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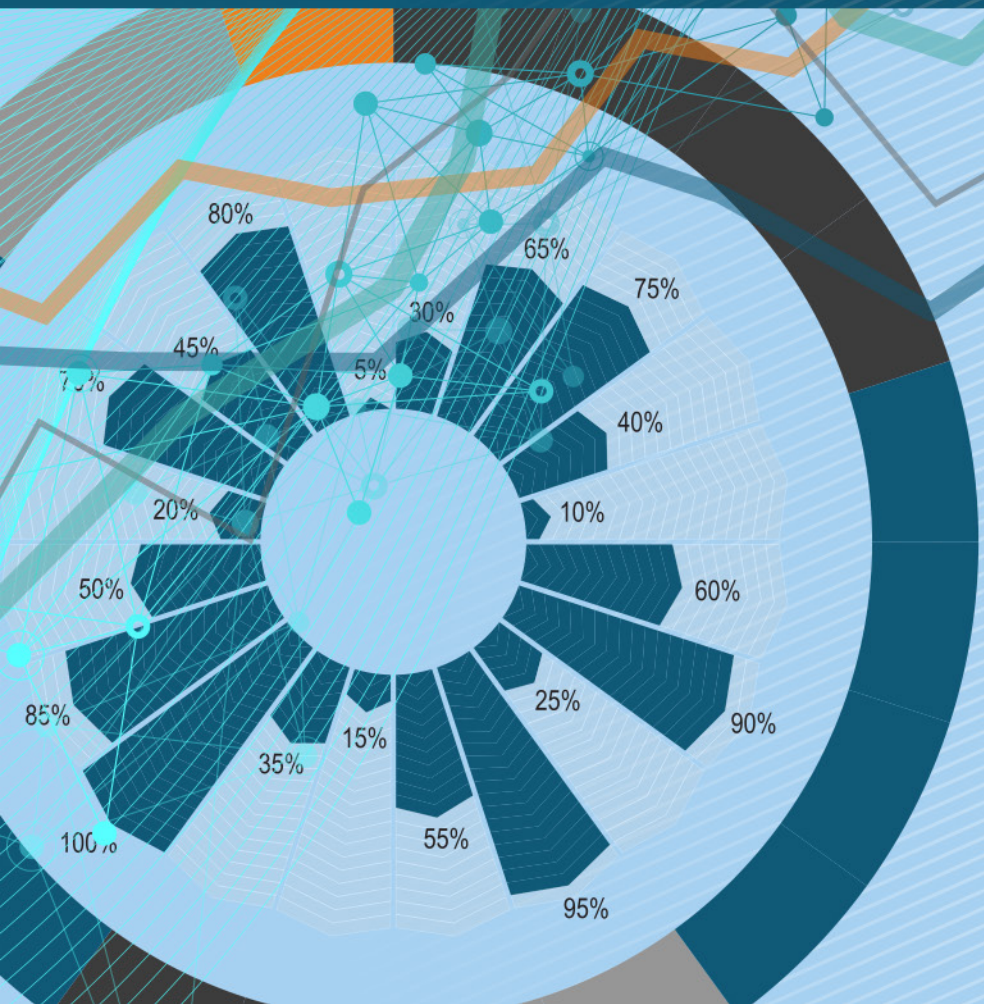

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Contents

GLOBAL COMPETITIVENESS

New phenomena in the international localisation of investments in sustainable energy and digitalisation 4
Igor A. Karachev, Elena V. Sapir

National features of Central Bank Digital Currency (CBDC) development in the post-covid period: global experience 14
Elizaveta A. Mosakova

Study of the correlation between the growth rates of interregional trade and GDP of the EAEU member countries 21
Maksim I. Markin

NATIONAL COMPETITIVENESS

Russian ecosystems market and specific features of its performance 30
Vera V. Matersheva

REGIONS COMPETITIVENESS

Analysis of industrial digital development in the Ivanovo region 38
Oleg A. Savin

INDUSTRY COMPETITIVENESS

Compliance certification system development as a priority criterion for improving product competitiveness 47
Sofya A. Tsareva, Yana V. Denisova, Alexandra I. Semenova, Varvara A. Selezneva

YOUNG SCIENCE

Non-tariff regulation in the Eurasian Economic Union: current state and ways for improvement . 55
Anastasia A. Khoroshavina

Blockchain technology use in economic practice 63
Alexander S. Pryakhin, Maxim S. Komarov, Oksana V. Kosnikova

OPEN DISCUSSION

The issue of correlation between «digitalisation» and «humanisation» of the economy in the epoch of the great evolutionary breakthrough as the era of humanity transition to noospheric development 70
Alexander I. Subetto

New phenomena in the international localisation of investments in sustainable energy and digitalisation

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Abstract. The article analyzes new phenomena of international investments localization into the development of sustainable energy and related R&D technologies, digital solutions, and intersectoral projects. Paper identifies new trends in investment localization, and concerns, firstly, with shifting the focus of the investment process to industries characterized by intensive establishment of global value chains, primarily in the sectors of complex high-tech electronics and electrical equipment. Secondly, investors pay special attention to the latest digital solutions as an innovative metatechnology of production, regardless of industry specifics. Thirdly, paper notes strengthening of new players role among investors from developing countries, leading in the primary, extractive links of value chains in conditions of increasing demand for rare fossil elements and minerals from manufacturers of digital equipment and clean energy systems. Therefore, involvement of new global companies from developing countries in the processes of energy transition investing and creating sustainable energy, and active inclusion in international sustainable energy chains is a relevant issue. The paper considers controversial correlation of the decarbonization policy aimed at reducing greenhouse gas emissions into the atmosphere, growing need for additional energy consumption, and investment into design and development of «clean» industrial technologies. Hence, it makes most environmentally friendly industrial technologies commercially unavailable nowadays. We also agree with the United Nations Conference on Trade and Development (UNCTAD) proposal to develop a Global Compact for Action on Investments in Sustainable Energy.

Keywords: investments, sustainable energy, digitalization of the economy, global value chains, renewable energy sources, international investment projects.

JEL codes: F21, F64

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Introduction

Large-scale investments in sustainable energy and digitalization of the economy provide great opportunities for a global energy and digital technological transition. These investments are growing very rapidly worldwide in recent years, significantly surpassing investments into conventional industrial sector projects International investments in renewable energy and digital solutions have almost tripled since the adoption of the Paris Agreement in 2015. However, most of this expansion is concentrated in developed countries. More than 30 developing countries have not yet registered any international investment projects in the field of renewable energy sources (RES). These projects high capital intensity is a key barrier to energy investments in developing countries. Attracting international investors in partnership with the public sector and financial institutions significantly increases the effectiveness of project implementation.

Projects aimed at reducing the cost of capital and risk for energy transition investments in developing countries have been supported recently. International investment agreements provide additional technical assistance for investment planning and project preparation. They stimulated many countries to expand the economic space for combating climate change, and promoting and facilitating the investment. In 2023, in its annual Report on Global Investments, UNCTAD proposed a project of global agreement – «A global

Compact for Action on Investments in Sustainable Energy for All with Recommendations on National and International Investment Policies, Global and Regional Partnerships, Financing, and Capital Markets Participation» (World Investment Report, 2023).

Discussing this project, there is an issue of assessing the emerging trends and new phenomena of investment localisation for sustainable energy and digital development in recent years.

Main part

Trends in localization of investments in Global Value Chains (GVC) – intensive industries

The global shocks of recent years, including the COVID-19 pandemic, the Corona crisis, the disruption of traditional supply chains facilitating massive reshoring of industries, geopolitically engaged confrontations between key economic players in the energy, food, and high-tech markets resulted in the intensification of all types of economic and extra-economic risks in the world economy. The result has been an increase in international investment in industries with intensive use of global value chains (GVS). The number of announced new investment projects increased by 21.7% over the period 2020-2022, and their total cost – by 161.2% (see Table 1). Moreover, the cost and number of new investment projects increased most dynamically in the field of electronics and electrical equipment: by 31.4% (number of projects) and by 279.2% (cost of projects), respectively.

The global semiconductor deficit has prompted several investment megaprojects. The three largest projects announced for 2022 were precisely related to semiconductors: a Taiwanese semiconductor company announced a commitment to spend more than US $ 28 bn to develop advanced chips and build a new manufacturing plant in the US; Foxconn (also Taiwan) and Vedanta Resources (India) plan to invest US $ 19 bn to build one of India's first chip plants; and Intel (US) committed to invest a additional US $ 13 bn into its production in Ireland, the UK. As we can see, nowadays the specified production is not localized mainly in the labor-surplus region of Southeast Asia; the three largest projects are located across three main continents producing the final product: South Asia, North America, and Europe.

Table 1 – Sectors with intensive use of GVC: announced new investment projects in 2020-2022, number and cost (USD, mln)

Industry	2020	2021	2022	Industry share in project cost (2022), %	2022 / 2020, %
Investment projects in the industry with intensive use of GVC					
- value (total)	101,373	197,388	264, 813	100	261.2
- number (total)	2 ,796	3, 232	3, 402		121.7
including:					
Electronics and electrical equipment					
- value	47, 714	137,928	180,928	68.3	379.2
- number	888	1, 100	1, 167		131.4
Automotive industry					
- value	35, 096	38, 567	58, 949	22.3	168.0
- number	578	718	694		120.1
Machinery					
- value	7, 238	8, 061	12, 224	4.6	168.9
- number	670	650	727		108.5

Industry	2020	2021	2022	Industry share in project cost (2022), %	2022 / 2020, %
Other industries					
- value	11, 326	12, 883	12 ,712	4.8	112.2
- number	660	764	814		123.3

Source: composed by the authors according to FDi Markets[1]

Furthermore, GVC-intensive investments dominant in projects on electronics an electrical equipment. In the total value of all new investment projects of this type their share accounts for almost 70% (180.9 out of US $ 264.8 bn). The automotive industry, ranked 2nd, has only 22.3% of all newly announced projects value. The other branches of GVC-integrated production account for less than 10% of new investment projects total value.

Investment localisation trends in digital industries

Indeed, digital TNCs, as a rule, are less involved into new projects investment. Firstly, they have no requirement to invest in large tangible assets. Secondly, in digital business it is more common to merge or acquire competing companies or start-ups. E-commerce companies are exceptional ones; they need to establish logistics networks including warehouses, terminals, transshipment, and distribution facilities. The pandemic-induced boom in e-commerce investment activity continued in 2022. Indeed, it has lower rate, as boom declines as the global economy recovers from the pandemic. The number of projects decreased, but remained high compared to previous years (see Table 2). However, most of the decline concerns with the e-commerce giant Amazon (USA). It announced twice less projects in 2022 as in 2021. Overall, its total cost of US $18 bn was slightly lower than in 2021. The largest projects announced in 2022 included the launch of a new service infrastructure in Europe with headquarters in Switzerland. Their total cost is about US $ 5.9 bn, and a cloud infrastructure cost in Thailand is about US $ 5 bn.

Internet platforms also actively invested in new projects in 2022: the number of projects, as well as their cost, increased almost 1.5 times compared to 2020 and reached a record US $ 6.3 bn. Most of them were on the 2 largest platforms: Alphabet and Meta. Alphabet is actively investing. Over the past three years the company invests an average of US $ 3 bn annually in new projects. Meta's foreign investments in new projects increased significantly: from US $103 mln in 2021 to US $ 2.7 bn in 2022. The key geographical directions of this investment flow are as follows: investments of US $1.5 bn in a new R&D project in Canada, and US $1 bn to built a Data center in Spain. Apparently, the company aims to maintain equal parity between the North American and European destinations (World Investment Report, 2023).

Table 2 – Digital industries: announced new investment projects in 2020-2022, number and value (USD, mln)

Digital industry	2020	2021	2022	Industry share in project cost (2022), %	2022 / 2020, %
Investment projects in digital industries					
- value (total)	21, 211	31, 172	32, 057	100	151.1
- number (total)	306	376	338		110.5
including:					

[1] *FDi Markets. The crossborder investment monitor. Available at: https://www.fdimarkets.com / (accessed: 06.11.2023).*

Digital industry	2020	2021	2022	Industry share in project cost (2022), %	2022 / 2020, %
Digital content					
- value	506	1, 804	506	1.6	100
- number	30	43	37		123.3
Digital solutions					
- value	1, 206	2, 962	2, 929	9.1	242.9
- number	38	48	59		155.3
Electronic commerce					
- value	15, 214	23, 837	22, 368	69.8	147.0
- number	199	231	185		93.0
Internet platforms					
- value	4, 285	2, 569	6, 254	19.5	146.0
- number	39	54	57		146.2

Source: composed by the authors according to FDi Markets [2]

Challenges of decarbonisation and new demand for sustainable energy

The world is decarbonizing. Plans to reduce carbon dioxide emissions meet the commitments of the Paris Agreement on Climate Change and the plans adopted at the 26th United Nations Climate Change Conference (COP26) caused many international, national, and corporate initiatives aimed at eliminating net greenhouse gas emissions by the middle of the century. The plans of the major economies and manufacturers are very ambitious. The European Union predicts zero emissions by 2050 and aims to halve emissions over the next decade. China declared net zero by 2060; India aims to reach zero emissions by 2070. Simultaneously, customers and end-users have new demands on all sectors to gain assurances the products and services they supply do not exacerbate the problem.

All greenhouse gas (GHG) emissions are conditionally divided into three categories (Scope 1, Scope 2, Scope 3). Both greenhouse gas emissions from production itself and emissions from the purchase of electricity and heat (steam) are taken into account. According to experts, carbon emissions account for 81% of total greenhouse gas emissions.This is largely due to the production. The remaining GHG emissions include methane (10%), nitrous oxide (7%), and fluorinated gases (3%) (see Figure 1).

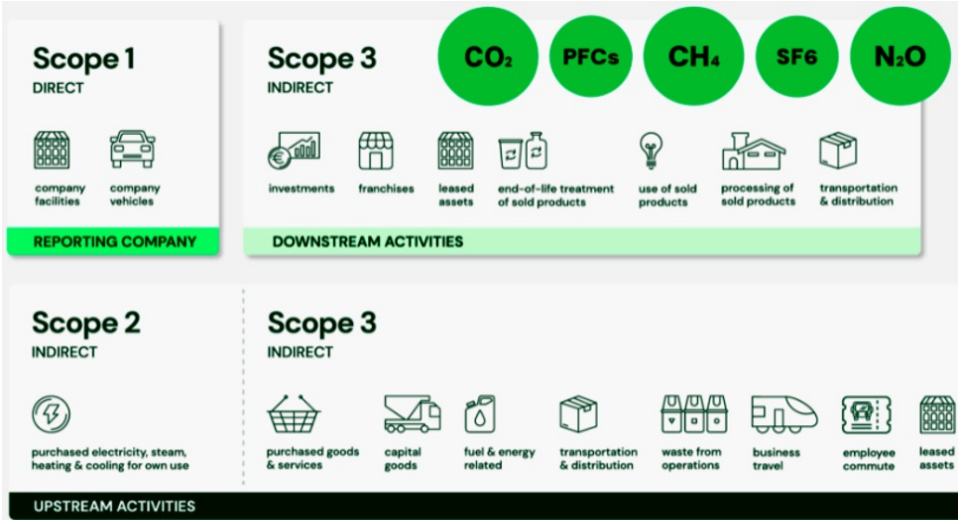

Figure 1. Three categories of greenhouse gas emissions

Source: Ranganathan et al., 2004

[2] *FDi Markets. The crossborder investment monitor. Available at: https://www.fdimarkets.com / (accessed: 06.11.2023).*

Category 1: direct emissions

Category 1 emissions are direct emissions from resources owned and controlled by the company. They are divided into four types. The first is stationary combustion (for example, heating, boiler room, etc.). The second is mobile combustion – emissions from all vehicles owned or controlled by the company (e.g. cars, buses, vans, lorries, etc.). The growing use of electric vehicles and electric buses and the associated growth in purchased power supply implies some activities of organisations' fleets may be classified as Category 2 emission generating activities. The third is volatile emissions – are greenhouse gas leakages (e.g. vapours from refrigeration, air conditioning, etc.). The fourth is technological emissions. They occur during industrial processes directly at the production site (for example, the release of CO2 during cement production, factory smoke emissions, chemical emissions as a side effect of petrochemical industries, etc.).

Category 2: indirect emissions

Category 2 emissions are indirect emissions from the production of purchased energy from a utility provider. There are all GHG emissions released into the atmosphere from the consumption of purchased electricity, steam, lighting, heat, and cooling. For most organizations, electricity is the only source of category 2 emissions.

Category 3: indirect emissions outside the company's control

Category 3 emissions are indirect emissions, not included in Category 2. They occur in the company's value chain, including both upstream and downstream emissions along the production chain of operations. In other words, emissions related to the company's activities. In accordance with the protocol on greenhouse gases, category 3 emissions are divided into 15 types. Activities generating Category 3 emissions include, for example, business travel (e.g., air travel, rail travel, metro and light rail, taxis, buses, and business travel using personal vehicles). Also, Category 3 also includes use of personal cars by employees for commuting to and from work, as they also generate GHG emissions. These emissions can be reduced by increasing the use of public transport, or by remote work from home. Emissions generated during operation refer to waste sent to landfills and treatment plants. Waste disposal releases methane (CH4) and nitrous oxide (N2O), which cause more damage than CO2 emissions.

The decarbonization trend imposes strict requirements on energy, since it accounts for a significant part of global emissions. Moreover, energy sector is one of the most energy-intensive industries; hydrocarbons still being the main raw material. And more than half of its total emissions belong to the first and second categories, i.e. they are the results of the organization activities. Reducing these emissions will require huge investments. According to the International Energy Agency, technologies which can achieve 75% of the required emission reductions by 2050 are currently commercially unavailable. The task challenging is evident in three scenarios developed by the German Chemical Industry Association. They show the possible change in greenhouse gas emissions over time. The roadmap developed by German experts describes the upcoming path to carbon neutrality from 2020 to 2050 in three possible directions, which can be understood as different levels of ambition (see Figure 2).

The basic path. The companies continue to manufacture products on the same technological basis. Their investments also remain at the current level and serve to maintain and improve system efficiency. Companies will pay more attention to recycling. Germany's energy supply will permanently reduce emissions due to the expected cessation of coal-fired power generation in 2038.

The technological path. Companies will invest into new «clean» technologies reducing CO2 emissions, which will be implemented as soon as they become economically profitable. The role of renewable energy sources in energy supply and increased processing of carbon-containing products will grow.

The path of carbon neutrality. All restrictions are removed on this pathway; carbon neutrality scheduled to be achieved by the middle of the 21st century. However, all traditional processes must be completely replaced by alternative ones (Geres et al., 2019).

The basic path will provide the German economy with a 27% reduction in GHG emissions by 2050 compared to the level in 2020 due to the gradual abandonment of coal and increased energy efficiency. The technological pathway will ensure a 61% reduction in GHG emissions by 2050 compared to the level

in 2020 due to increased investments in new processes. Although, the demand for electricity will increase approximately fourfold by 2050. The path of carbon neutrality will ensure by 2050 an almost 100 % reduction in GHG emissions due to maximum investments in alternative processes. Indeed, it increases the electricity demand by 11 times.

