the PHC produced during the 14 years reviewed has levelled very markedly, and the existing personnel "fluxes" have largely dissipated. For example, in 2005 the share of trained personnel in the arts and humanities in Russia was 5.6 times lower than in Germany, and in 2018 — already 2.8 times lower. We can also speak about the underdeveloped field of training of doctors, whose share in 2005 in Russia was 4.4 times less than in the USA and in 2018 — already only 1.4 times. At the same time in 2005, Russia was still blowing up a personnel bubble in social specialties (business, management, law), as a result, the corresponding share of Russian HE graduates was almost twice as high as in Germany, almost 1.5 times as high as in the USA and almost 3 times as high as in South Korea. In 2018, the hypertrophy of this branch of training in Russia was eliminated, and its

share adopted the standard values. It is a remarkable fact that the previous "overflow" of abstract managers in the direction of specific industrial production in 2018 has been replaced by accelerated training of engineering personnel in comparison with three other countries.

In view of the above, it can be said that over the past decade and a half Russia has overcome obvious distortions in the structure of the preparation of the PHC and has built a model of HE that is not very different from other developed States of the world. In our view, this is due in large part to the *simulation* activities of both the regulator and the participants in the HE-market imitating international standards and norms. Nevertheless, country comparisons indicate that there are no strategic errors in PHC preparation in Russia. Author's will check this point below on the basis of other statistics..

CROSS-COUNTRY ANALYSIS OF SECTORAL EMPLOYMENT

The next step in establishing personnel discrepancies in the Russian education system in relation to current requirements is to compare the sectoral employment structures of the three countries.[4] The results of this comparison are shown in *table 3* on the basis of which the following conclusions can be drawn.

First, the structure of employment in the Russian economy is not very different from that in other developed countries. The differences are within acceptable values and can be attributed to the national specificities of economic models. For example, a large share of Russia's mining sector is objective and unattainable due to the country's endowment of natural resources compared to, for example, South Korea. Similarly, the "excess" of 3.5% in transport and storage in Russia is due to the fact of the length of road communications and the need to service the mining sector. Overall, there are no global differences in employment patterns between Russia and other countries (Germany and South Korea). Consequently, the Russian economy is in line with global economic trends.

Second, the most noticeable "failure" of the Russian economic structure is the state of two branches — manufacturing industry and scientific and technical activity. In comparison with Germany, the share of the first industry in Russia "is insufficient" 5% of the total number of employees, and the share of the second — j2.5%. Both are directly linked to technological progress and largely shape the national economy. Taking into account the cumulative gap between Russia and Germany (7.5%) and South Korea (5.6%), it can be argued that Russia needs a certain manpower shift towards knowledge-based activities. The requirement to meet the modern standard — the relative scale of the two industries in Germany and South Korea — means that the Russian engineering market needs to be replenished by 4.1–5.4 million people. It is here that there *is a disturbing fact in the form of a pressure point of the Russian Federation's HE for processing plants*. However, the share of manufacturing in developed countries is declining as its technological level and productivity increase, so that the shortage of engineering specialties in Russian PHC doesn't seem catastrophic.

LEVEL OF EDUCATION OF RUSSIAN STAFF

The third step in understanding the scope of "national disaster" in the field of training is to consider the level of education of employees of branches of the Russian economy, as which we will use the share of persons with higher education in the total employment of

[4] Due to international sanctions against Russia, the USA is blocking Russian users from accessing American statistics. This fact led us to consider only three countries later, but this does not affect the objectivity of the results.

Table 4

The level of education of employment in the Russian economy sectors, 2019

Economic sector	Коэффициент образованности, %
Agriculture, forestry and fisheries	12.9
Mining and quarrying	29.8
Manufacturing	26.8
Electricity, gas, steam and air conditioning	33.4
Water supply, sewerage, waste management and environmental remediation	23.4
Construction	25.5
Wholesale and retail trade, repair of motor vehicles and motorcycles	25.3
Transport and storage	20.4
Accommodation and catering	18.2
Information and communication	63.3
Financial activities and insurance	68.2
Real estate	30.8
Professional, scientific and technical activities	73.0
Activities in administrative and support services	34.1
Public administration and defence; compulsory social insurance	58.5
Education	55.7
Activities in health and social services	35.0
Art, entertainment and leisure	46.1

Source: compiled by the authors according to Rosstat data.

the branch (educational rate) (*table 4*). The following paradoxical conclusions can be drawn from the data.