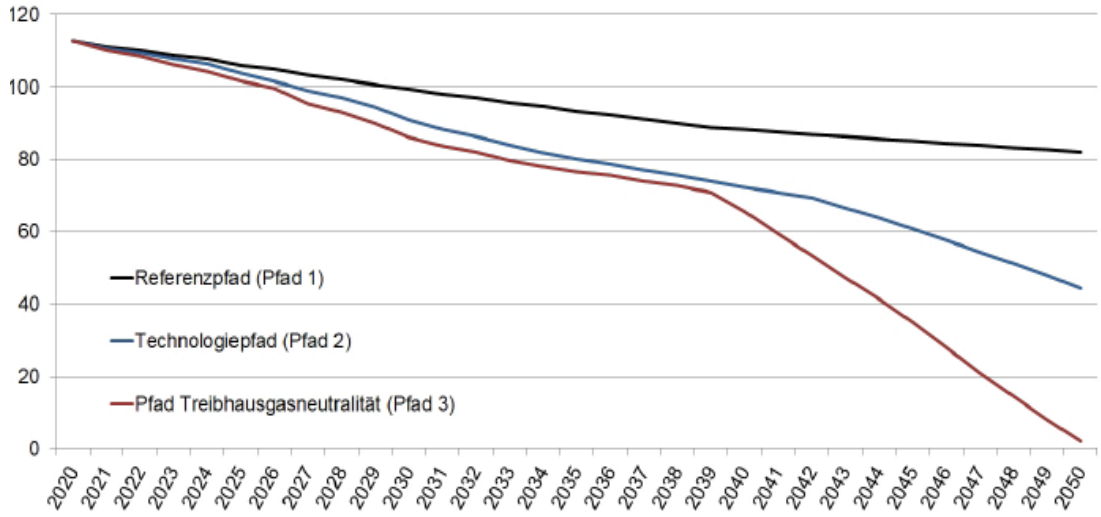

Figure 2. Dynamics of greenhouse gas emissions (in million tons with CO2-equivalent) from 2020 to 2050 according to three scenarios by the German Chemical Industry Association

Source: Geres et al., 2019

The more companies and countries strive for carbon neutrality, the more the associated costs increase. Therefore, decarbonization and the transition to sustainable energy are becoming a key task, without which the solution of the issues of achieving carbon neutrality can be delayed far beyond 2050.

Projects related to sustainable energy in developing countries

More than 80% of investments in digitalization and renewable energy are private ones. Today leaders are China and several developed countries. They are implementing the world largest investment projects in renewable energy technology. However, in recent years there has been a sharp increase and a shift in attracting investment in high-tech projects to developing countries. It is because production is becoming increasingly diversified and developing countries are actively occupying new niches in high-tech sectors, apply public funding, and actively co-operating with world-leading companies.

Most of the technology projects needed for the energy transition also enjoy government support in developing countries, large investments are made within countries, and the most ambitious projects are within the framework of joint projects with foreign private investors (see Table 3).

Table 3 – Top 10 largest internationally funded projects announced in 2022 in developing countries in the field of sustainable energy, USD mln

Country	Sector	Project name	Value
Vietnam	Renewables	Marine wind farm project with AES (USA) in Bin Tuan Province with a capacity of 4 GW[3]	13, 000
South Africa	Energy industry	Project «Green Hydrogen» with the output capacity of 500 thousand tons per year of green hydrogen by 2030[4]	10, 000

[3] *AES Corporation unveils a 4 GW offshore wind project in Vietnam. Available at: https://www.enerdata.net/publications/daily-energy-news/aes-corporation-unveils-4-gw-offshore-wind-project-vietnam.html (accessed: 06.11.2023).*

[4] *Green hydrogen vision. GH2 Country Portal – South Africa. Available at: https://gh2.org/countries/south-africa (accessed: 06.11.2023).*

Country	Sector	Project name	Value
Brazil	Renewables	Ceara marine wind farm project on the north-east coast of Brazil with a capacity of 3840 MW[5]	9, 462
China	Renewables	Joint project with Canadian Solar Inc. (Canada) to create a cross-industry new energy chain in Haidong. High-purity polysilicone plant with a capacity of 500 thousand per year for solar energy production[6]	8, 874
Egypt	Energy industry	Joint project with ReNewPower (India) to produce green hydrogen in the Suez Canal Special Economic Zone with a capacity of 220 thousand tons of green hydrogen per year[7]	8, 000
Thailand	Energy industry	Green hydrogen and ammonia plant project	7, 000
Mexico	Water, sanitation and hygiene	Desalination and pipeline project with IDE Technologies	5, 000
Sudan	Transport infrastructure	Abu Amama port construction	4, 000
Malaysia	Telecommunications	Project of construction of Technopark «Green Data Center» in Johor, with a capacity of 500 MW, working with solar energy[8]	3, 497
Ghana	Transport infrastructure	Western Railway Project in Ghana	3, 200

Source: composed by the authors

An additional phenomenon in the localisation of sustainable energy investments has been the dramatic increase in the presence of companies from developing countries in the pool of the world's largest investors. It increased the bias towards investing in the developing economies themselves (see Table 4). By table 4, the 10 largest global investors in the period 2015-2022 are 10 companies from EU countries and one company from Canada. They have implemented many different projects during this period: from 361 (Enel) to 95 (Impala). The global giants BP and Shell did not rank the top 10, although they placed 12th and 16th, respectively. The US investors mainly invested in domestic projects. The largest American sustainable energy companies NextEra Energy, AES, and Duke Energy implemented 59, 45 and 44 projects in the American market, respectively.

Against this background, there is an increase in the activity of investors from top 10 developing countries: China, Saudi Arabia, Singapore, the United Arab Emirates. Hence, the largest investors implemented 60-100 investment projects in sustainable energy and related digitalization during the study period: two Saudi companies – 103 projects; three Chinese companies – 84 projects; two companies from the UAE – 71 projects;

[5] *Geradora Eolica Brigadeiro – Costa Nordeste Offshore Wind Complex 3840 MW – Ceara. Available at: https://www.globaldata.com/store/report/geradora-eolica-brigadeiro-costa-nordeste-offshore-wind-complex-3840-mw-ceara-profile-snapshot/ (accessed: 06.11.2023)*

[6] *Qinghai Haidong New Energy Whole Industry Chain Project Signed. Available at: https://www.seetao.com/details/175632.html (accessed: 06.11.2023).*

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[8] *YTL Green Data Center Park launches in Johor, the First Integrated Data Center Park Powered by Renewable Solar Energy in Malaysia. Available at: https://www.ytl.com/shownews.asp?newsID=4892&category=pressreleases (accessed: 06.11.2023).*

2 Singaporean companies – 63 projects (World Investment Report, 2023).

Table 4 – The largest investors in sustainable energy (leaders by the number of projects in 2015-2022)

Developed countries			Developing countries		
Company	Industry	Country	Company	Industry	Country
Enel	Energy services	Italy	ACWA Power	Renewable energy	Saudi Arabia
Engie	Energy services	France	Abdul Latif Jameel	Multi industry	Saudi Arabia
Électricité de France	Energy services	France	Masdar Clean Energy	Renewable energy	UAE
Iberdrola	Energy services	Spain	Vena Energy	Infrastructure	Singapore
Energias de Portugal	Energy services	Portugal	China General Nuclear Power Corp	Energy industry	China
Canadian Solar	Renewable energy	Canada	Ayala Group	Multi industry	Philippines
RWE	Energy services	Germany	Power Construction Corporation of China	Energy industry	China
Total Energies	Oil and gas	France	AMEA Power	Renewable energy	UAE
Orsted (Dong Energy)	Renewable energy	Denmark	ReneSola	Renewable energy	China
Impala	Multi industry	France	Sembcorp Industries	Infrastructure	Singapore

Source: World Investment Report, 2023

Localisation of renewable energy value chains

Clean energy strategies are increasingly shaping industrial policy. There are new players emerging among developing countries in addition to traditional developed economies, aiming to establish themselves as production centres for clean energy technologies. The upstream and midstream links of renewable energy value chains – for now – remain concentrated in developed countries. But the middle and downstream links are strengthening in Asia, Latin America, Africa:

– firstly, the energy transition has increased the demand for metals and minerals. Copper, nickel, cobalt, aluminum, chromium, lithium, manganese, and molybdenum are required for a number of low-carbon technologies, in particular for wind turbines, solar photovoltaic panels and electric vehicle batteries. Moreover, solar energy production, transmission lines, and distribution cables also require large amounts of copper. These important minerals are traditionally mined in developing countries: the Democratic Republic of the Congo (cobalt), Indonesia (nickel), and Latin American countries (copper). Australia is one of the major extractor of minerals. However, currently the key location is China, which provides processing of 88% of rare earth metals, 65% cobalt, 58% lithium, 40% copper, and 35% nickel. But the situation is gradually changing. Over the past two years, the growth of announced investments in essential minerals has doubled, and further growth is expected. According to forecasts, the demand for copper in 2050 will double the supply in 2020, and the demand for nickel will triple. Lithium is expected to show the highest growth in demand, with a forecast value of 5 to 10 times. The shift of investments in the middle links of the GVC will occur towards the geographical location of the deposits (World Energy Transitions Outlook, 2022);

– secondly, the local concentration of international investment projects in the production of solar energy components is decreasing. In 2022, The top five destinations included the USA, Brazil, India, Vietnam, and China, which accounted for 42% of all projects. But other developing countries have also attracted large projects for the production of solar components: Malaysia, Turkey, Mexico, and South Africa (World Energy Outlook, 2022);

– thirdly, the main locations for the production of components for wind energy are increasingly being captured not only by developed, but also by developing countries. The UK, the USA, Turkey, India, and China have almost half of the total number of projects in 2016-2022;

– fourthly, the geography of the location of the key link in the electric vehicle production chain – the manufacture of batteries – has expanded. Before 2020, the world leaders in terms of investment inflows in the sector were companies from the EU, the USA, and China. Recently, investments have also actively gone to Brazil, India, Malaysia, and Mexico, which are the leading countries in the production of batteries (World Investment Report, 2023).

Conclusions

The research conducted allows us to draw the following conclusions.

The growing investments in the digitalization of the economy and sustainable energy reflect the processes of technological transformation of production. It is also primarily related to the formation of a global digital environment and ensuring a «green» economic course. These investments are significantly outpacing investments in conventional industrial projects.

In industries with intensive formation and use of global value chains, there is a faster growth in investments in the sectors of electronics, electrical equipment, and the automotive industry, mainly related to the production of electric vehicles and buses.

The Digital Solutions segment is the absolute leader in the group of digital industries in terms of the growth rate of attracted investments. It is significantly outperforming both e-commerce and the development of Internet platforms.

The transition to sustainable energy has attracted new players to the global market of «clean industrial technologies»; technology giants and large investors from developing countries are among them: China, India, Saudi Arabia, the United Arab Emirates, Singapore.

The sustainable energy and digitalisation investment gap will gradually shrink for developing countries due to an increase in the number and total value of projects localised. They also include the technology upgrades and supply chain restructuring in electronics, renewable energy, and electric vehicle manufacturing.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR'S CONTRIBUTION

Elena V. Sapir – Conceptualization, Project administrat
Igor A. Karachev – Writing – review, Editing

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National features of Central Bank Digital Currency (CBDC) development in the post-covid period: global experience

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Abstract. The article considers a new modern form of money – central bank digital currencies (CBDCs). Their main characteristics are security, fast and inexpensive transactions. Digital currencies are currently going through a stage of institutionalisation and active development. The Bank for International Settlements predicts that 20 per cent of regulators plan to launch retail CBDCs by 2026. Currently, the global community has not developed a unified position either on the issue of the expediency of their issuance (although every year more and more countries are engaged in their development and issuance), or on the issues of volumes and areas of regulation. A number of countries are taking a wait-and-see attitude, closely monitoring the development of digital currencies (e.g., Japan). Therefore, the study of global experience is extremely relevant, especially for Russia. The study identified a number of legislative, technical, and economic problems related to the functioning of digital currency. There are challenges on national governments recognition of digital currency as a legal tender; cybersecurity risks and threats; challenges caused by different ways of integrating digital currency into monetary policy; digital currency as a real threat to the entire global financial system, etc. Thus, the practical development and testing of CBDCs are one of the main trends in the modern monetary sphere development. However, as part of the development of CBDCs, in order to maintain public trust, the central bank should act by engaging with market participants while maintaining its primary role in the ecosystem.

Keywords: central bank digital currencies (CBDCs), cryptocurrency market regulation, central bank, payment system, international currency, e-wallet.

JEL codes: G28, E58, F33

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Introduction

The digital currency market has gone through several stages in its development. Thus, the very first cryptocurrency appeared almost a decade and a half ago. Today there are about 20,000 different types of cryptocurrencies. Since their emergence in 2009, cryptocurrencies have been an uncontrolled coin of regulatory bodies. Moreover, their impact on the national economy has not been investigated, so at the initial stage after their emergence, states tried to restrain their functioning.

States aim to control transactions with cryptocurrencies and digital currencies, primarily to prevent the financing of terrorism and money laundering. Therefore, they create their national coins, which are issued and regulated by central banks. In many ways, today central banks digital currencies are already coming to the forefront, with cryptocurrency being the basis for their creation and functioning. Thus, today states are actively adopting their national cryptocurrency, which is issued by the country's central bank; it is also considered a legal tender like other traditional currencies. In July 2018, 15 countries were conducting studies on the possibility of developing and implementing CBDC; in 2023, more than half of all world central banks were studying the prospects of using digital currencies. Today, half a dozen countries, mainly in Africa, the Caribbean and South-East Asia, have fully operational CBDCs. In general, these countries have a low level of access to bank services. Therefore, in such circumstances, digital currency is an innovative way to develop national payment systems.

Main part

There was initial interest in digital currency in 2014. For the first time, Ecuador tested the rationality of using digital currency, as almost 40% of the country's population did not have access to financial services. The Ecuadorian authorities decided to fix the economic situation in the country by launching the digital sucre in order to realise the rapid development of the payment infrastructure and solve the problem regarding financial inclusion. Ecuador has not been able to achieve the successful implementation of digital sucre. The main reasons are, firstly, the level of country economic development is too low, and secondly, there is low demand.

Uruguay also had the experience of launching a digital currency – e-Peso in 2018. The International Monetary Fund appreciated the implementation of the country's pilot project, but the digital currency was withdrawn from circulation.

Two Scandinavian countries – Norway and Sweden – in 2018 started an active study of the digital currency implementation. Riksbank (Bank of Sweden) is testing a digital currency – e-krona, the launch of which is driven by the recent sharp decline in the use of cash in payment transactions. A complete transition to cashless money is gradually taking place in Switzerland. According to the Bank of Sweden's research, digital currency will enable to support pure competition between fintech companies and commercial banks, and expand the possibilities of state control over money flows. But despite the increased interest of the Nordic region in launching a digital currency, there is no decision to start issuing a digital currency – the implications, challenges, and risks of its launch are still only being explored. Notably, among the challenges of the CBDC launching, the issues of smooth functioning of the technical infrastructure, effective supervision, and protection of personal data are also highlighted[1].

One of the nations in the Southeast Asian region also testing a digital currency – the digital baht (BoT) (wholesale CBDC), is Thailand. This pilot project began its development in 2018. It involves strengthening cooperation between the Central Bank and some major financial institutions. In 2020, the BoT announced the creation of another cross-border transfer method, and developed it with the Hong Kong Monetary Authority. Thailand's CBDC aims to enter the retail market, but the authorities are concerned about the implications - considering the benefits and risks of introducing it into the monetary sphere. This Thai pilot project has made it possible to conduct bank payments bypassing any banking institution participants (Digitalisation on Financial Services and Implications for Monetary Policy in Thailand, 2018).

In autumn 2020, Cambodia and the Commonwealth of the Bahamas were the first states to announce the equal properties of an international currency with an issued national cryptocurrency. The Bahamas has significant limits on access to finance by foreign governments as a result of its special geographical location. In addition, it is quite common for the islands to experience cash losses due to frequent natural disasters. Therefore, for Bahamians the development of digital currency is one of the methods of safeguarding their money, as well as a way to make online payments. Storage and transactions of money are performed through an electronic wallet. The Bahamas' digital currency, the SandDollar, is valued at a 1:1 ratio to the Bahamian dollar, which in turn is pegged to the US dollar (Zhang et al., 2017).

In 2020, Cambodia announced Bakong, a national cryptocurrency. It performs payment transactions with both the Cambodian riel and the US dollar. To access Bakong, one must have a Cambodian phone number as well as an active Cambodian bank account. The Bakong e-wallet is linked to the bank accounts of the system users, which is supervised by the National Bank of Cambodia – all transactions are controlled by the Central Bank of Cambodia. The main motivation for the CBDC establishment in Cambodia is the development of financial inclusion. As a consequence, the development of digital payment services becomes a natural way to maximise the efficiency of the national payment system.

In 2021, member countries of the currency union of the Organisation of Eastern Caribbean States (OECS) began developing a national cryptocurrency. In the spring of 2021, the Central Bank of the Eastern Caribbean began issuing the national cryptocurrency DCash in the member countries: St. Kitts and Nevis, Barbuda and Antigua, St. Lucia and Grenada. The main goal of DCash implementation was to improve the

[1] *Riksbank, E-krona. Bank of Sweden Official Website. Available at: https://www.riksbank.se/en-gb/payments--cash/e-krona/ (accessed 06.11.2023)*

availability, security, and quality of payment services. In addition, its introduction has significantly increased the speed of transactions to other countries (Kochergin & Yangirova, 2019).

In 2021, Nigeria announced the launch of its national cryptocurrency – the digital naira, eNaira. According to international rankings, Nigeria is the country with the highest cryptocurrency ownership in the world (24.2%)[2]. The main purpose of the CBDC establishment in Nigeria was to create a situation related to financial stability, strengthen monetary sovereignty, and the development of payment services. Nigeria's national cryptocurrency was created as part of a programme to develop the digital economy and had the major motive of simplifying financial transactions for citizens, and thereby promoting financial inclusion.

Japan launched testing of the digital yen in 2021. The government plans to conduct three phases, the first aimed at testing the supporting functions, the second – to study its «behaviour» in the financial environment, and the third, which began in the spring of 2023 – aims to gradually connect individuals and businesses. At the same time, it plans to test credit cards that support the Bank of Japan's digital currency, marking the beginning of the development of the user's infrastructure. However, the test transactions with the digital yen today are of a simulated nature, i.e. without involving individuals. Thus, it is expected all these processes and the testing itself will be completed by 2026.

A particular feature of the digital currency creation in Japan is that large Japanese companies are interested in their creation and development. Government initiatives in this area are actively supported by business. Thus, an association of more than 70 companies and non-governmental banks are working on the creation of their own digital currency called DCJPY. It is planned to create a unified platform for making transactions, the security of which will be based on blockchain technology. The ratio to the yen is also planned to be set at 1:1. Bank deposits, on the other hand, will provide this digital currency. The interest of companies in this development lies in the need to increase the speed of transactions, as well as to reduce commissions[3].

The main reasons for Japan's introduction of a state digital currency include: the interest of Japanese companies and banks in it (reduction of commissions, increase in the speed of transactions, etc.); the global trend towards digitalisation, and Japan, as a high-tech country, should not lower the bar, but develop in an innovation-technological direction in accordance with the time; reduction of the state's costs for production, storage, security, and transportation of tangible money; strengthening of the yen to increase its competitiveness in relation to the national currency; and the introduction of a digital currencies in other countries – among regional neighbours (South Korea, China).

Japan remains hesitant to adopt the digital yen and is taking a wait-and-see attitude. It is closely following the development of digital currencies in the U.S., Europe, China and other countries to create an innovative, competitive currency that could contribute to Japan's influence in the international arena[4].

Moreover, Japan is one of the most technologically advanced countries in the world. It is still dominated by cash payments, even when it comes to large transactions. Perhaps, before a full-scale introduction of digital currency, the Japanese authorities will have to establish fiat cashless settlement by providing initial advantages or incentives.

In general, 2021 was a period of active research by authorities on digital currency, its benefits and threats associated with its emission. Also, central banks in this period began to launch pilot projects. The most striking event was the large-scale testing of the cryptoyuan in China – e-CNY. In just a few years, China has become a world leader in terms of its CBDC scale of piloting project (Takuma, 2020). The distinctive feature of the creation and development of the digital yuan is the presence of the state structure represented by the NBK. NBK is the main initiator and executor since the beginning of the project. It provides its activity with the approval of the highest leadership of the country, which is an important advantage of this project.

Development of a national cryptocurrency in China began in 2014, and consisted of several phases. The

[2] *Finder Cryptocurrency Adoption Index. Available at: https://blog.chainalysis.com/ reports/2021-global-crypto-adoption-index/ (accessed 06.11.2023)*

[3] *More than 70 Japanese companies in 2022 intend to launch a new digital currency. Available at: https://tass-ru.turbopages.org/turbo/tass.ru/s/ekonomika/13015921 (accessed 06.11.2023).*

[4] *The Bank of Japan will start the last stage of testing the digital yen in 2023. Available at: https://tass.ru/ekonomika/16412717/amp. (accessed 06.11.2023).*

first phase took place from 2014 to 2016, when a digital currency development working group was established and began research. In 2016, the NBK created a prototype of the first-generation digital currency and established the Digital Currency Institute. It developed the concept of digital yuan. The second phase began in late 2017, involving major commercial banks, telecommunications companies, and payment service providers (Kochergin, 2022). During this phase, applications for interacting with digital RMB were created, digital wallet standards were developed, and requirements for payment security and regulation were formulated. In 2019, the third stage began with the launch of pilot projects for the use of digital yuan in the country.

China's active testing of its national digital currency e-CNY has attracted considerable attention from all over the world, both in terms of the volume of testing itself and the number of digital yuan users. The issue of the consequences of its launch in full directly for China itself becomes a logical one. We will consider the prospects of e-CNY implementation for China and its citizens. Firstly, the digital yuan helps China fight threats to monetary sovereignty from private cryptocurrencies. According to the Chinese authorities, the emission of the state digital currency is an alternative to private cryptocurrencies. Therefore, the yuan's position will be stronger, and it will be easier for the government itself to maintain its stability. Secondly, it is a good opportunity for the Chinese government, particularly the NBK, to collect the most accurate and reliable data on all the preferences and habits of the country's population based on the expenditures made by them. Moreover, it is important for a comprehensive study of current economic trends and making forecasts of consumer behaviour[5].

An important advantage, according to the PRC, is the development of cryptoyuan for the purpose of providing material assistance in a difficult situation to its citizens: the possibility of sending digital money for food and medicine. Moreover, the Chinese authorities will have the ability to decide who can access these digital assets in order to prevent alcoholism, drug use, etc. Also, it concerns unstable political and economic situation, in case of illegal activities, citizens' wallets will be switched off.

The prospects for the cryptoyuan development are both in the global and domestic market of the PRC. Since 2021, China's digital currency has been appearing on various stock exchanges. The main goal of the Chinese authorities regarding cryptoyuan is to turn it into a national currency, which will be the main competitor of virtual coins. Moreover, China is exploring cross-border transactions using cryptoyuan.

One of the main reasons for the digital yuan's creation was an attempt to counter the dominant dollar. Today, US dollar is the leading currency, and it has a huge impact on the global economy and politics. China, in turn, stands out in the world market with its productive power and high level of exports. However, most settlements are still made in dollars. It strengthens this currency and makes China and other countries dependent on it, which strengthens the position of the USA. This gives America the opportunity to impose its own rules in various international spheres, infiltrate and influence global processes. To counter the hegemony of the US and the dollar, China is taking steps to establish and develop its national currency (in any form), internationalise it, and offer it as an alternative, as well as to increase the level of its own economic independence[6].

The European Central Bank (ECB) has launched a digital currency, the digital euro. The ECB, actively explore all the possibilities of the TIPS fast payment service, tend to provide a technical solution for its digital currency. The main motivations were to ensure the sovereignty of the digital euro, include it in the pan-European payment system, the European Payments Initiative, and apply it to international transactions. Nevertheless, the US does not participate as a member of the ECB Advisory Group. It could damage Europe's financial stability and sovereignty[7].

The US approached the issue of launching a digital dollar in detail in 2020. The country's authorities have decided to explore the challenges and opportunities associated with issuing a digital currency. The Federal Reserve Bank of Boston, which will work with the Massachusetts Institute of Technology to develop, study

[5] *China launches state cryptocurrency: how it can change the financial world. Available at: https://vc.ru/finance/ 122749-kitay-zapuskaet-gosudarstvennuyu-kriptovalyutu-kak-eto-mozhet-izmenit-finansovyy-mir (in Russian) (accessed 06.11.2023).*

[6] *Chinese digital currency threatens the «status» of the U.S. dollar. Available at: https://zn.ua/amp/WORLD/kitajskaja-tsifrovaja-valjuta-uhrozh aet-statusu-ameri kanskoho-dollara-ft.html (accessed 06.11.2023)*

[7] *Cryptoast. Available at: https://cryptoast.fr/ (accessed 06.11.2023)*

and test the DH in conjunction with the Federal Reserve Bank of Boston, announced about the potentially issued digital currency of the US Federal Reserve. At the same time, the US has not yet officially decided to issue a digital dollar (while China and the EU are already well ahead of them in the process of digital currency development). According to the researchers, if the international financial infrastructure based on the US leadership develops a more modern and technological alternative (for example, based on the successful experience of China), it may lead to the beginning of «dedollarisation» of the global financial system[8]. An important feature of the US digital dollar development is the private sector's efforts and initiatives, while the government takes a wait-and-see attitude (in contrast to China and the EU, where official government agencies are involved in the development). This is also evidenced by the statement of a senior FRS official Nelly Liang. In December 2022 she stated that there was no need for accelerated implementation of the digital dollar. According to her, the leading international position of the dollar is not due to technological, but to the political and economic achievements of the United States[9]. Therefore, there is no need to expect a full-scale implementation of the digital dollar in the near future.

According to international experience, the opportunities and challenges directly related to the launch of the CBDC in the Eurasian space are being explored. Kazakhstan and Russia are leaders in this region in exploring the above issue and making progress.

Officials in Russia began testing the digital rouble at the end of winter 2022. On 1 August 2023, the law on the digital rouble, which is a digital code storing in an electronic wallet, goes on to the statute book. The digital rouble is the third form of money, along with cash and non-cash. But it will not yet enter widespread circulation. The Central Bank of Russia started testing it in August 2023. 13 banks were taking part in this testing. The tests are conducted on a limited circle of clients and employees of large credit organisations[10].

Moreover, for people using the digital rouble, the main feature of the digital rouble will be the possibility to use it when the Internet is switched off, unlike non-cash funds. According to the experts, by using the digital rouble it is possible to avoid illegal transfers and stealing money from the citizens accounts. A distinctive country viewpoint is the statement declaring cryptocurrencies in general not to be money. Additionally, the authorities note that CBDCs are not cryptocurrencies.

Currently, in Russia there is an issue of developing a new payment system. An important fact is to prevent monopolization of the ecosystem by the fast payment system. Then Russia will have access to the market of fintech companies. There will be an increase in the payment market and financial services market competition. As a result it will cause a decrease in the tariffs set for the transactions made and an increase in their quality and quantity.

However, Armenia, Belarus, and the Kyrgyz Republic are interested in CBDC; they are also developing approaches to its use. For example, the President of the Kyrgyz Republic recently announced the «e-Som» project, which will be backed by national gold. Representatives of the National Bank of Belarus stated the potential benefits of introducing a digital national currency for both users and businesses[11].

Nevertheless, experts in international economic development have differing views on the prospects for digital currencies. In particular, the integration of digital and traditional markets into each other will be one of the possible ways of digital currencies development. It will provide favourable conditions for a common ecosystem development. This system involves interrelation between the economic sectors (Mosakova, 2023). However, the development of digital currencies issued by central banks can negatively effect on the use of cryptocurrencies as they become more insecure and expensive.

However, there are a number of legislative, technical, and economic problems with the functioning of

[8] *Cryptoast. Available at: https://cryptoast.fr/ (accessed 06.11.2023)*

[9] *Digital Dollar Is a Long Way From Reality, US Treasury Official Says. Available at: https://www.bloomberg.com/technology?source=eyebrow (accessed 06.11.2023)*

[10] *Sberbank, VTB, Alfa Bank, Tinkoff Bank, Gazprombank, Rosbank, Promsvyazbank, Sovcombank, Ak Bars, Dom.RF, Sinara, Soyuz, TCB, MTS Bank and Qiwi Bank participated in the first stage of testing the prototype digital rouble platform, which ended in February 2023.*

[11] *Rise of the central bank digital currencies: drivers, approaches and technologies. Available at: https://www.bis.org/publ/work880.pdf/ (accessed 06.11.2023)*

CBDCs.

Firstly, national governmental accept of CBDCs as legal tender. In case of rejection, CBDCs will not be able to become widespread currency. Moreover, the issuance of CBDCs in some world countries is likely to have a negative impact on the economies of other countries. In particular, there may be capital flows from one country to another (depending on the interest rate). As a consequence, there will be a need for coordination of national government monetary policies at the international level, including the participation of the IMF (Meaning, 2018).

Secondly, cybersecurity. The cryptocurrency market is very unstable due to a high risk of hacker attacks. It somethimes causes the bankruptcy of leading crypto exchanges and non-return of users' funds. Therefore, there is a need to develop robust mechanisms to protect CBDCs, taking into account the experience of private cryptocurrencies. One way to minimise cyber risks is to emit a relatively small amount of CBDC for parallel circulation with existing fiat money in order to test the security system.

Thirdly, there are challenges arising from the different ways of integrating the CBDCs into monetary policy – cash substitution, cash complementation, or parallel circulation (Kochergin & Yangirova, 2019).

In the first case, their impact will be minimal. However, in the other two cases, the degree of influence can be higher – by strengthening the transmission mechanism of monetary policy: in the case of introduction of the CBDC, the time lag between changes in the key rate of the Central Bank, and changes in deposit and lending rates will be significantly reduced. It can cause a significant reduction in lending.

Fourthly, the issue of the legitimacy of CBDCs: formally, the Central Bank today does not have the right to emit its own digital currencies. Therefore, it is necessary to make appropriate changes in the current legislation of the world's countries. Today, only a quarter of CBs already has had this right or in the process of reforming their national legislation.

Fifthly, CBDCs may become a real threat to the entire global financial system. Therefore, it is necessary to coordinate legislative regulation of CBDCs at the intergovernmental level. Thus, if retail CBDCs became a real alternative to risk-free bank deposits within the investment portfolio, there will be a free flow of capital. Especially in case of an economic crisis, there will be a «digital flow of capital» from private banks to the central bank (Meaning, 2018).

Thus, the introduction of CBDCs has its advantages and disadvantages. The national financial regulators should take them into account when introducing into the monetary sphere.

Today, the potential for cross-border use of CBDCs is being actively explored within the framework of bilateral and multilateral agreements between CBs as well as international organisations. The mCBDC Bridge (mBridge) project, which was initiated by Hong Kong and Thailand back in 2019, is being actively developed[12]. The project is aimed at creating a system of multi-currency exchanges using the CBDCs of its member countries – the main objective of the mBridge system is to unite the markets of the member countries for cross-border transfers[13].

Conclusion

Currently, digital currency is going through a stage of its active development, use, and detailed research. Thus, according to the forecasts of the Bank for International Settlements, 20% of regulators plan to put retail digital currency into circulation by 2026. Its main characteristics are security, fast and inexpensive transactions. Based on the experience of launching CBDCs by different world countries, the issuance of CBDCs is conducted with the aim of increasing financial accessibility. The experience of launching digital currencies in world countries also shows the feasibility of creating new payment systems to ensure the smooth functioning of international transactions. Practical development and testing of CBDCs is one of the main trends in the development of the modern money circulation sphere. For example, China, Singapore, Japan, Switzerland, Canada, etc. implement it. Moreover, every year more and more central banks and/or

[12] *China also joined this project in February 2021, which is an indirect indication of the project's high degree of readiness.*

[13] *Inthanon-LionRock to mBridge: Building a Multi CBDC Platform for International Payments. – Hong Kong Monetary Authority's official website. Available at: URL: https://www.hkma.gov.hk/media/eng/doc/key-functions/financial-infrastructure/Inthanon-LionRock_to_mBridge_Building_a_multi_CBDC_platform_for_interna tional_ payments.pdf (accessed 06.11.2023)*

financial regulators are involved in the process of CBDCs development. The importance of the development and successful implementation of a domestic digital currency is enhanced with the opportunity to develop standards for the interoperability of digital currencies between different countries at the international level. China is already partially influencing this process by participating in the m-CBDC project and initiating the creation of a single Asian digital currency.

Therefore, in terms of CBDCs development, and, in order to maintain public trust, the central bank should act in co-operation with market participants, preserving its main role in the ecosystem. Interestingly, the global community has not yet reached a consensus on the feasibility of their creation and the prospects for their introduction into the financial and economic sphere.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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Study of the correlation between the growth rates of interregional trade and GDP of the EAEU member countries

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Abstract. Integration processes generate so-called "spillover effects", which have an impact on the welfare of the population of the countries involved in integration processes. Russia, as the largest economy of the Eurasian Economic Union (EAEU), acts as the main generator of economic impulses / "shocks" for the other member states of the economic association. The purpose of the study is to verify the existence of a statistically significant relationship between the mutual trade turnover dynamics of the EAEU member states and the economic growth rates of the integrating states using regression analysis. We used regression analysis to validate the hypothesis put forward in this paper (changes in the volume of mutual trade in the EAEU area have an impact on the GDP of the EAEU member countries). The use of regression analysis helped to exclude the Armenian economy from the list of countries where there is a statistically significant relationship between the volume of mutual trade within the EAEU and GDP growth rates (previously, the use of correlation analysis allowed to identify such a relationship for three of the five integration economies). The obtained results indicate that the GDP of the economies under study is generally insignificantly affected by the volume of mutual trade within the EAEU.

Keywords: interregional trade, spillover effects, regression analysis, GDP, EAEU.

JEL codes: F15, O14

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Introduction

This paper is the second stage of research by members of the research team investigating the spillover effects of integration in the EAEU area. At the first stage of the study, the growth rates of trade turnover within the EAEU and GDP growth rates of the EAEU countries were compared; the growth rates of foreign trade turnover of the EAEU countries and the growth rates of the world economy. The study considered two hypotheses: the growth rate of trade turnover within the EAEU will be inferior to the development dynamics of the EAEU member states' regional economies; the growth rate of EAEU member states' foreign trade with third countries will outpace the dynamics of the global economy. The results of the correlation analysis did not provide an unambiguous response to the hypotheses put forward in the paper: a) it was found that there is a direct statistically significant relationship between the dynamics of mutual trade turnover within the EAEU and GDP dynamics for the three member countries of the integration association, except for Kyrgyzstan and Kazakhstan; b) it was found that there is no correlation between the dynamics of foreign trade of EAEU countries and the dynamics of global GDP (Shkiotov, 2023).

At the second stage of the study, we use regression analysis to verify the existence of the identified statistically significant relationship between the dynamics of trade turnover within the EAEU and GDP growth rates of the EAEU member countries.

The existence of such a relationship (between the rate of mutual trade and GDP) is confirmed by a number of earlier studies:

Zoidov & Zoidov (2021): the main idea of authors approach is a gravitational econometric model of foreign trade and foreign trade turnover, which directly depends on the economic capabilities of trading countries (GDP) and inversely depends on the distance between these countries. Based on the results of

the gravitational econometric model of foreign trade, it is established that in the future the growth of trade turnover between the EAEU+ countries are possible taking into account the GDP growth of these countries. The EAEU+ countries have significant economic potential to increase mutual trade flows and further integration into world trade.

Terletskiy & Madiyarova (2023): the authors applied the methods of correlation and comparative analysis to identify the main ways to increase foreign trade flows between integration countries under the conditions of foreign trade barriers. After using the analysis of the correlation relationship between the mutual foreign trade turnover of the EAEU countries, covering the commodity group "mineral products", and other main statistical indicators, the authors identified the main drivers of mutual trade in mineral products. Among such methods of enhancing mutual merchandise trade are GDP growth, strengthening of revealed comparative advantages, cargo tracking mechanisms, the quality of logistics services and the level of organisation of international shipments. Transport infrastructure, timeliness of delivery and the share of domestic R&D expenditures in GDP have a less positive impact on the mutual trade of integration countries, while geographical distance and customs checks, on the contrary, have a negative impact on trade flows.

Orudzhev & Alizade (2021): this article studies the integration processes between Azerbaijan and Ukraine by using the indicators of the integratedness of the GDPs of these countries and of the trade turnover between them. The annual data from 1994 to 2018 are studied as the period of monitoring. The article uses the econometric methodology of the gravity modelling of the correlation between non-stationary time series. Based on the constructed model, econometrically sound recommendations that enable a dynamic analysis of effective regulation of the export and import transactions between these countries by the governments to balance the mutual trade have been developed.

Ali, Huang & Xie (2022): China is making large investments in Pakistan's transport infrastructure under the China-Pakistan Economic Corridor. This study aims to quantitatively analyze the bilateral impacts of these investments through several policy scenarios in 2025 using a global economic model. Our results show that due to transport infrastructure development, the GDP and welfare of both Pakistan and China will improve, with a maximum of 0.3% and 0.01% increase in GDP, and USD 2.6 billion USD 1.8 billion gains in welfare for Pakistan and China, respectively. Regarding mutual trade, Pakistan's total and agricultural exports to China will increase in the range of USD 9.6-13.7 billion and USD 4.7-6.6 billion, respectively. The percentage increase in Pakistan's net exports of agricultural commodities to China will be higher than that of non-agricultural products. Pakistan will tap into China's import demand for fresh fruits and vegetables and other perishable food products. Due to changing trade relations, Pakistan's production structure will undergo slight structural adjustments. For Pakistan's agriculture sector, the rice and fruit sectors will be top gainers, with 2.1-2.6% and 1.2-1.7% output expansion, respectively. Pakistan will also experience some leveling of income due to a relatively higher increase in wages of unskilled labor than skilled labor. The output of China's rice sector will drop the most (–1- –1.3%). Overall, the effects on China's economy are minimal.

Khan (2019): The United States of America (USA) and People's Republic of China are waging a war against each other in the field of mutual trade. If the erstwhile open mutual trade gets replaced by a somewhat restricted trade, the economic consequences for both the countries will be disastrous and it will also affect the world trade negatively. The same will happen with EU, Mexico and Canada if the trend continues. The effect of this war will be a cause of concern for world growth too. If this modern day commercial war keeps itself limited to US and China only still the negative impact on the global economy will be almost – 0.5% on world GDP, but if other countries also start playing the same tune and the trade war moves forward than the world GDP is likely to get reduced by not less than 3%. This may lead to a major recession in the global economy.

Drapkin, Sidorov & Mariev (2022): The authors analyze the influence of sanctions on bilateral trade flows between the European Union and the Russian Federation during 2015-2019. Despite trade sanctions and counter-sanctions being imposed against particular groups of commodities, their influence affected trade flows between Russia and the EU in all sectors. The augmented gravity approach is used to construct an econometric model, while the Poisson pseudo maximum likelihood method is applied to derive unbiased estimates. It is shown that during 2015-2019, due to EU sanctions Russia lost USD 41.3 billion in export

revenues annually, comprising 2.5 percent of its GDP. Russian exports to Europe declined in all basic industries, but the petroleum industry took 91.2 percent of the total losses. European aggregate exports to Russia have not suffered from mutual sanctions: Although the European food industry lost USD 2.7 billion annually, these losses were compensated for by export growth in other industries.

The purpose of the study is to verify the existence of a statistically significant relationship between the mutual trade turnover dynamics of the EAEU member states and the economic growth rates of the integrating states using regression analysis.

Methods

Figure 1 shows that correlation coefficients for three of the five EAEU economies are significant, which means that there is a strong relationship between the variables under study (dynamics of mutual trade of EAEU member states and GDP). This may indicate that the linear model is a good fit to describe the data and can be used for predictions. However, it is important to remember that the presence of significant coefficients does not guarantee the accuracy of the predictions, additional data analysis is required to ensure the quality of the model.

We chose regression analysis to solve this research task (significance level 5%, data were processed in the software package "Statistica" from StatSoft).

Therefore, we use the simplest model and the assumption that changes in the volume of mutual trade in the EAEU area affect the GDP of EAEU member countries.