First, despite the phenomenon of the "educational bubble" with its consequence in the form of the phenomenon of universal higher education, the share of PHC in the Russian economy is still suspiciously small.

According to Rosstat data, the average education rate of the Russian economy in 2019 was 34.2%. To illustrate this anomaly, authors will make some rough calculations. Available data indicate that by 2020, 24.3 million people with higher education were working in the country. In 1992, the education rate of the employed in Russia was 16.1 per cent, with a corresponding figure of 11.4 million. Given a period of less than 30 years of analysis, it is reasonable to assume that the age group of today's 50+ workers consists of people who have been employed in the economy since 1992. By 2020, 27.6 per cent of the total number of employed persons were employed. If we assume that among these people the share of specialists with higher education is at the level of 1992, then today the number of PHC of the previous era (USSR) is 3.2 million people. According to Rosstat's

data, the number of graduates for the period 1992–2020 was 27.8 million. that the largest number of registered PHC in the domestic economy. All 27.8 million "new" PHC have entered the labour market in the past 30 years and remain there because of their still small age — less than 52 years. If you add to them "old" PHC, the total number of employees with higher education should be about 32 million (not 24.3 million according to available data). We stress that we have estimated the minimum value of potential PHC. Thus, we come to the paradoxical conclusion that in past years the country "produced" about 8 million people with higher education, which have "disappeared" without a trace.[5]

The human resources imbalance identified is not a random but a systemic phenomenon. Similar computational operations for agriculture, forestry and fisheries are feasible to prove this thesis. By 2020, it had 4.2 million employees (see *table 3*). Of these, only 540,000 persons have higher education (see *table. 4*), of which 150,000 in turn — "old" (Soviet) cadres. Consequently, "new" PHC amounted to only 390 thousand people, while according to our calculations according to Rosstat data for the period 1992–2020. PHC countries prepared for the industry 905 thousand person. Thus, more than half a million certified specialists of the agrarian sector, forestry and fishing "disappeared without a trace".

The human resources imbalances identified were too significant to be overlooked and needed to be assessed. Without going into unsubstantiated hypotheses, we will only indicate the possible fate of the 8 million army of qualified personnel of various specialties. Apparently, these HE graduates created a peculiar "personnel canopy", which for various reasons proved to be inactive, and therefore distributed through several channels: migration from the country[6]; existence of a double and triple account in connection with the acquisition by many people of several higher entities[7]; migration to the informal sector[8]; Leaving for the household sector; marginalizing university graduates from declassification and employment in areas not requiring higher education[9] (with corresponding omission from statistics), to complete social deprivation (long-term unemployed, small rentier,[10] homeless persons, etc.).

The main conclusion from the previous analysis is that the country's education bubble has led to the separation of HE from the real economy in the form of the supply of surplus and unutilized skills to the labour

[5] Given the assumptions, in fact, a more realistic figure could be 10 million.

[6] In the Global Talent Competitiveness Index (GTCI), Russia ranked 106th out of 119 countries in 2018 on the criterion of attracting (creating opportunities) talent — member rating [18, p. 24]. Concrete examples of "leakage" from Russia of such innovators as Google founder S. Bryn, inventors of graphene and Nobel laureates in physics A. Geim and K. Novoselov (who refused an offer to work in Skolkovo), Founder of the social network Vkontakte and cross-platform messenger Telegram P. Durov (who emigrated due to conflict with the Federal Security Service of the Russian Federation) etc. only confirm the pronounced loss of Russian "brains".

[7] Until recently, it was considered a sign of good taste to have several degrees in higher education. For example, engineering and economic higher education was a prerequisite for employment in the ROSNANO Corporation.

[8] According to estimates by various scientific and analytical organizations, the share of informal employment in the Russian labour market by the end of the Second Decade 21st was 22–45%. URL: https://d-russia.ru/wp-content/uploads/2017/11/Skills_Outline_web_tcm26–175469.pdf.