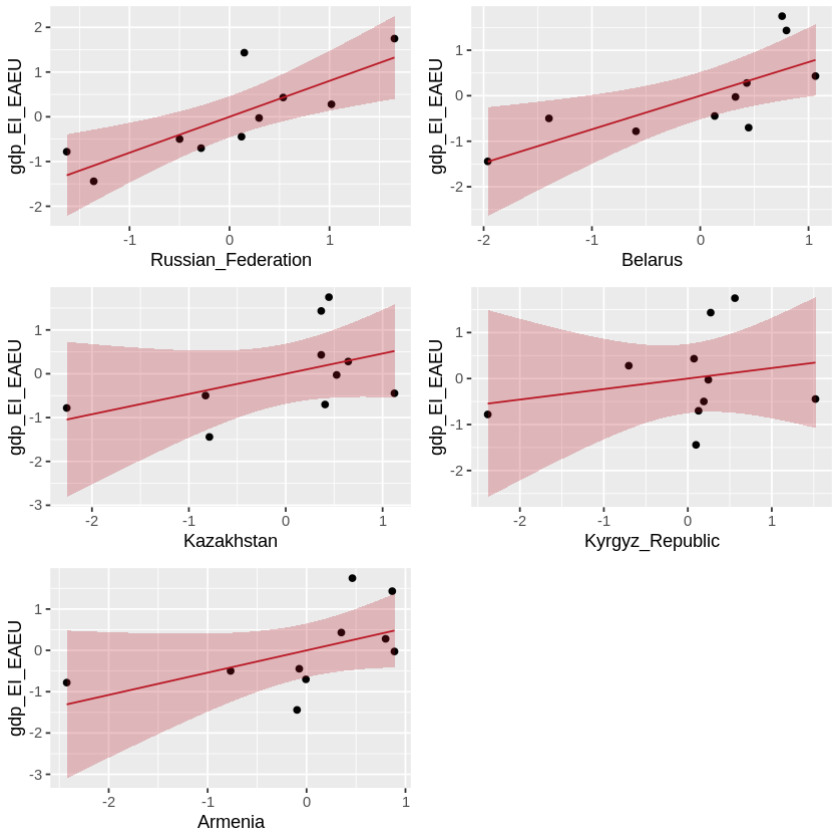

Figure 1. Scatter diagram between the growth rate of mutual trade within the EAEU and the GDP growth rate of EAEU member countries

Source: composed by the author

Results

To analyse the dependence of GDP growth rates of the EAEU member countries on the mutual trade volumes, we will use a model with a general form:

$$GDP\ of\ the\ country=\beta_0+\beta_1*Mutual\ trade\ growth\ rate+\varepsilon$$

The results of estimating the regression model for Russia are as follows:

$$GDP\ of\ RF=0{,}8032*Mutual\ trade\ growth\ rate$$

```
Residuals:
    Min      1Q  Median      3Q     Max
-1.0033 -0.1751  0.2183  0.3073  0.7948

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -2.388e-16  1.998e-01   0.000  1.00000
gdp_EI_EAEU  8.032e-01  2.106e-01   3.813  0.00514 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6319 on 8 degrees of freedom
Multiple R-squared:  0.6451,  Adjusted R-squared:  0.6007
F-statistic: 14.54 on 1 and 8 DF,  p-value: 0.005141


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = M)

                     Value   p-value             Decision
Global Stat        2.60420  0.6261 Assumptions acceptable.
Skewness           0.91438  0.3390 Assumptions acceptable.
Kurtosis           0.12908  0.7194 Assumptions acceptable.
Link Function      1.53233  0.2158 Assumptions acceptable.
Heteroscedasticity 0.02842  0.8661 Assumptions acceptable.
```

Regression analysis provides information on how each variable affects the dependent variable. In this case, we have data for Russia on the GDP value and the volume of mutual trade with EAEU countries. The analysis of regression analysis coefficients shows the following: the coefficient value of the variable "Growth rate of mutual trade" is 0.8032 and has a standard error of 0.1998. This means that every one unit change in the value of the variable "Mutual Trade Growth Rate" results in a 0.8032 unit change in the value of the dependent variable. This coefficient is statistically different from zero at the significance level of 0.01.

The results of estimating the entire regression equation show that the regression model fits the original data well because:

– R-squared value is 0.6451. This value indicates how much of the total variation on the dependent variable can be explained by the model. The closer the R-squared value is to 1, the better the model explains the variation of the dependent variable;

– the Adjusted R-squared value is 0.6007. This value indicates how much of the total variation on the dependent variable can be explained by the model after accounting for outliers or missing values. The closer the Adjusted R-squared value is to 1, the better the model explains the variation on the dependent variable after accounting for outliers or missing values;

– The F-statistic value is 14.54 with p-value equal to 0.005141 indicating a significant level of explanation by the equation for the behaviour of the data.

Hence, the results of estimating the entire regression equation show that the regression model fits the data, explains a significant proportion of the variation on the dependent variable and is statistically significant.

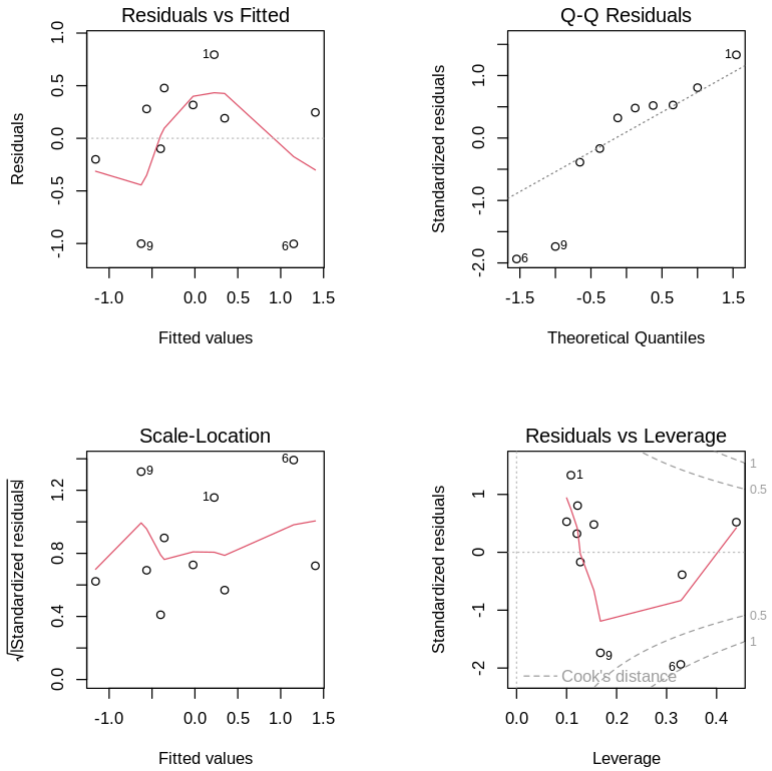

Figure 2. Results of the residual regression analysis on the economy of Russian Federation
Source: composed by the author

The results of estimating the regression model for Belarus are as follows:

*GDP of RB=0,7387*Mutual trade growth rate*

```
Residuals:
    Min      1Q  Median      3Q     Max
-1.0292 -0.4671  0.1032  0.4331  0.9648

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -2.593e-17  2.261e-01     0.0   1.0000
gdp_EI_EAEU  7.387e-01  2.383e-01     3.1   0.0147 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7149 on 8 degrees of freedom
Multiple R-squared:  0.5457,  Adjusted R-squared:  0.4889
F-statistic: 9.608 on 1 and 8 DF,  p-value: 0.01467


ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
Level of Significance =  0.05

Call:
 gvlma(x = M)

                    Value    p-value                Decision
Global Stat       4.58632  0.3324    Assumptions acceptable.
Skewness          0.06596  0.7973    Assumptions acceptable.
```

Kurtosis	0.55055	0.4581	Assumptions acceptable.
Link Function	3.72835	0.0535	Assumptions acceptable.
Heteroscedasticity	0.24147	0.6231	Assumptions acceptable.

The analysis of regression analysis coefficients show the following: the coefficient value of the variable "Growth rate of mutual trade" is 0.7387 and has a standard error of 0.2261. This means that every one unit change in the value of the variable "Mutual Trade Growth Rate" results in a 0.7387 unit change in the value of the dependent variable. This coefficient is statistically different from zero at the significance level of 0.05.

The results of estimating the entire regression equation show that the regression model fits the original data well because:

– R-squared value is 0.5457. This value indicates how much of the total variation on the dependent variable can be explained by the model. The closer the R-squared value is to 1, the better the model explains the variation of the dependent variable;

– the Adjusted R-squared value is 0.4889. This value indicates how much of the total variation on the dependent variable can be explained by the model after accounting for outliers or missing values. The closer the Adjusted R-squared value is to 1, the better the model explains the variation on the dependent variable after accounting for outliers or missing values;

– The F-statistic value is 9.608 with p-value equal to 0.01467 indicating a significant level of explanation by the equation for the behaviour of the data.

Hence, the results of estimating the entire regression equation show that the regression model fits the data, explains a significant proportion of the variation on the dependent variable and is statistically significant.

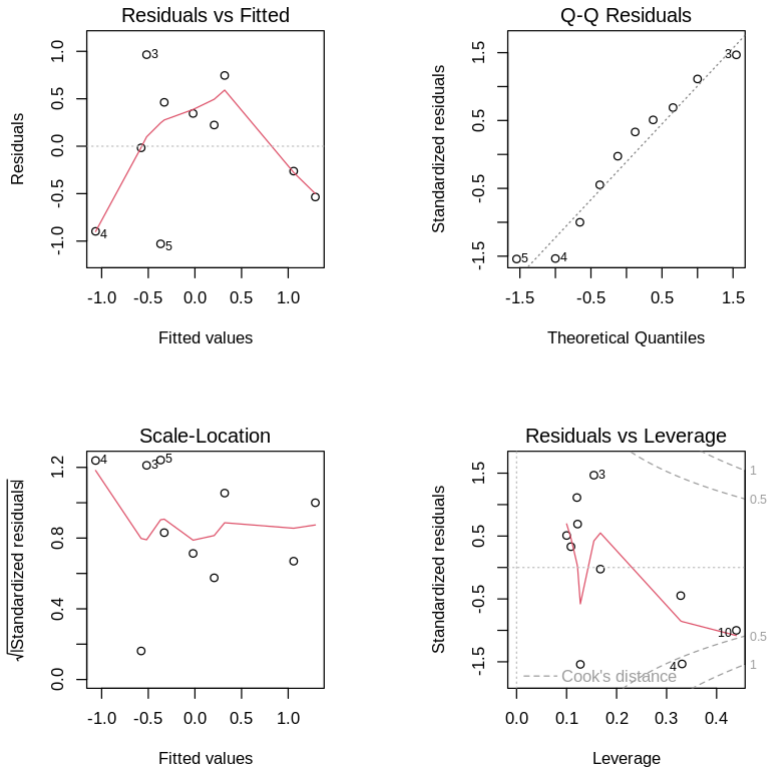

Figure 3. Results of the residual regression analysis on the economy of Belarus[1]

Source: composed by the author

In this case, R-squared=0.5457, which indicates that 54.57% of the variance of the Belarus GDP growth

[1] *All the obtained diagrams show that the "outliers" among the residuals of the obtained model are quite moderate, and the express test is passed successfully.*

rate can be explained by the growth rate of mutual trade within the EAEU (which may also indicate the influence of other factors on the GDP growth rate).

The results of estimating the regression model for Armenia are as follows:

```
Residuals:
    Min      1Q  Median      3Q     Max
-2.0037 -0.3361  0.1425  0.5791  0.9031

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.617e-17  2.825e-01   0.000    1.000
gdp_EI_EAEU 5.393e-01  2.977e-01   1.811    0.108

Residual standard error: 0.8932 on 8 degrees of freedom
Multiple R-squared:  0.2909,  Adjusted R-squared:  0.2022
F-statistic: 3.281 on 1 and 8 DF,  p-value: 0.1077
```

For the Armenian economy both coefficients of the equation are statistically indistinguishable from zero (as evidenced by the parameters: t-value = 1.811 Pr(>|t|)=0.109), the results of estimation of the whole equation show its statistical insignificance (as evidenced by the parameters: F-statistic: 3.281 on 1 and 8 DF, p-value: 0.1077).

The results of estimating the regression model for Kazakhstan are as follows:

```
Residuals:
     Min       1Q   Median       3Q      Max
-1.90032 -0.34507  0.02234  0.53210  1.32794

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 8.911e-17  2.975e-01   0.000    1.000
gdp_EI_EAEU 4.618e-01  3.136e-01   1.473    0.179

Residual standard error: 0.9408 on 8 degrees of freedom
Multiple R-squared:  0.2133,  Adjusted R-squared:  0.1149
F-statistic: 2.169 on 1 and 8 DF,  p-value: 0.1791
```

For the Kazakhstan economy both coefficients of the equation are statistically indistinguishable from zero (as evidenced by the parameters: t-value = 1.473 Pr(>|t|)=0.179), the results of estimation of the whole equation show its statistical insignificance (as evidenced by the parameters: F-statistic: 2.169 on 1 and 8 DF, p-value: 0.1791).

The results of estimating the regression model for Kyrgyzstan are as follows:

```
Call:
lm(formula = (Kyrgyz_Republic) ~ (gdp_EI_EAEU))

Residuals:
     Min       1Q   Median       3Q      Max
-2.20466 -0.04771  0.20570  0.30013  1.62193

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -4.313e-17  3.265e-01   0.000    1.000
gdp_EI_EAEU  2.285e-01  3.442e-01   0.664    0.525
```

Residual standard error: 1.033 on 8 degrees of freedom
Multiple R-squared: 0.05221, Adjusted R-squared: -0.06626
F-statistic: 0.4407 on 1 and 8 DF, p-value: 0.5254

For the Kyrgyzstan economy both coefficients of the equation are statistically indistinguishable from zero (as evidenced by the parameters: t-value = 0.664 Pr(>|t|)=0.525), the results of estimation of the whole equation show its statistical insignificance (as evidenced by the parameters: F-statistic: 0.4407 on 1 and 8 DF, p-value: 0.5254).

Table 1 summarises the results of the regression analysis for the EAEU countries.

Table 1 – Results of testing regression model assumptions for EAEU countries

Linear regression assumptions	Russia	Belarus	Armenia	Kyrghyzstan	Kazakhstan
Global Stat	Assumptions acceptable	Assumptions acceptable	n/a	n/a	n/a
Skewness	Assumptions acceptable	Assumptions acceptable	n/a	n/a	n/a
Kurtosis	Assumptions acceptable	Assumptions acceptable	n/a	n/a	n/a
Link Function	Assumptions acceptable	Assumptions acceptable	n/a	n/a	n/a
Heteroscedasticity	Assumptions acceptable	Assumptions acceptable	n/a	n/a	n/a

Source: composed by the author

Conclusion

Table 1 shows that the model assumptions are appropriate for two of the five EAEU economies. Hence, the use of regression analysis helped to exclude the Armenian economy from the list of countries where there is a statistically significant relationship between the volume of mutual trade within the EAEU and GDP growth rates (it should be noted that in the first part of the study the use of correlation analysis allowed to identify such a relationship for three of the five economies of the integration association). The obtained results indicate that the GDP of the economies under study is generally insignificantly affected by the volume of mutual trade within the EAEU.

It is important to realize, the results obtained should be interpreted carefully, as they are depending on the sample size and other model limitations.

Research limitations:

- the initial stage of the integration process within the EAEU zone (insufficient data sampling and too short research interval);
- data outliers distorting the overall result, influenced by the coronavirus pandemic and subsequent lockdown in 2019 and 2020; economic sanctions against Russia since 2014; and the start of the Special Military Operation in 2022;
- strong differences in GDP values of the EAEU member countries (which also leads to the problem of data outliers);
- perhaps the use of correlation analysis for the research task was not optimal (the research methodology is being tested and searched for appropriate to the research tasks).

We hope that the data obtained as a result of the study and the problems solved will activate a new wave of applied research related to the evaluation of the EAEU functioning.

FUNDING

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Russian ecosystems market and specific features of its performance

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Abstract. Modern Russian ecosystem market involves major players with ecosystems of different scales. The paper assesses the development of competition in the ecosystem market, highlights the features, and defines this market leaders and outsiders. According to research results, the implemented diversification strategies in the Russian market are not effective enough in terms of minimizing losses. Indeed, they allow one's to stabilize revenue growth. However, it might be explained by annual investments in new economic sectors, which have not yet reached stable incom. Those companies are searching for new profitable niches. It will allow them to expand effectively the ecosystem business structure in the future.

Keywords: ecosystem, digital economy, Herfindahl-Hirschman index, competition.

JEL codes: G23, O16, O32

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Introduction

The development of Russian ecosystems is one of the key trend of digital economy. The Digital Economy of the Russian Federation Program aims to "establish at least 10 national leading companies – high-tech enterprises developing end-to-end technologies and managing digital platforms able to operate on the global market; they form a system of "start-ups", research teams, and industry enterprises, ensuring the development of the digital economy".[1] Accordingly, establishing conditions to encourage big business to implement a diversification strategy through an ecosystem approach is the main priority of state regulation of this field.

Modern Russian ecosystem market involves major players with ecosystems of different scales. The companies included in the Ruseco index of ecosystems in Russia are considered as ecosystems. This is a market capitalisation-weighted index including shares of the largest issuing companies on the Moscow Exchange, which can be considered ecosystems or companies providing a wide range of services within a single space. Nowadays, it includes:

PAO Moscow Exchange MICEX-RTS;
PAO Mobilniye TeleSystemy (MTS);
Ozon Holdings PLC;
PAO Rostelecom;
PAO Sberbank
TCS Group Holding PLC ("Tinkoff");
VK Company Limited;
VTB Bank (PAO);
PLLC Yandex N.V.[2]

According to the presented list, the number of ecosystems has almost reached the target values of the Digital Economy of the Russian Federation Program (9 of 10 companies). Additionally, the list of companies diversified according to the ecosystem model is more extensive. Figure 1 shows companies as follows: Magnit (AO Tander) and Wildberries (OOO Wildberries). However, in terms off their economic role, the scale of

[1] *The program "Digital Economy of the Russian Federation": approved by the Decree of the Government of the Russian Federation on July 28, 2017 No. 1632-r. Available at: http://static.government.ru/media/files/9gFM4FHj4PsB79I5v7yLVuPgu4bvR7M0.pdf (accessed: 15.06.2023).*

[2] *Ecosystem Index in Russia (Ruseco). Available at: https://ipei.ranepa.ru/ru/capm-ru/ruseco-index (accessed: 15.06.2023).*

ecosystem connections is considered to be too insignificant to include them in the index.

Main part

The Russian ecosystem market has a number of features. Firstly, it is in a growth phase and is characterised by a de-saturation. In 2022, the ecosystem subscriptions market grew at 24% in financial terms over 2021, and 36% in volume (number of subscribers) over 2021, despite external and internal economic challenges[3].

Secondly, the market has a dynamic competitive situation. However, the structure of services offered by market-leading companies presents areas with fierce competition (see Fig. 1).

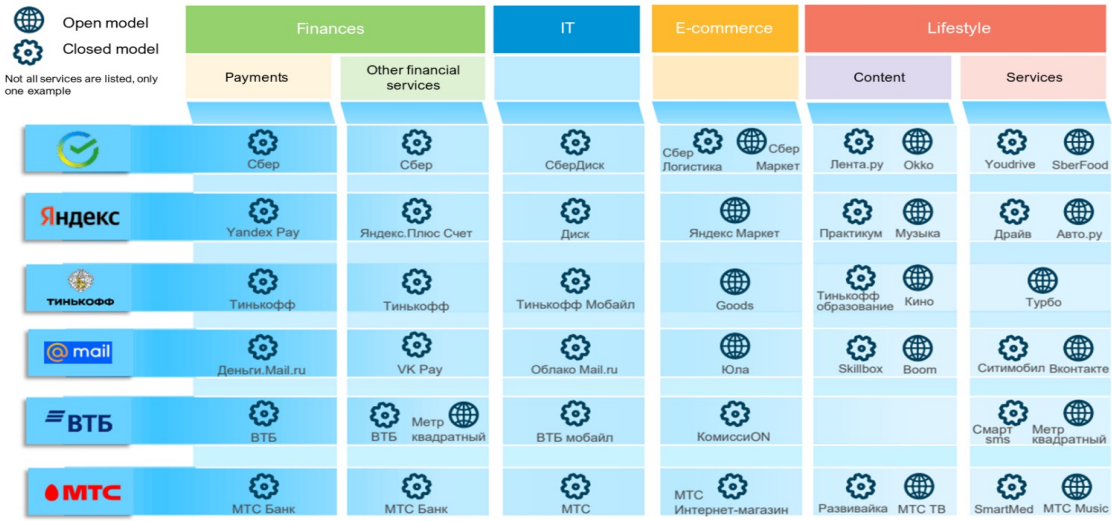

Figure 1. The largest Russian ecosystems

Source: The Bank of Russia, 2021

The market leaders are "Sber", "Yandex", "Tinkoff", "Mail.ru" (after the merger – "VK", since the holding Mail.ru Group changed its name), VTB, MTS. According to the main business, the companies operate in different areas: banking, IT, and telecommunications industry. However, the development of new services made them direct competitors in different areas.

– Finance. This area is traditional for banks. However, IT and telecommunication companies had to invest in the development of payment systems. Indeed, this area is being developed not only by market leaders, but also by smaller players. For instance, Ozon established its own bank and the corresponding debit card payment system.

– IT. Otherwise, banks have already had to explore a new area, developing their own mobile applications and cloud technologies. Moreover, the strategies for the development of players are different. For instance, Tinkoff was originally established as a high-tech company (an online banking model without branches); Sberbank and VTB have to transformed rapidly.

– E-commerce. Some companies (for example, MTS) are developing in terms of e-commerce. They establish online stores with branded goods or marketplaces, provide sellers with the opportunity to sell their goods through the company's servers, etc.

– Lifestyle. This area mainly includes entertainment services. There is no universal policy of companies in forming of a set of services (Figure 1). Companies offer services for listening to music (Yandex, VK), watching movies (Sber, Yandex, Tinkoff, MTS), education, taxi, real estate, etc.

However, increased competition has not negatively affected ecosystem enterprises. The product is significantly differentiated, and various tools are used to retain market share: loyalty programs based on the subscription mechanism. Nevertheless, the ecosystem market is characterized by a dynamic competitive situation: leaders are constantly changing. For example, in 2022, MTS surpassed Sber and took second place among the market leaders (see Fig. 2).

[3] *Experts named the largest Russian ecosystems. Available at: https://iz.ru/1522669/2023-06-02/eksperty-nazvali-krupneishie-rossiiskie-ekosistemy (accessed: 15.06.2023).*

According to Figure 2, Yandex is the absolute market leader followed by Sberbank and MTS. The Yandex diversification model assumes a huge number of products and markets, which can be a factor in the company's success.

To measure market concentration, the Herfindahl-Hirschman Index (HHI) should be determined. It is calculated as the sum of the squares of the market shares of companies in the market. Market share is the sales of the company as a percentage of total sales in the market (Kim, 2018). Since the market share of the smaller players is unknown, we assume their number as 6 (since 9 companies belong to ecosystems, and the shares of three are known). The calculation results are presented in Table 1.

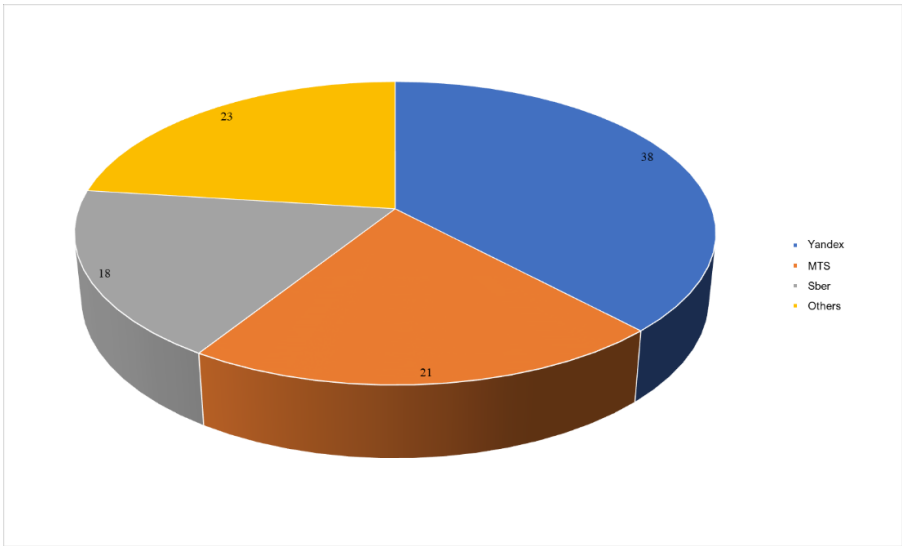

Figure 2. The structure of the Russian ecosystem market in 2022, % of revenue from services
Source: Experts named the largest Russian ecosystems. Available at: https://iz.ru/1522669/2023-06-02/eksperty-nazvali-krupneishie-rossiiskie-ekosistemy

Table 1 – Calculation for finding the value of the Herfindahl-Hirschman index

Company	Market share, %	The square of the market share
Yandex	38.00	1444.00
MTS	21.00	441.00
Sber	18.00	324.00
Others	23 / 6 = 3.83	14.67*6 = 88.01
HHI		2297.01

Source: calculated by the author

The index value is within the range of 1500 < HHI < 2500, which corresponds to a moderate concentration of the market. Therefore, the degree of market power of the leading companies is severely limited, but at the same time mergers and acquisitions can cause anti-competitive challenges and partially monopolised the market.

Another feature of the market is the ecosystem-specific diversification strategy, characterising as follows:
- strong core product;
- complementary products;
- strong technological base providing seamless experience for customers;
- mechanisms uniting products: a common identity, branding, and a common loyalty programme;
- perfect management[4].

Hence, the modern Russian ecosystem market is characterized by the growth and complexity of the ecosystem structure of market leaders.

[4] *How Russian digital ecosystems will develop in 2023. Available at: https://vc.ru/u/1036998-sees-group/630383-kak-budut-razvivatsya-rossiyskie-cifrovye-ekosistemy-v-2023-godu (accessed: 14.06.2023).*

Analysing the performance of Russian ecosystems market leaders, the performance of companies in previous years was affected by unpredictable negative environmental factors, so-called "black swan events": rare events that are difficult to predict and have tangible consequences. In 2020, it was the COVID-19 pandemic; in 2022 – geopolitical events. Consequently, when assessing the companies performance over these periods, it is necessary to take into account the ability of companies to adapt to crises and survive in a difficult economic period rather than profitability growth as an indicator of efficiency. It is inappropriate to study only the earlier years. The most holdings have seriously changed many aspects and areas of activity significantly.

The performance indicators of the six largest companies in the ecosystem market: Yandex, MTS, Sber, VK, VTB, Tinkoff were analysed.

The companies revenue figures are presented in Figure 3. However, not all of the companies represented have made financial statements publicly available: PAO VTB refused to publish financial results. Indeed, in 2022 the bank suffered a significant loss[5].

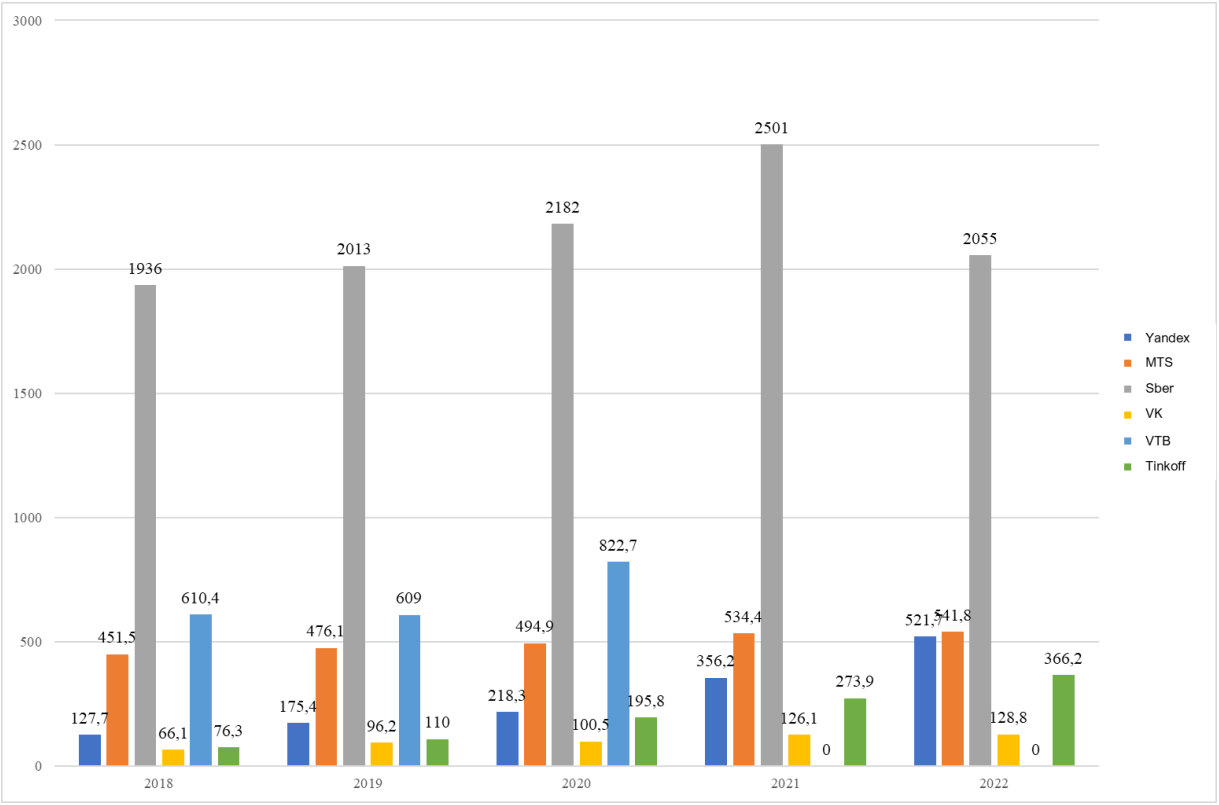

Figure 3. Revenue dynamics of the largest ecosystem companies in Russia in 2018-2022, RUB bn
Source: Fundamental stock analysis. Smart-lab. Available at: https://smart-lab.ru

Analyzing the data presented in Figure 3, we can conclude following:

– Sberbank is the absolute leader in terms of revenue. For example, in 2022, its revenue was 1.32 times higher compared to all other companies combined (excluding VTB). At the same time, its market share in the ecosystem services market is lower than both Yandex and MTS ones. Accordingly, the main (banking) line of business has a greater influence on revenue generation;

– most of the companies demonstrate stable revenue growth. The exceptions are Sber (in 2022, due to crisis and currency dynamics, it experienced a reduction, before that it also grew) and VTB (its revenue in 2021-2022 is unknown).

However, this confirms the thesis concerning the ecosystem market being in a growth phase: even in the crisis period of 2020, revenues were growing.

Meanwhile, the growth rates of the companies revenues are different (see Table 2).

[5] *VTB will not publish financial statements. Available at: https://bcs-express.ru/novosti-i-analitika/vtb-ne-budet-publikovat-finansovuiu-otchetnost (accessed: 15.06.2023).*

Table 2 – Revenue growth rates of the largest ecosystem companies in Russia, 2018-2022, % compared to the previous year

Company	2019	2020	2021	2022	Average annual growth rate
Yandex	137.35	124.46	163.17	146.46	142.17
MTS	105.45	103.95	107.98	101.38	104.66
Sber	103.98	108.40	114.62	82.17	101.50
VK	145.54	104.47	125.47	102.14	118.15
VTB	99.77	135.09	x	x	116.09
Tinkoff	144.17	178.00	139.89	133.70	148.01

Source: composed by the author

All companies, with the exception of VTB and Sberbank, showed an increase in the indicator in 2022 (a decrease in revenue by 17.83%). The largest growth rates are demonstrated by Tinkoff (148.01% on average) and Yandex (142.17% on average). These companies also show the highest growth rates in the difficult period of 2022 – revenue growth – 33.70% and 46.46%, respectively. These results indicate the development of these companies ecosystem completely satisfies the goal of minimising revenue-related risks: negative environmental factors have not caused a decline of this index.

To assess the companies performance, it is reasonable to analyse their asset dynamics (see Fig. 4).

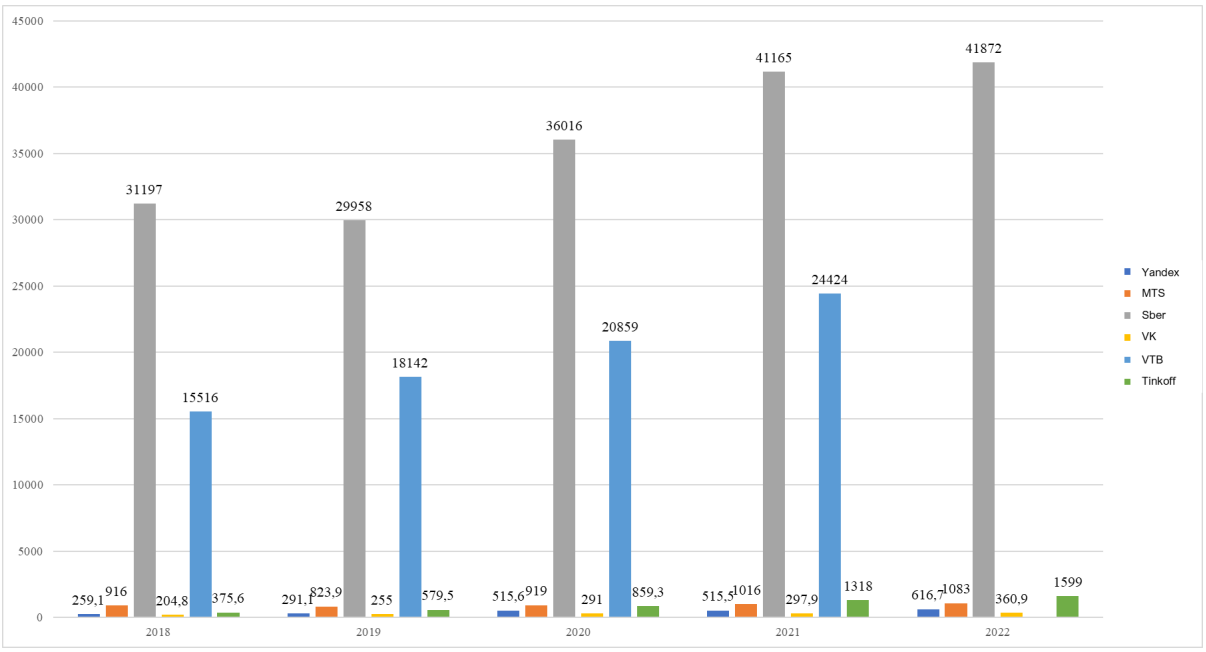

Figure 4. Revenue dynamics of the largest ecosystem companies in Russia, 2018-2022, RUB bn
Source: Fundamental stock analysis. Smart-lab. Available at: https://smart-lab.ru

According to Figure 4, the largest assets have the companies existing for a long time as traditional ones and began the process of digital transformation relatively recently: Sber and VTB have the largest assets; VTB is steadily increasing them (except 2022 with the unknown dynamics). Meanwhile, functioning in one industry (banking system) is not the reason: Tinkoff, also being a bank, shows a low asset value. Actually, we believe the reason for this ratio relates to high digitalisation companies (online banks and internet platforms) generating revenue from intellectual resources. These assets are not completely y accounted for (in terms of real business value) in the formation of intangible assets.

Analyzing the companies net profit (see Fig. 5), we can note its largely corresponding to the dynamics of revenue.

Sber is the leader in terms of revenue and net profit. Moreover, the dynamics is extremely unstable:

the trend of reduction was replaced by growth in 2021 (by 64.37%), and it was followed by a sharp drop in 4.62 times. VTB and Yandex had significant losses in 2021; although the size of Yandex loss was lower one. Since 2020, the operation of VK has been unprofitable. Diversification showed positive results in terms of minimising the risks to net income, which was not always positive. In terms of VK situation the investments in new areas have not yet reached profitability after the company's merger with Mail.ru Group. For other companies it is an issue of insufficient resistance of the diversification strategy to crises.

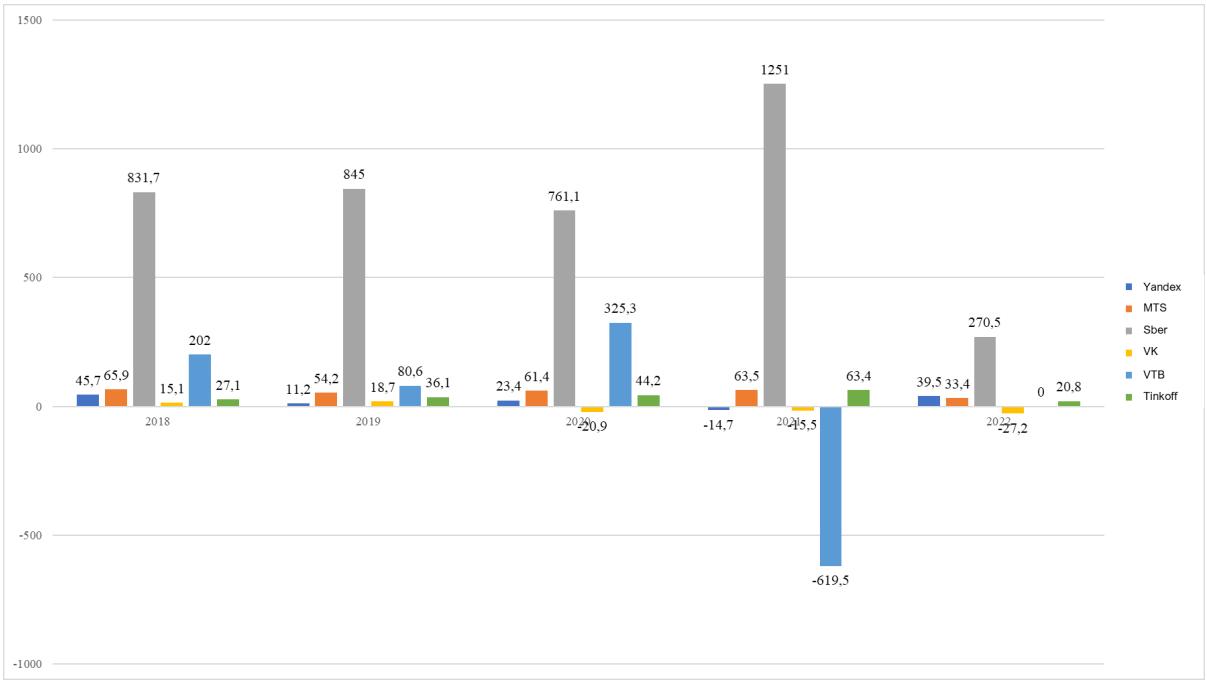

Figure 5. Asset dynamics of Russia's largest ecosystem companies, 2018-2022, RUB bn
Source: Fundamental stock analysis. Smart-lab. Available at: https://smart-lab.ru

The companies differ significantly in terms of scale of operations and market shares. To compare their performance, we should consider relative measures of profitability (total – net profit to revenue – and assets – net profit to asset value).

The dynamics of total profitability is presented in Figure 6.