[9] According to estimates by analysts at the Higher School of Economics (HSE), half of Russians with higher education do not work in the field of specialization, and 26.6% of university graduates accept professional declassification for positions that do not require higher education; 41.2% of agricultural graduates. URL: http://demoscope.ru/weekly/2017/0713/tema01.php. According to Rosstat's estimation, about 60% of the economically active population work outside their specialty and up to 73% according to Rostrud's estimation. URL: https://russian.eurasianet.org/node/65166.

[10] Characteristic is the example of a resident of Moscow who, having received three higher education in physics, mathematics and economics, did not work half of his life anywhere, living on the income from renting his inheritance of a one-room apartment in the capital.

Table 5

Manufacturing productivity in the different countries of the world in 2019 (in constant prices 2015)

Country	Absolute LP, thous. USD / person	Relative LP	
		Base — Russia, time	Base — USA, %
USA	137.2	6.0	100.0
South Korea	97.7	4.3	71.2
Germany	89.1	3.9	64.9
Russia	22.9	1.0	16.7

Source: compiled by the authors according to UNDATA and ILOSTAT data.

Table 6

Industry robotization in different countries of the world, 2018

Country	Absolute robotization, robot units / 10,000 people in manufacturing	Relative robotization	
		Base — Russia, time	Base — South Korea, %
South Korea	774	154.8	100.0
Germany	338	67.6	43.7
USA	217	43.4	28.0
Russia	5	1.0	0.6

Source: compiled by the authors*.

* URL: https://econs.online/articles/details/gde-bolshe-vsego-robotov/.

market. The logical outcome of such a process was the paradoxical "evaporation" of 8–10 million top-level professionals. The reasons for the non-availability of persons with a higher education are obvious: the lack of jobs in the Russian economy for graduates of the relevant HE and their unsuitability for work and, consequently, inability to work in the specialty at the required level of the market.

Second, the Russian economy faces glaring structural-industrial discrepancies as a workforce. For example, the rate of education in manufacturing is lower than in mining, which is an obvious economic nonsense. Equally shocking is the fact that people in the arts, sports, entertainment and leisure sectors are 1.7 times more educated than those in manufacturing. These facts once again confirm the inadequacy of the demand of the branches of the economy for the quality of the personnel attracted, in particular the lack of use of HE graduates from knowledge-intensive sectors.

HIGH-TECH SECTOR OF THE ECONOMY: LOOKING FROM WITHIN

The above-mentioned macroeconomic human resource imbalances in the Russian economy make it possible to formulate a hypothesis on the low quality of graduates of the Russian HE. To test this hypothesis, it's sufficient to consider labour productivity (LP) in manufacturing in four reference countries

(*table 5*). The calculations show an ugly and unexpected picture.

First, the global high-technology marketplace has undergone major changes and country rankings. For example, one of the world's traditional industrial leaders — Germany — has already yielded to South Korea, which in turn is actively pursuing the USA. This fact proves once again that Europe, even through its champion, lags behind the leading Asian countries. Moreover, at the Macroeconomic Research Centre of the Financial University under the Government of the Russian Federation in 2019, further calculations were made to define the technological boundary,[11] of which the value was equal to 71.7%. From the *table 5* shows that South Korea has reached this level of technological frontier and can compete fully with the US in high-tech development, while Germany is still below that frontier and cannot claim leadership in the new industry.

Second, the technological level of Russia's manufacturing industry is extremely low. For example, the LP of a given industry is a fraction of that of three reference countries. At the same time, the trend of recent years is of particular concern: while in 2000 the relative LP in USA to Russia was 6.5 times, in 2017 it decreased to 5.2 times [19], then in 2019, it went up again to 6 times. All this clearly shows that the Russian manufacturing arsenal is archaic and the engineering personnel working in the industry have qualifications that do not meet any international requirements and standards. It is this circumstance that creates a stalemate in the human resources sector — the manufacturing industries of the country are not developed and therefore do not use qualified engineering personnel, but higher education institutions, without the possibility of establishing direct links with high-tech companies, training staff on patterns software.[12]

Recent popular statistics on the density of the robotization of national economies fully confirm the above findings (*table 6*). In fact, Russia is at the earliest stage of robotics, which determines the problems described.