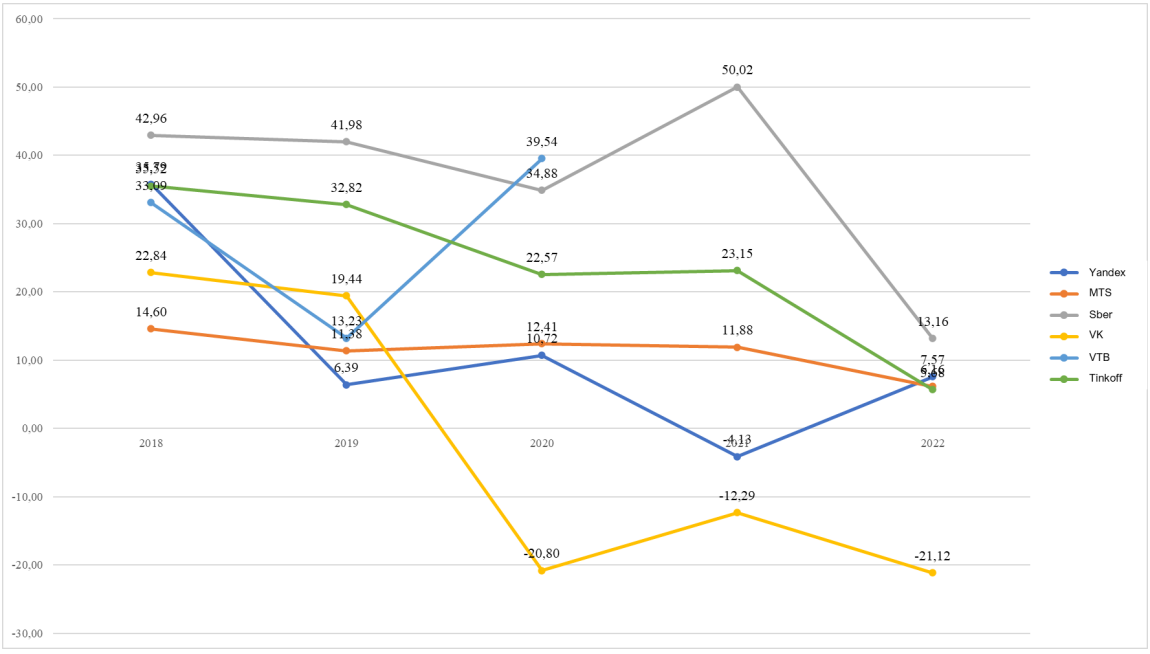

Figure 6. Dynamics of total profitability of Russia's largest ecosystem companies, 2018-2022, %
Source: composed by the author

According to the data in Figure 6, the companies performance is declining: most of the indices of overall profitability show a downward trend. This trend appeared in the pre-crisis period (2019).

The dynamics of return on assets is shown in Figure 7.

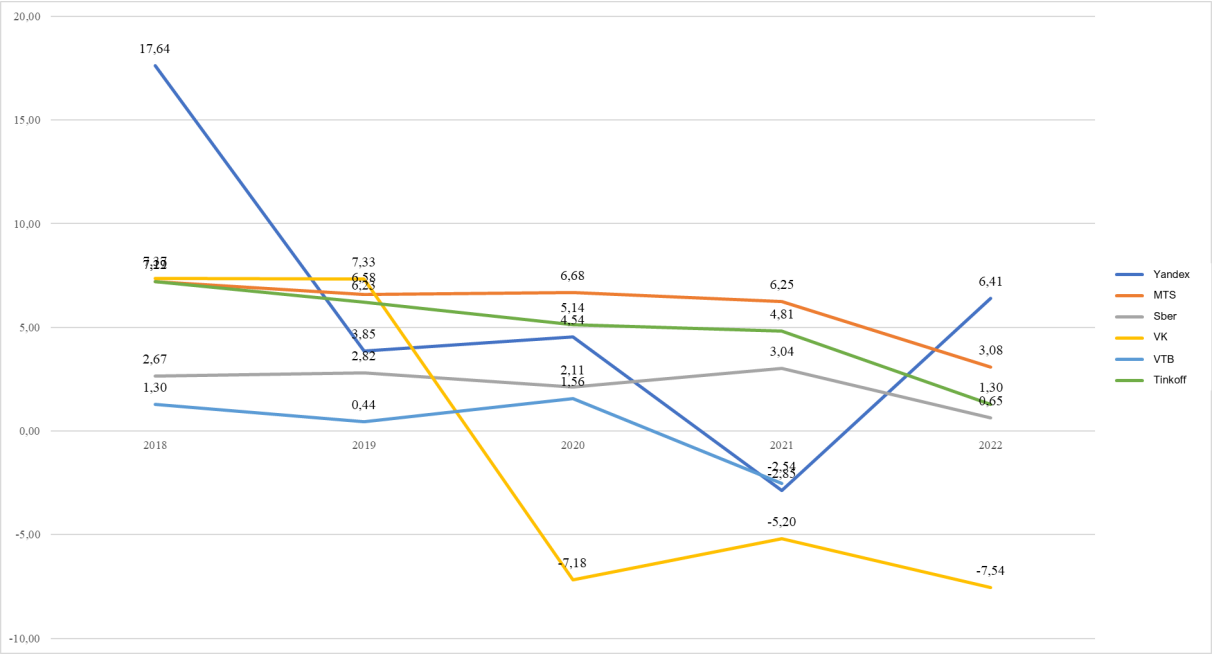

Figure 7. Dynamics of return on assets of Russia's largest ecosystem companies, 2018-2022, %
Source: composed by the author

Regarding return on assets, the situation is similar: the index trends are downward; in 2022, only Yandex showed growth, while the other companies experienced a rapid profitability decline.

Conclusion

Consequently, the diversification strategies implemented are not justified in terms of minimising losses (although they allow ones to stabilise revenue growth). However, it might be explained by annual investments in new economic sectors, which have not yet reached stable incom. Those companies are searching for new profitable niches. It will allow them to effectively expand the ecosystem business structure in the future.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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Analysis of industrial digital development in the Ivanovo region

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Abstract. The formation of the Russian Federation digital sovereignty for the successful implementation of all stages of domestic industries digital transformation and enhancement of national competitiveness is impossible without the development of a support system based on the domestic hardware. The developed and efficient system of domestic electronic computer components production is the foundation of the national digital assets productivity. On the basis of the Federal State Statistics Service public official data, paper studies and analyses the relationship between three main economic indicators of the production process: investment in fixed capital, industrial production, the volume of shipped goods, works and services, in terms of «Manufacture of computers, electronic and optical products» as a type of economic activity for Ivanovo region and the Russian Federation. The study analyses a time period 2015-1st half 2023. To obtain objective results of the industrial digital development analysis of the Ivanovo region, the article additionally conducts a comprehensive analysis of the companies performance in terms of «Manufacture of computers, electronic and optical products» based on indicators of enterprises profitability. According to the research results, we determined state and trends of the digital industry in the Ivanovo region. Therefore, the industrial capabilities for hardware base development of electronic computer components and devices in the Ivanovo region is the key points of sustainable industrial diversification of regional economic system.

Keywords: digital transformation, investment, development, strategy, innovative development, information technology, digital sovereignty.

JEL codes: R11, R58, L52

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Introduction

The formation of digital sovereignty system of the Russian Federation is impossible without digital transformation of the national economy sectors. Meanwhile, each constituent entity of the Russian Federation has its own special production profile. It provided by the historical specifics of regional industry, its geographical location, in terms of proximity to the Federal Centre or to foreign countries. The implementation of modern and innovative digital technologies directly affects enterprise labour productivity. It also provides the competitiveness in a free market. It has a strong positive impact on the growth of the country's gross domestic product and, as a result, the well-being of its residents.

The effective implementation of digital transformation as an important component of a developed economic system architecture, and the introduction of successful digital solutions request modern hardware base or electronic digital devices. It allows us to increase the national digital resources productivity, enhance business communications, improve labour efficiency, quality, and competitiveness of production. Therefore, the purpose of this research is to assess the state of the digital industry as one of the digital sovereignty system elements in the Russian Federation and in the Ivanovo region.

The term «Digital sovereignty» first appeared in the project «Long-term Development Plan for the Russian segment of the Information and Communication Network and related Industries» (hereinafter – Project). The Project was compiled by the Internet Development Institute at the direct request of the President of the Russian Federation Vladimir Putin on 29 September, 2015 (Efremov, 2017). The plan was compiled after the meeting of V.V. Putin and representatives of Russian IT community: search engines, domain providers, security companies, etc. Following this meeting, a concept of «Digital Sovereign» Russia was proposed. The concept implied both technological and economic independence of the country[1].

[1] *The Institute project Development Internet /Proposals for the formation of a long-term development program for the Russian part*

The term «Digital sovereignty» itself was defined as high level of self-sufficiency and technological independence and was most often used in the Project in terms of three areas of Internet policy: economic protectionism (import substitution of hardware, software, and support for domestic IT companies in the foreign markets); security of the Russian Internet infrastructure, and big data and data localization (Brokes, 2018).

Foreign researchers consider «technological sovereignty» as the basis of national digital independence. The content of this term is defined as «the development of digital technologies and the design of digital infrastructure using freely distributed software, server devices, and encryption technologies, both collectively and alone» (Kaloudis, 2021).

Many Russian researchers interpret the concept of «Digital sovereignty» differently; they also replace the essence of this term with «Information sovereignty», or the right of the state to control the information flows distributed on its territory[2]. However, most domestic authors on digital transformation of the national economy sectors pay attention to the introduction of digital resources such as the World Wide Web or specialized software; but they do not consider the issue of the effectiveness, which directly depends on hardware base performance.

Some experts make attempts to identify modern trends of digital independence based on the developed foreign countries experience. They also focus on digital ecosystems covering a lot of aspects of daily human life (Bezrukov et al., 2021).

Recently, there are a lot of forums on digital sovereignty formation. Hence, some experts dwell on electronic computing base development as a necessary basis for the digital infrastructure of the Russian Federation[3].

However, there are very few modern scientific works of domestic researchers devoted to the analysis of hardware basis current state of the Russian Federation digital sovereignty. Therefore, this paper provides a contribution to this scientific challenge.

Main part

An important indicator of any country digital sovereignty is the state of economic activity «Production of computers, electronic and optical products», which belongs to the manufacturing industries. The general dynamics of the main economic indicators of economic activity «Production of computers, electronic and optical products» in the Russian Federation is shown in Figure 1.

Based on the data obtained, digital technologies development in the Russian Federation since 2015 to the present can be divided into 2 periods:

The first one is 2015-2020. A distinctive feature of this period is a gradual decline in the volume of shipped goods on the economic activity «Production of computers, electronic and optical products» from 111.7% in 2015 to 98.2% in 2020. It was a result of reduced investment in this industry development. The hypothesised reason for the decline in the volume of domestic digital devices shipped over the period is high competition with imported digital products. Indeed, those products had higher manufacturing characteristics and lower costs.

The second period: since 2020 to the present. A distinctive feature of this period is the rapid growth of investments in the production of domestic digital devices caused by the COVID-19 pandemic and the epidemiological restrictions imposed. Furthermore, the international sanctions regime imposed on Russia in 2022 as a result of Russia's measures to protect its borders also had a positive impact on the growth of capital investment in the «Manufacture of computers, electronic and optical products» industry. The changing nature and tactics of SMO with a tendency to use the modern digital devices (drones, tracking devices, etc.) has also

of the Internet information and communication network and related sectors of the economy/ Available at: https://filearchive.cnews.ru/img/cnews/2015/10/08/dolgosrochnaya_programma_iri.docx (accessed: 08.11.2023).

[2] Ashmanov, I. Information sovereignty of Russia: a new reality. Available at: http://rossiyanavsegda.ru/read/948 / (accessed: 07.11.2023).

[3] Digital sovereignty. Discussion (summary) 2.09.2021. Roscongress Information and Analytical system. Available at: https://roscongress.org/sessions/eef-2021-tsifrovoy-suverenitet/discussion /# (accessed: 10.11.2023).

influenced active investment in the domestic digital industry. Moreover, an additional distinctive feature of this period is the high efficiency of investments in the development of the manufacturing industries digital sector. It shows the high growth of the industrial production index and the volume of shipped goods of own production, completed works and services, despite the decline in investments in 2022 to 98.5%.

The active growth of investments in the digital industry of the Russian Federation in the 1st half of 2023 is directly related to the introduction of IT soft-window facility by the Government of the Russian Federation. The IT Companies Support Program was adopted by Decree of the Government of the Russian Federation on 06.05.2023 No. 707 «On Amendments to the Rules for Granting Subsidies from the Federal Budget to Ensure Soft Lending to Digital Transformation Projects Implemented on the Basis of Russian Solutions in IT, and Invalidation of Certain Provisions of Certain Acts of the Government of the Russian Federation.» The purpose of its implementing was to accelerate the digital transformation of national economy sectors, and the introduction of domestic digital solutions.

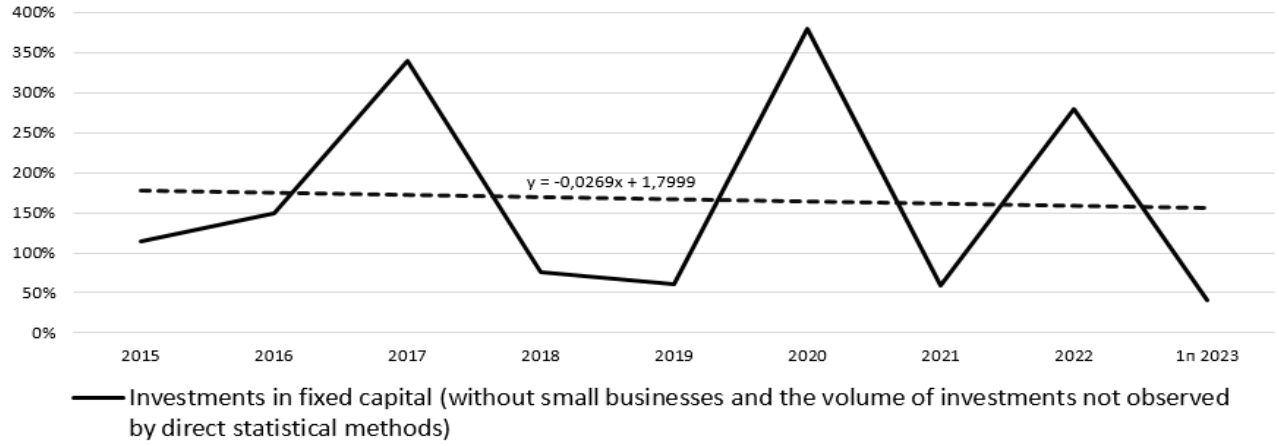

Figure 1. The general dynamics of the main economic indicators of «Production of computers, electronic and optical products» in the Russian Federation[4]

Source: composed by the author based on Unified Interdepartmental Statistical Information System[5]

The main advantage of the IT project support program was 3% soft lending for accredited IT companies tax relief free[6]. According to the Russian Government, the use of soft lending is expected to help IT companies maintain their current operations and implement new digital projects. Furthermore, the IT project support programme provides an opportunity to use loan funds for incentive payments to IT specialists and reimbursement of their expenditures.

But the terms of soft lending for IT companies are different:

- preferential loan rate: from 1 to 5% (up to 3% for accredited IT organizations);
- the loan value for IT project implementation: minimum – 5 RUB mln, maximum – 5 RUB bn;
- the loan amount for implementation of the program (a set of projects): minimum – 500 RUB mln, maximum – 10 RUB bn.

Indeed, the main risk of implementing the IT project support program is the limitation of budget funds aimed at the digital transformation of the national economy sectors. This risk is directly correlated with the monetary policy pursued by the Central Bank of the Russian Federation.

The implementation of the IT project support programme, according to statistics on capital investment in the development of the «Manufacture of computers, electronic and optical products» industry of the Russian Federation, has already provided an active introduction of domestic digital solutions. This prompt

[4] *The analysis 2015-2016 uses «Production of electrical equipment, electronic and optical equipment» in the absence of statistical information on the studied branch of production for the given period (the correction is applicable to all paper analyses for the given period).*

[5] *Available at: https://www.fedstat.ru/indicator/61497*

[6] *Ministry of Digital Development, Communications and Mass Media of the Russian Federation /Activities/ Preferential lending to companies. Available at: https://digital.gov.ru/ru/activity / directions/942 (accessed: 01.11.2023).*

and effective governmental action, meanwhile, makes it possible to increase the digital sovereignty of the Russian Federation from the import of software products to a higher level.

An effective use of industrial trends in management activities for the growth of economy and well-being of the residents of any Russian region makes the Head of this entity an effective leader.

Currently, the industrial profile of the Ivanovo region is determined by manufacturing industries. For instance, the largest volume in the structure of the Gross Regional Product (hereinafter – GRP) of the Ivanovo region at the end of 2021 for manufacturing industries was 22.7%. Besides, only manufacturing industries show stable positive dynamics in terms of their share in the Ivanovo region GRP structure, increasing from 14.5% to 22.7% over the period of 2016-2021. This positive trend in the change of the GRP structure is a positive factor for the development of Ivanovo region. Hence, the development of the real economic sector increases the region's population quality of life (Savin, 2023).

Additional evidence of the development of regional manufacturing industry is increasing of the share of manufacturing industries, shipped goods of own production, completed works and services for the period 2015-2023 by 11.66% from 75.48% to 87.14%, respectively.

The analysis of manufacturing industries by the structure of shipped goods for 2022 reveals the tendency for the Ivanovo Region economy to be stable due to the historically established branches of textile products (share of 35.5%) and clothing (share of 8.6%). Moreover, new promising direction of development of the region's economic system «Manufacture of computers, electronic and optical products» (share of 7.9%) appeared. In the first half of 2023, since the production of textile products (37.1%) increased to meet the needs of the SMO, the shares of clothing production, production of computers, electronic, and optical products decreased to 8% and 6.4%, respectively. Despite the decrease of its share in the structure of the total volume of shipped goods, works, and services, currently «Manufacture of computers, electronic and optical products» belongs to the group of leading branches of the Ivanovo region manufacturing industries.

Figure 2 shows the dynamics of investments in fixed capital (without small businesses and the volume of investments not observed by direct statistical methods) in the Ivanovo region according to «Production of computers, electronic and optical products» industry since 2015 to the present.

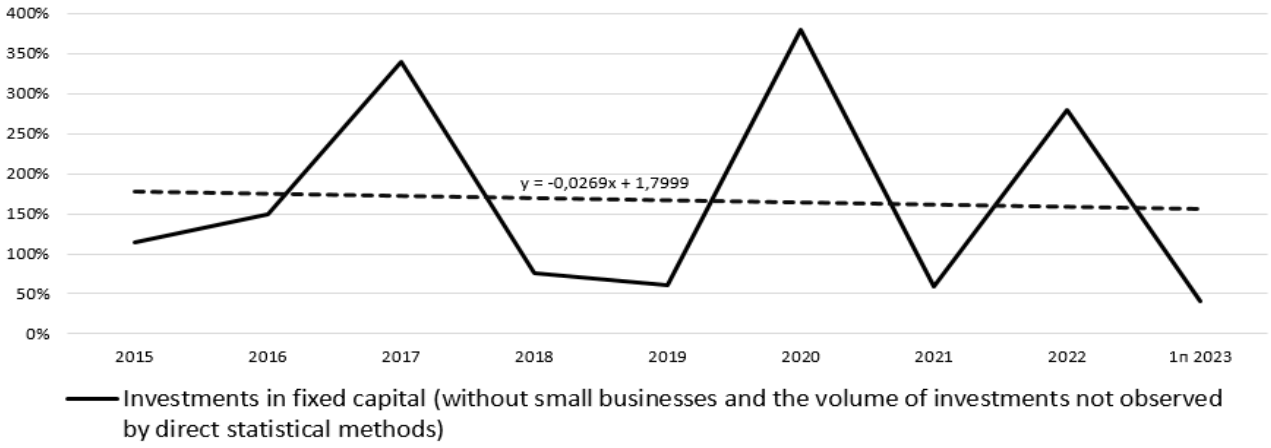

Figure 2. Dynamics of investments in the Ivanovo region

Source: composed by the author based on Federal State Statistics Service for the Ivanovo region[7]

The high-fluctuating nature of investments in the production of digital devices in the Ivanovo region indicates the low efficiency of measures implemented toward the realisation of a sustainable long-term strategy of digital transformation in the Ivanovo region. They also show insufficient realisation of the great potential for its development as a new economic growth potential for the region.

The higher capital investment in digital devices production in the Ivanovo Region in 2020 is caused by the large government order. For instance, within the framework of the All-Russian Population Census in 2020, the IT company Aquarius, Shuya, Ivanovo region, produced 225 thousand tablets and specialized

[7] *Territorial authority of the Federal State Statistics Service for the Ivanovo region. Report «Socio-economic situation of the Ivanovo region». Available at: https://37.rosstat.gov.ru/folder/31699 (accessed: 01.11.2023).*

software for the purposes of the population census for the Federal State Statistics Service.

Although the general trend of investments in «Manufacture of computers, electronic and optical products» industry in the Ivanovo region for the period under study is decreasing and described by the formula y = - 0.0269x + 1.7999 (the trend is calculated in the MS Excel software), it is still involved into the range of fixed capital investment growth. This growth is 150% per year. The declining trend of capital investment in the digital industry indicates the insufficient efficiency of operational and tactical managerial decisions of the Ivanovo region authorities in terms of this type of production development.

Indeed, an important indicator of any industry state is the volume of own shipped goods, works, and services. This indicator is a direct consequence of investments efficiency. Figure 3 shows this indicator dynamics in the Ivanovo region since 2015 to the present.

A decrease in the share of «Production of computers, electronic and optical products» industry in terms of the volume of goods shipped, works, and services in the Ivanovo region from 7.9% in 2022 to 6.4% in the 1st half of 2023 is direct consequence of reduced investment in this industry by regional enterprises. In addition, changing the share of digital industry in the manufacturing structure of Ivanovo region is directly related to the structural reorganisation of the Russian economic system to meet the needs of SMO.

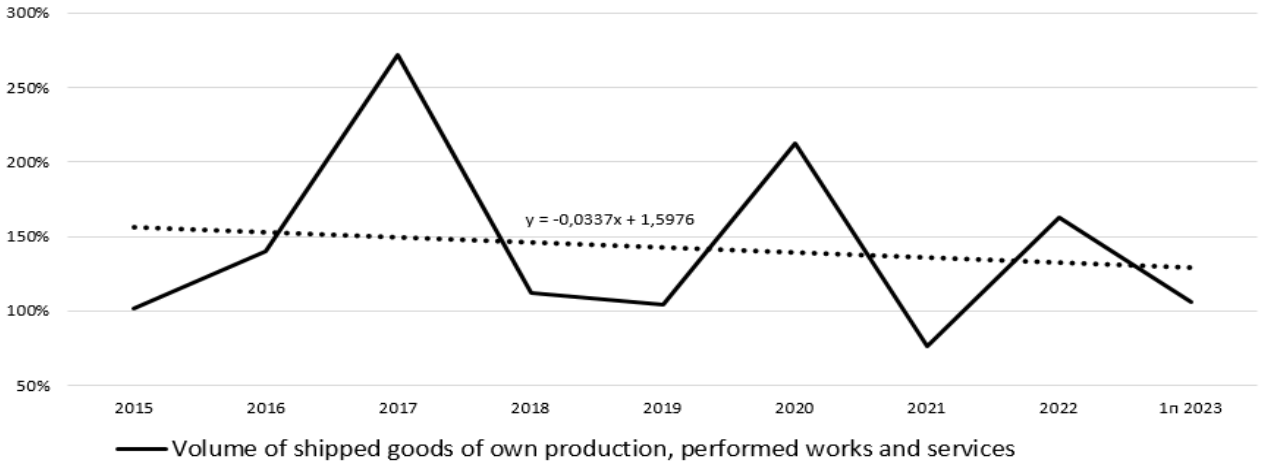

Figure 3. Dynamics of the volume of own shipped goods, works, and services in the Ivanovo region
Source: composed by the author based on Federal State Statistics Service for the Ivanovo region[8]

In the Ivanovo region, during the period under study, the economic indicator volume of shipped goods, works, and services was in a positive growth zone and decreased below 100% only once in 2021, reaching 76.3% compared to the previous year; it was 212.1%. The peak value was 271.6% in 2017 compared to the previous year fairly high value – 139.6%. These results may indicate the active spread of regional digital solutions to the IT product market.

The general appearance of the indicator is the volume of shipped goods, works and services of «Production of computers, electronic and optical products» industry. In the structure of manufacturing industries, like investments in fixed capital, it has an oscillatory character with a negative trend described by the formula y = - 0.0337x + 1.5976 (calculated in the MS Excel software). Moreover, the general trend of shipped goods, works and services of the industry under study is currently in the positive zone above 130% annual growth of this indicator. It may be a consequence of the active process of investment in the digital industry.

The general situation of the digital industry development in the Ivanovo region since 2015 to the present is shown in Figure 4. Combining the main economic indicators of «Manufacture of computers, electronic and optical products» industry into a common system allows us to conduct a more objective analysis of the efficiency assessment of capital investment in the digital development of manufacturing industries in the Ivanovo region.

[8] *Territorial authority of the Federal State Statistics Service for the Ivanovo region. Report «Socio-economic situation of the Ivanovo region». Available at: https://37.rosstat.gov.ru/folder/31699 (accessed: 01.11.2023).*

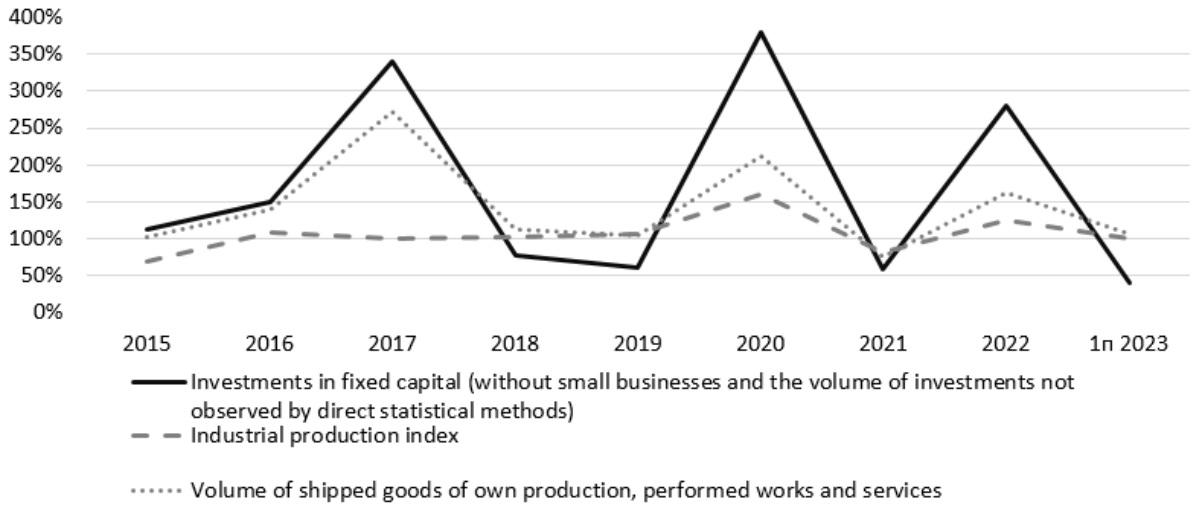

Figure 4. The general dynamics of the main economic indicators of «Production of computers, electronic and optical products» industry in the Russian Federation

Source: composed by the author based on Federal State Statistics Service for the Ivanovo region[9]

The common analysis of the main economic indicators of «Manufacture of computers, electronic and optical products» industry shows the short-term nature and low efficiency of capital investments caused by a high percentage spread. However, a significant decline of fixed capital investment efficiency in the development of digital devices in the Ivanovo Region started since 2020 and still continues. However, the efficiency of fixed capital investments in the development of the digital industry is, on the contrary, highly efficient in the Russian Federation since 2022.

An additional indicators allow us to analyse the industrial digital development of the Ivanovo region are regional IT companies financial results (Fig.5).

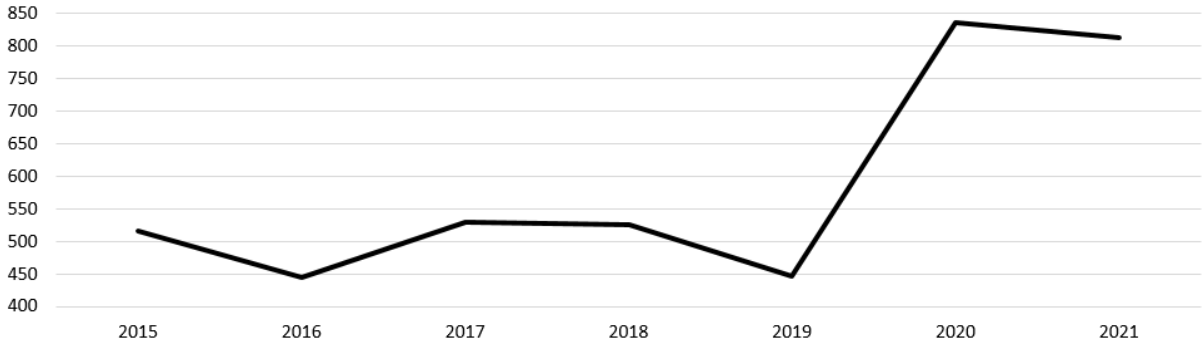

Figure 5. The financial result of «Production of computers, electronic and optical products» industry, the Ivanovo region, RUB, mln[10]

Source: composed by the author based on Federal State Statistics Service for the Ivanovo region[11]

In 2015-2019, the financial result of «Production of computers, electronic and optical products» industry in the Ivanovo region, according to digital enterprises accounting documentation, was 445-529 RUB, mln in actual prices. However, the peak values of capital investments were in 2017. It affected on the profit growth of 118.8% in relation to the previous year (in actual prices).

Hence, based on financial statistics, the period 2015-2019 for «Manufacture of computers, electronic and optical products» industry in the Ivanovo region, despite a single active surge in fixed capital investment

[9] *Territorial authority of the Federal State Statistics Service for the Ivanovo region. Report «Socio-economic situation of the Ivanovo region». Available at: https://37.rosstat.gov.ru/folder/31699 (accessed: 01.11.2023).*

[10] *Figure 5 shows the financial result for organizations in actual prices (according to accounting documents). Extended data for 2022-1023 by the entities of the Federal State Statistics Service for the Ivanovo region have not been published yet.*

[11] *Territorial authority of the Federal State Statistics Service for the Ivanovo region. Statistical Yearbook «Ivanovo region». Available at: https://37.rosstat.gov.ru/folder /31706 (accessed: 11/01/2023).*

in 2017, can be characterised as stagnating.

The rapid growth of capital investments in 2020 caused by the state order to provide the All-Russian Census with digital devices resulted in «Manufacture of computers, electronic and optical products» industry recovering from stagnation. The result of this state order immediately had an impact on the financial result of regional enterprises. The growth of the positive result in actual prices in 2020 compared to the previous year amounted to 187.3%, and reached 835.5 RUB mln.

Operating profitability is an important financial indicator representing the efficiency of the economic activity (Fig.6).

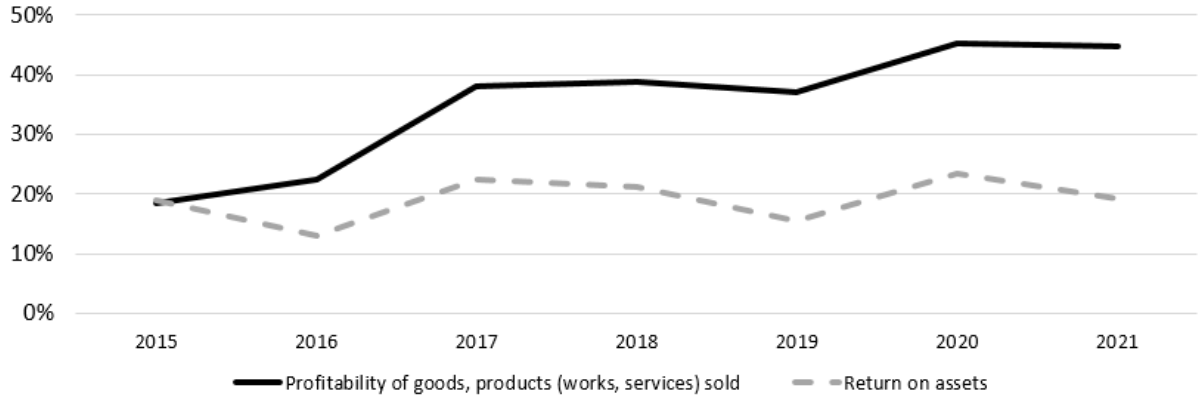

Figure 6. The operating profitability of «Production of computers, electronic and optical products» industry, the Ivanovo region, RUB, mln

Source: composed by the author based on Federal State Statistics Service for the Ivanovo region[12]

Profitability of selling goods, products (works, services) is calculated as the ratio between the value of the balanced financial result (profits minus losses) from the sale of goods, products (works, services) and the cost of goods, products (works, services) sold, including selling and administrative expenses[13]. Nevertheless, during the period of financial stagnation in 2015-2019, the enterprises of the Ivanovo region's digital industry annually attempted to improve production processes to reduce costs. As a result, it had a qualitative impact on the profitability indicators for this period. The capital investments in 2020 made it possible to increase the profitability.

Meanwhile, the profitability of goods sold, products (works, services) above the level of 30% is a very high indicator. In 2020-2021, this indicator for»Manufacture of computers, electronic and optical products» industry in the Ivanovo region was 45%. It indicates a high internal efficiency of regional IT companies.

However, the Ivanovo region has a large potential to provide a hardware base for the modern and innovative digital devices, despite some aspects of management decision-making efficiency. OOO PC Aquarius, Shuya, is a leader in the production development of computer equipment in the Ivanovo region. For more than 30 years, OOO PC Aquarius has been producing high-tech equipment. Currently, its production capacity is more than 800,000 digital devices per year. At the same time, the enterprise is one of the largest manufacturers of computer equipment in the Russian Federation.

In the information technology market, OOO PC Aquarius has a well-developed two-bin system. Its partner network includes more than 1,300 organizations throughout the Russian Federation. Company has the largest service network in Russia, consisting of more than 200 service centers in 135 cities of the Russian Federation. OOO PC Aquarius product portfolio is as follows: personal computers, laptops, servers, monitors, and data storage systems.

The engineers of the Scientific and Technical Center of OOO PC Aquarius are engaged in the creation of integrated software and hardware solutions in addition to new digital devices development.

[12] *Territorial authority of the Federal State Statistics Service for the Ivanovo region. Statistical Yearbook «Ivanovo region». Available at: https://37.rosstat.gov.ru/folder /31706 (accessed: 11/01/2023).*

[13] *Territorial authority of the Federal State Statistics Service for the Ivanovo region. Statistical Yearbook «Ivanovo region». Available at: https://37.rosstat.gov.ru/folder /31706 (accessed: 11/01/2023).*

The enterprise produces computer equipment for government agencies, large organizations, and small developing companies. Currently, the most well-known partners of OOO PC Aquarius are Federal Ministries, Regional Government Authorities, the Federal Tax Service, the Central Bank of the Russian Federation, the Federal State Statistics Service, the Social Insurance Fund of the Russian Federation, the Pension Fund of the Russian Federation, Rosreestr, Sber, Russian Post, Russian Railways, Yandex, Mail.ru, VK and etc.[14]

The modernization of the motherboard installation workshop in 2022 allows OOO PC Aquarius to assemble all types of motherboards for modern digital devices. The production capacity also allows the enterprise to produce about one million digital devices per year. In 2021-2025, Aquarius plans to invest more than 1.5 RUB bn for the development of its production facilities in Shuya, Ivanovo region.

Moreover, besides the current work on the development and implementation of the hardware base of digital devices, the successful implementation of individual elements of digital transformation in the Ivanovo region is its recognition as the best one among the entities of the Russian Federation in terms of the efficiency of industrial policy implementation by the end of 2022. The result of effective work in the State Information System of Industry of the Ministry of Industry and Trade of Russia was presented at the international industrial exhibition Innoprom-2023[15].

Nevertheless, enterprises in the Ivanovo region have been successfully applying the achievements of individual elements of the Russian Federation digital transformation system. For instance, sales via online marketplaces. It resulted in the leading positions of the Ivanovo region in this segment. This transition to a new type of marketing of manufactured products outside the Ivanovo region allows local producers to increase the volume of manufactured products sales and find new markets.

Conclusions

The analysis of the industrial digital development of the Ivanovo region allows us to conclude the following:

- the efficiency of investments in «Production of computers, electronic and optical products» industry of the Ivanovo region needs additional adjustment;
- regional IT companies have high profitability indicators; it indicates high internal production efficiency;
- the Ivanovo region has a strong production base for the further development of regional digital industry;
- in the Ivanovo region, «Production of computers, electronic and optical products» industry can become one of the leading branches of production, qualitatively increasing its share in the structure of regional manufacturing industries.

Therefore, on the way to digital sovereignty system formation the Ivanovo region, like any other constituent entity of the Russian Federation, barriers to development may be encountered. They are: incorrectly set goals and objectives of the digital transformation project, errors in planning the types and sequence of work; incorrect initial information about the object of digital solutions implementation, technological incompetence of users; absence of special measures of state support for the use of digital technologies by companies; regulatory restrictions on the use of digital technologies by companies; and the absence of special measures to support the use of digital technologies by companies.

To avoid these barriers to the digital transformation of the Russian Federation to digital sovereignty, it is necessary to take consistent and effective measures for foreign economic activity sustainable development in terms of «Production of computers, electronic and optical products» industry. To its successful implementation both in the Ivanovo region and other entities of the Russian Federation, there is a need to actively implement and apply innovative digital solutions based on international experience, so as import digital technologies and devices for subsequent replication within the framework of the import substitution program.

Sustainable digitalization of national economy branches of the Russian Federation entities will ensure

[14] *The official website of OOO PC Aquarius. Available at: http://www.aqs.ru (accessed: 22.11.2023).*

[15] *Ivanovo Region is the country's leader in the development of digital and online capabilities in the economy / Available at: https://ivanovoobl.ru/?type=news&id=57943 (accessed: 22.11.2023).*

the steady growth of the national economy, its GDP, and become the basis of national digital sovereignty system.

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CONFLICT OF INTEREST

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Compliance certification system development as a priority criterion for improving product competitiveness

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Abstract. The paper characterises the elements of compliance certification in the context of ensuring independent conformity assessment and improving product quality. The authors described the features of adapting a new model of compliance certification on the example for a regional certification body, which go beyond the traditional conformity assurance system. The paper discusses the essence of the compliance certification system, levels and types of compliance system, and prerequisites for its adaptation in certification. The research recommendations for the development and implementation of compliance certification in manufacturing plants are based on the results of a single-factor variance analysis. It allows ones to assess the production process reproducibility. The study of manufacturing process stability reveals the potential inclusion of vegetable fats in the products under study. The authors analysed the reproducibility using an event tree. This tree identified the main production control parameters. The authors show the risk of added vegetable oils presence in the raw materials at the homogenisation, pasteurisation, and fermentation stages. The analysed data on statistical stability and reproducibility assessment suggest the necessity to provide conditions for the software development and implementation for monitoring of production processes in order to implement the principles of compliance certification on the basis of the selected production enterprise. The implementation of compliance certification system increases the competitiveness of products, ensuring reliability and quality.

Keywords: certification compliance system, organisation activity, certificate of conformity, confirmation of conformity, one-factor variance analysis, statistical stability and reproducibility of technological processes.