Thus, an attempt to look inside the domestic manufacturing industry reveals an unpleasant fact: the quality of Russian engineers is 6 times lower than that of American engineers, and the quality of jobs in manufacturing plants — is 43 times lower. And this is the main consequence of the "educational bubble" 1991–2007. The very slow modernization of jobs leads to their archaic nature, resulting in a lack of demand for highly skilled engineers, which in turn makes it impossible to accelerate the modernization of production. The circle is closing, with the result that the real economy and HE continue to exist semi-autonomous, falling further behind the world's technological leaders.

ENGINEERING TRAINING: A TEST OF INTERNATIONAL COMPETITIVENESS

The above was found to be a professional failure of Russian engineers. This is a very categorical and unpleasant conclusion that requires further substantiation and evidence. In this context, consider the international competitiveness of the engineering personnel being trained by the Russian HE, for which we will take advantage of the information provided by the rating company QS on the degree of success of different universities of the world in different scientific and practical directions in this field (*table 7*).

We will make some preliminary methodological comments. The subject

[11] In this case, the technology boundary refers to the relative level of the leading country's (USA) LP, which exceeds the level of readiness of the country/industry to move from a policy of borrowing foreign technologies to their development and domestically.

[12] According to the Russian Public Opinion Research Center survey, 91% of Russian employers consider that university graduates lack practical skills (Russia 2025…, 2017, p. 40).

Table 7

The Russian universities in the QS World University Ranking by Subject 2021

Russian universities	Engineering Science and Technology	Scientific fields					
		Informatics and information technology	Chemical technology	Engineering in electronics	Engineering, aerospace and industrial engineering	Engineering in the mining industry	Engineering in the oil industry
Lomonosov Moscow State University	67	58	–	–	67	–	32
National Research University ITMO	160	74	–	201–250	251–300	–	–
Novosibirsk National Research State University NSU	206	301–350	151–200	251–300	251–300	–	51–100
St. Petersburg State University	218	151–200	–	–	–	–	51–100
National Research Technological University MISSIS	285	–	–	451–500	201–250	42	51–100
National Research Tomsk Polytechnic University	288	351–400	201–250	251–300	201–250	–	23
Ural Federal University named after the first President of Russia B.N. Yeltsin	401–450	451–500	–	401–450	351–400	–	51–100
Kazan Federal University	–	501–550	351–400	–	–	–	51–100
St. Petersburg Mining University	–	–	–	–	–	12	101–150

Source: compiled by the authors according to QS data.

rankings of global rankers provide very important information about which sciences and disciplines universities in different countries are successful. In author's opinion, the most representative information of this kind is provided by the company *Quacquarelli Symonds* (QS). At the same time, a convenient empirical rule has been established: reaching world level in the respective subject areas is characteristic of higher education institutions which have entered the top-50 subject ratings [17]. Let us recall that World Class Universities (WCU) status has traditionally been claimed by Top 100 Global University Rankings (GUR), however, there are many specialized universities that do not conduct research in a broad range of scientific fields, but that do have outstanding results in one or two specific areas. Such success becomes undeniable, usually when the university is ranked in the top-50 subject ratings. It is this criterion that can be used to diagnose the international competitiveness of Russian higher educational establishments in engineering fields.

From the *table 7,* a few important conclusions follow.

First, in Russia there are 4 universities that train world-class engineering cadres, but they all train specialists primarily for the mining industry — mining (MISSIS, St. Petersburg Mining University) and oil [Lomonosov Moscow State University, National Research Tomsk Polytechnic University]. Thus, world-class engineering personnel for manufacturing industries in Russia are not prepared at all, which confirms the previously formulated thesis that there are no specialists in this field in the country.

Second, there are five other universities in the country that produce, if not the most advanced but sufficiently qualified engineering cadres (National Research University ITMO, Novosibirsk National Research, St. Petersburg State University, Ural Federal University, Kazan Federal University). These universities have entered the second half of the list of top-100 subject rating QS. This fact shows that these higher schools have some potential for the reproduction of high-class engineers, but once again we find that they are personnel for the purely oil industry. The insignificant impact of MSU and ITMO in the field of information technology and engineering is not sufficient to support modern types of manufacturing.

With regard to higher education establishments listed as 101–500, in addition to the 9 listed institutions, there are 14 such institutions in the Russian Federation. These 23 universities form the nucleus of the HE, in which the training of engineers of satisfactory quality can be provided in the future. In the next 5–10 years, however, graduates of these institutions are likely to be unable to develop the manufacturing technologies of the Fourth Industrial Revolution. In this way, *table 7* confirms the earlier conclusion that Russia does not have the necessary human capacity for impending robotics.

CONCLUSION: A POST-INDUSTRIAL WORLD WITHOUT INDUSTRY

An analysis of the country's human resources imbalances provides a clear picture of the following features.

First, superficial monitoring of personnel macro-projects in employment and university students does not allow to "catch" existing problems on the labour market. Moreover, a consolidated analysis of staffing structures by type of activity, on the contrary, masks the seriousness of the accumulated imbalances. This fact calls for the examination of the labour market "from within" for the assessment of the quality of the available personnel and their demand by the real sector of the economy.

Second, the phenomenon of the "education bubble" of the last 30 years has led to a complete severance of ties between the HE and the real economy. As a result of this development, Russian universities are generating an excess of graduates, mostly *general* and very *obsolete* knowledge, not aimed at rapid integration into the modern economy. Due to the flexibility and adaptability of the labour force, the problems of most branches of the economy are somehow solved by the mutual "fitting" of workers and jobs, but there are also segments of it whose staffing cannot be solved by such spontaneous "learning" population in the workplace. The key economic sector of this type is the manufacturing industry, which accumulates all modern advances in technology and imposes high engineering skill requirements. Today, it is manufacturing that acts as a "bottleneck" in the domestic labour market, where there is a clear professional stagnation.

Thirdly, the developed world is now moving towards a post-industrial economy, while Russia cannot organically fit into that process. This is because the post-industrial economy implies little employment in the agricultural and industrial sectors and a concentration of the rest of the working population in services.

However, this economic model is based on extremely high productivity in the agricultural and industrial sectors.[13] In Russia, this basic condition has not been met, and it enters the post-industrial world with extremely inefficient agriculture and industry. The social consequences of building a service society without economic constructs in the form of these two branches can be most negative.[14]

To sum up, the break-up that took place in 1991 between the HE and the real economy has led to a vicious circle of technological innovation that has not yet been broken. The which contributed to the accumulation of serious human resource imbalances in the country and a technological failure in the manufacturing sector. Unless the close links between the universities and the market sector are re-established and a technological leap is made in industry through the most aggressive borrowing of new technologies, This state of affairs is fraught with the possibility of building a post-industrial society without a developed industry like the underdeveloped countries of the third world.

[13] The scale of the technological transformation envisaged is enormous. A study carried out by *The Boston Consulting Group* found that Russia also has single acts of modernization. For example, a number of domestic dairy farms, which used to require 250 milkmaids per 5 million head, now have the same number of heads for 2 operators and a robot milkmaids. (https://d-russia.ru/wp-content/uploads/2017/11/Skills_Outline_web_tcm26–175469.pdf). On the whole, however, such acts do not change the situation: Russia's LP in the agricultural sector is about 4.5 times lower than in the US.

[14] We emphasize that Russia is characterized by extremely sluggish borrowing of new technologies. For example, in 2015, Russia purchased 550 industrial robots and China bought 69 thous. (https://www.vedomosti.ru/technology/articles/2016/11/14/664697-roboti-ne-prizhivayutsya). Even adjusting these figures for the size of the population, it is easy to see that China is on an order of magnitude more active in modernizing production equipment. Against this background, it is particularly disharmonizing that the purchase of service robots (in the sphere of medicine, education, etc.) in Russia is much more active. It is clear that in the long run this will lead to a complete loss of the country's economic and technological independence.

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