JEL codes: C13, L15, L64

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Introduction

In recent years, there has been a global trend of increasing product competitiveness. It consists in increasing requirements to the ways of proving product conformity. Compliance certification is a new direction of professional activity in conformity assessment introduced by international certification bodies into Russian organisations. There is nothing surprising in such borrowing in the era of business globalisation, especially since this practice provides consumer confidence in the transparency of the conformity confirmation

procedure. Certification is one of the prevailing confirmations of compliance with the requirements of various types and categories of standards, as well as directives and technical regulations (Bataeva & Cherepanova, 2017). Certification as a confirmation of conformity is based on the use of a significant number of measuring methods, testing, and control of product quality and safety. This determines the necessity of compliance control, requiring compliance with the established rules of internal interaction, procedures, and decision-making process to international requirements, identification, and assessment of compliance risks (Gvozdeva, 2010).

The application of the fairness doctrine in certification ensures, primarily, the quality and competitiveness of products, as well as their safety in the market. The national certification system of the Russian Federation has standardised approaches to various methods of conformity confirmation. In particular, standardised schemes of conformity confirmation have been developed. They based on different methods of proving conformity. For example, analysis of production or mandatory confirmation of conformity of products with the involvement of accredited bodies (certification bodies, testing laboratories) or the manufacturer's measures to ensure the release of products meeting the requirements of technical regulations, priorities its own production control (Aydynov & Grosheva, 2020).

Moreover, despite the introduction of standardised certification schemes, there are still unscrupulous certification bodies and testing laboratories committing the following violations:

– they don't take product samples;
– they don't analyse the production;
– they form an unrepresentative sample when certifying a batch of products (too small volume and/or incorrect type representatives), as a result, the test results do not provide a true representation of the entire batch of products' safety;
– they do not perform tests or perform them incompletely;
– they use incorrect test methods.

Therefore, control over the certification market requires more drastic measures. Namely, changes to legislative and regulatory documents are introduced and prerequisites are created to maintain transparency of activities within the sphere of conformity assessment. Over the last year, global changes in the legislation on technical regulation have been introduced. Federal Law No. 460 amended Federal Law No. 184 "On Technical Regulation". The main part of these changes goes on to the statute book on 21 June 2021.

The amendments officially introduced new terms "invalid declaration", "invalid certificate", "invalid test report". According to the Law, the invalidity of a declaration and certificate is a reason for control and supervisory authorities to terminate their validity in the prescribed cases. The adoption of amendments to the Federal Law on Technical Regulation was followed by a number of by-Laws.

The State adopted Decrees No. 934 and 936 of the Russian Government on 19 June 2021. These Decrees determine the procedure for invalidating test reports, declarations of conformity, and certificates of conformity. The procedure provides for cases for protocols, certificates and declarations to be declared invalid from the date of issue/registration, to be suspended or terminated. Certificates and declarations will be recognised as invalid not only as a result of non-conforming products identification, but also as non-compliance with mandatory conformity assessment procedures.

Decrees No. 934 and 936 allowed RusAccreditation to recognise certificates, declarations and test reports invalid. Now RusAccreditation assesses the completeness and correctness of the data transferred to the FSIS; the correctness of the selected conformity assessment scheme; identifies cases of violation by the first party of the declaration of conformity; cases of issuing conformity certificates in violation of the mandatory rules of conformity assessment by an accredited person, and performs other control functions[1].

All these measures are aimed at combating unscrupulous certification bodies and ensuring the distribution of reliably tested and safe products. The focus of these measures is shifted from product surveillance to compliance with mandatory conformity assessment rules and procedures. Applicants must

[1] *The World information-analytical and scientific-technical journal "Russian Engineer". Available at: https://mtz-transmash.ru/files/presscentr/publikacii/2021/rusinzh-112021.pdf4. (accessed: 12.10.2023).*

be ready to answer not only for their own actions, but also for the activities of certification bodies and testing laboratories providing certification and testing services. In fact, the product may be qualitative and safe, but due to violations committed by both the applicant and the certification body or testing laboratory, the certificate or declaration may be invalidated retroactively. Therefore, such products may have to be withdrawn from the market anyway.

The invalidation of conformity certificates and conformity declarations from the date of their issue/registration provides huge risks of financial losses for the manufacturer. This may include product recall, impossibility to sell residual goods, impossibility to fulfil supply agreements, loss of contracts, reputational losses. In order to avoid risks and financial losses, it is necessary to understand the issues of conformity assessment and consciously choose only reliable partners when performing certification. However, changes in the legislative sphere and the new procedure for declaration registration starting from 01.01.2021, as well as the control by the state authorities, cause a lot of questions among the stakeholders about finding a solution and recovery.

Therefore, the national certification body ROSTEST made a prompt decision to develop methodological principles for adapting the compliance certification system. "Compliance" is an effective tool for risk minimisation. In general terms, compliance is ensuring fulfilment of regulatory and legislative requirements in certain areas. US experts R. J. Burby, R. J. May, R. K. Paterson believe that "compliance" is the fulfilment by an economic entity of the requirements adopted in the appropriate order by the legislative authorities (Burby, May & Paterson, 1998). G. Governatori interprets it as the degree of compliance of business processes with those requirements both at the legislative level and within the organisation itself (Governatori et al., 2017). The international standard ISO 37301:2021 defines compliance as the activity of fulfilling by an organisation all its obligations to ensure norms conformity[2]. Compliance management in the sphere of technical regulation in the Russian market is a new, unexplored, and important phenomenon.

The "Compliance" service is the fulfilment of the current legislation in the field of technical regulation in terms of mandatory requirements for products, processes, rules, and procedures for first party conformity assessment (confirmation). The accreditation of the national certification body ROSTEST allows it to assess the products and processes. Compared to certification, within the framework of compliance, in addition to fulfilment of the current legislation in terms of mandatory requirements for products and processes, the correctness of the first party's application of the necessary rules and procedures – from product identification, development of a test plan to the adoption and registration of a declaration – is also assessed[3].

There are several types of compliance certification:

– compliance in the field of conformity with the established product requirements and the processes of design (including surveys), production, construction, installation, commissioning, operation, storage, transportation, sale, and disposal related to product requirements;

– compliance in procurement activities;

– compliance in the area of managing conflicts of interest (objective decision-making).

The compliance system developed by ROSTEST also has several levels (see Table 1).

Compliance is conducted beforehand at the stage of product market circulation. Based on the results of the conducted analysis on the first party's compliance with the norms of legislation in the sphere of technical regulation, a report on product compliance (compliance report) is issued. This document may form the basis for a declaration and will strengthen the evidence base.

By assessing, ROSTEST guarantees the structural format and logical control in the FSIS of RusAccreditation will be passed and the declaration will be reliable.

ROSTEST is ready to provide support to customers in case of questions from supervisory authorities at the stage of products market circulation in relation to conformity assessment. It was performed within the

[2] *ISO 37301:2021 Compliance management systems — Requirements with guidance for use. Available at: https://cdn.standards.iteh.ai/samples/75080/98db41625e0445a193a12f005dd5f30b/ISO-37301-2021.pdf. (accessed: 12.10.2023).*

[3] *Russian Union of Dairy Industry Enterprises. Available at: https://2023.dairyunion.ru/news/tpost/ubah57byk1-lyudmila-manitskaya-posetila-laboratorii. (accessed: 12.10.2023).*

framework of compliance before the declaration was adopted[4].

Table 1 – Compliance system levels

Level 1	
Version 1. Product Compliance	Version 2. Compliance certification of products
Compliance analysis and preparation of a product compliance report	Compliance analysis and issuance of a product compliance certificate
Result of the work performed	
Product conformity report signed by an expert. It serves a supplement to the evidence base formed, which will make the registration of the declaration justified and legitimate. Product conformity reports are accepted by all supervisory authorities	Product conformity report and certificate of conformity on a strictly accountable form. The certificate of conformity will increase the credibility of the product among inspection organisations, retailers, and end consumers, and minimise risks in case of supervisory measures
Level 2	
Version 1. Compliance of process	Version 2. Compliance certification of process
Compliance analysis and preparation of a process compliance report (taking into account the requirements of declaration schemes 1d, 3d, 5d, 6d on production control)	Compliance analysis and issuance of a conformity certificate for the process (taking into account the requirements of declaration schemes 1d, 3d, 5d, 6d for production control)
Result of the work performed	
A process conformity report includes mandatory product requirements. They will allow the third party to assess the processes and provide an opinion that will allow non-conformities to be identified and eliminated in advance.	A process conformity report and certificate of conformity on a strictly accountable form. The Certificate of Conformity is a full third party assessment of the processes and will provide additional assurance to inspection organisations and the end user.
Levels 3 and 4	
Development and assessment of compliance with the standards and requirements for the organisation management system, including compliance of products and processes with the compliance management system as a whole, including the provisions of ISO 19600.	

Source: Russian Union of Dairy Industry Enterprises, 2023

Few companies in Russia have yet been certified to the ISO 19600:2014 standard. It defines the principles of the compliance system. These include large business companies, such as MTS, Sberbank, Sibur, Aton, SUEK. The practice of certification to ISO 37001:2016 is even rarer in Russian business. Companies confirmed their anti-corruption compliance programmes in accordance with the above-mentioned international standard, and conducted a compliance assessment in accordance with ISO 19600:2014. Compliance standard certification is gradually becoming in demand, and a number of companies are in the process of preparing or undergoing compliance assessments. For example, TMK (Pipe Metallurgical Company) and Severstal.

Methods

The Yaroslavl State Institute for Quality of Raw Materials and Food Products (YaO YaGIKSPP) was chosen as the object of our study. The Institute has accreditation certificates in the national system of the Federal Accreditation Service for all areas of food testing and certification. Today, more than three quarters of

[4] *ROSTEST. Compliance. Available at: https://rtmsk.ru/uslugi/komplaens. (accessed: 12.10.2023).*

all regional food products are tested and received certificates of conformity[5] in the laboratories of YaGIKSPP.

The State Budget Institution of YaO YaGIKSPP established the Rules of functioning of the voluntary certification system "Yaroslavl Quality" and the Procedure of control over the use of certificates and marks of conformity in the voluntary certification system "Yaroslavl Quality". Producers using the "Yaroslavl Quality" mark on their products commit to annually provide certified food products for inspection control on the quality of goods produced[6].

In order to increase the certification process efficiency of the studied object, the prerequisites for adapting the principles of compliance certification have been created. Compliance certification will help to increase the level of confidence in the results of conformity assessment of products, processes, management systems, personnel in the National Certification System. It also allows ones to make activities transparent and accurate, reduce the number of appeals by increasing the reliability of the results of confirmation of compliance. Compliance certification systems are based on the following laws and regulations:

1. Federal Law "On Technical Regulation" No. 184-FZ.
2. GOST R 53603-2009 Conformity assessment. Schemes of product certification in Russian Federation.
3. GOST R ISO/IEC 17065-2012 Conformity assessment. Requirements for bodies certifying products, processes and services.
4. Federal Law of 25.12.2008 No. 273-FZ "On Anti-Corruption".
5. Federal Law No. 115-FZ of 07.08.2001 "On Anti-Money Laundering".
6. Administrative Offences Code of the Russian Federation of 30.12.2001 No. 195-FZ.

In general, the certification procedure is considered to be rather long and labour-intensive, involving a large number of certification body employees. The problem of risk analysis in the activities of the certification body has become particularly relevant with the introduction of the standard GOST R 56275-2014 Risk Management. Guidelines for good practice in project risk management (Berezina, 2014).

Certification bodies should consider the risks associated with implementing certification in a professional and impartial manner. Moreover, the operating system should also have a process for identifying, analysing, handling, and documenting conflict of interest risks arising during the certification process. However, the certification body of the Yaroslavl State Institute for Quality of Raw Materials and Foodstuffs adheres to impartial ways of proving conformity. For instance, they use certification schemes based on the analysis of production – the analysis of the implementation of the production control programme. This study identified the reasons for non-compliance with the industrial control programme using the expert method and Ishikawa diagram (see Fig. 1). The construction of the Ishikawa diagram ensures the reliability of the obtained data on the basis of their statistical validity.

The most important factors are non-compliance with confidentiality and impartiality rules by the certification body employees, problems in setting up the equipment, inaccurate measuring instruments, and the use of incomplete/outdated/incorrect documentation.

Hence, the main principles of compliance certification are confirmation of compliance at the place of production. Therefore, to implement the principles of compliance certification, stability and reproducibility assessment of technological processes of products manufacturing certified in the certification body YaO YaGIKSPP on the basis of single-factor analysis of variance was also conducted. In general, analysis of variance is possible if the results of observations are independent random variables obeying the normal distribution law with equal variance (Berezina, 2014). Analysis of variance is based on the property of variance additivity, i.e., the total variance of the indicator of interest is equal to the sum of its constituent partial variances.

The problem of one-factor analysis of variance (OVA) is posed as follows. Assume, the influence of factor x on a technological process or some quality indicator is studied. During the experiment the factor is maintained at u levels. At each level of the factor, m duplicate (parallel) experiments are conducted. The results of a single-factor experiment from Uxm observations are presented in the form of an observation

[5] *Yaroslavl State Institute of Raw Materials and Food Quality. Electronic resource. Available at: URL: https://yagik.ru (accessed: 16.10.2023).*
[6] *Federal Law "On Technical Regulation" No. 184-FZ (last edition). – Introduction. 2002-12-27 (in Russian)*

matrix (Frolova, 2017; Dedkov, 2011). However, the analysis of variance of the experimental observations (Nisaif, 2021) allows us to assess the influence of a factor only as a whole. The conclusions obtained can be applied only to the given experimental material at a given systematisation. Thus, for example, when changing the range of variation of the studied factor or the main (base) point, the assessment of the influence of the latter may change.

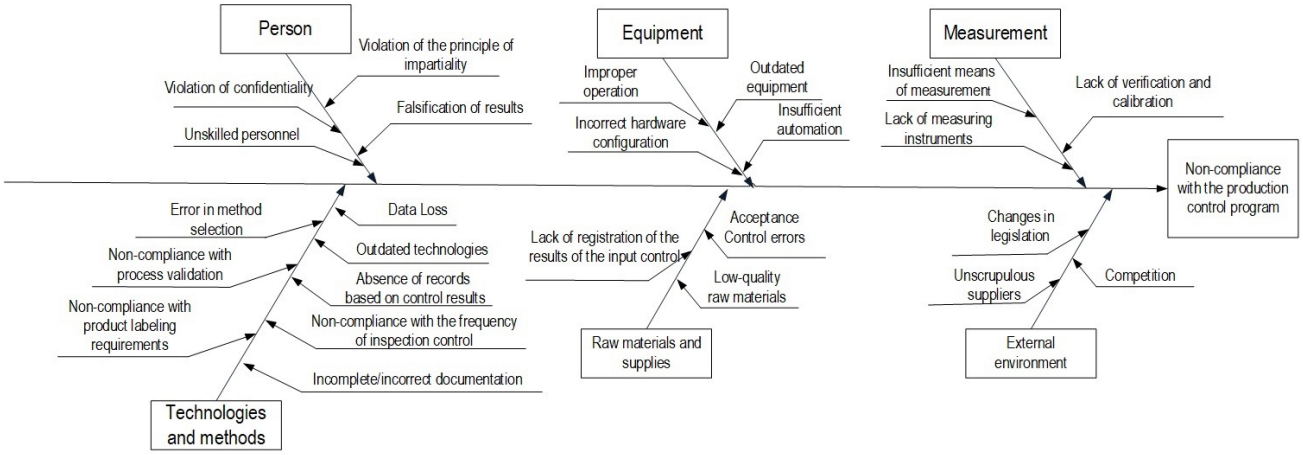

Figure 1. Ishikawa diagram to identify reasons for non-compliance with the production control programme
Source: composed by the authors

Results

Statistical stability and reproducibility of the production process was assessed on the example of production of dairy products (ryazhenka). This is the most common product group under certification of the certification body named above. Preliminary to determine the reproducibility of the process in the study was used such a methodological technique as an event tree. It represents the hierarchical structure of the technological process. On the basis of the shown event tree, it is possible to generally understand the reasons for the risks of producing low-quality products (see Fig. 2). It determines the transparency of the certification procedure.

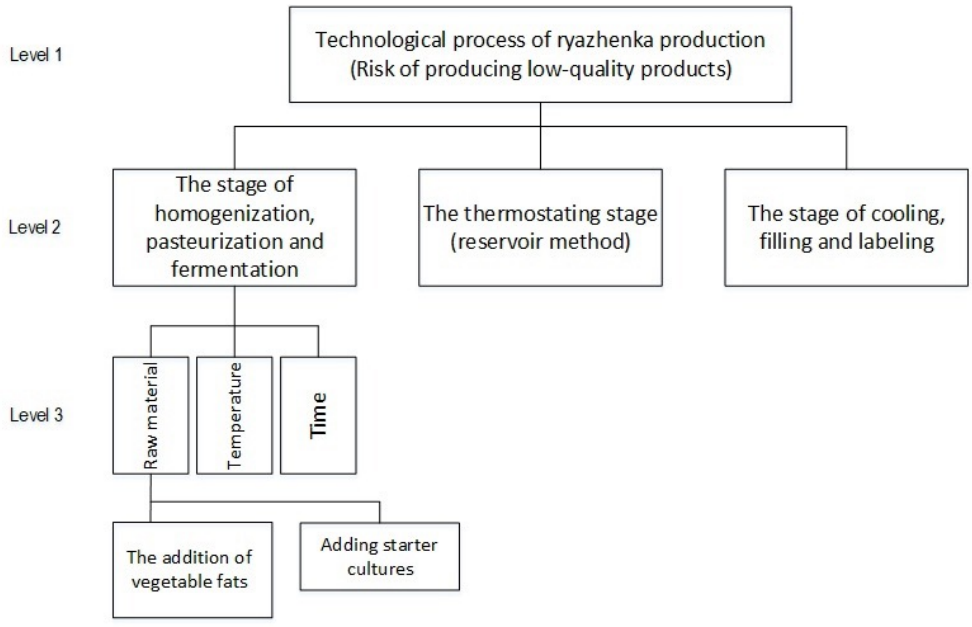

Figure 2. An event tree to investigate the risk of producing low-quality products
Source: Akramova & Moroz, 2016; Gorlenko, Mozhaeva & Vavili, 2016

However, the statistical reproducibility of the production process was assessed by means of one-factor analysis of variance. As an independent variable x was taken the indicator of fatty acid composition of the

fat phase – mass fraction of palmitic acid, as an indicator parameter of the quality of manufactured products. During the experiment, the factor x was varied at u = 5 levels. As a response function y, characterising the content of vegetable fats in ryazhenka, the data of test protocols were used. Therefore, m = 3 parallel experiments were conducted at each level of variation of the factor. The values of mass fraction of palmitic acid in three parallel experiments (m = 3) at all levels (u = 5) of variation of factors are presented. Table 2 presents the data.

Hereinafter, the following designations are used: the ordinal number of the level of variation of the factor – j (j = 1, 2, u); the ordinal number of the parallel experiment in the series at each j-th level – l (l = 1, 2, m).

Further, statistical processing of the experimental results was performed using one-factor analysis of variance. As a result of calculations it was established the influence of palmitic acid on the addition of plant raw materials. It should be recognised as significant one.

A process stability study showed a possibility of adding vegetable fats to the ryazhenka, and an event tree evaluation of reproducibility identified a key parameter in production control.

Table 2 – Results processing of one-factor analysis of variance

No. of product protocol	Variation level of factor j	Response function value in parallel experiments			Arithmetic mean of the response function in parallel experiments	Sum of observations by series Y_j	Square of observations in parallel experiments Y_{jl}^2			$\frac{Y_j^2}{m}$
		1	2	3			1	2	3	
Protocol 1	1	21	33.11	33	29.04	87.11	441	1096.3	1089	2529.38
Protocol 2	2	21	27.05	33	27.02	81.05	441	731.7	1089	2189.7
Protocol 3	3	21	31.36	33	28.45	85.36	441	983.45	1089	2428.78
Protocol 4	4	21	31.19	33	28.40	85.19	441	972.82	1089	2419.11
Protocol 5	5	21	29.37	33	27.79	83.37	441	862.6	1089	2316.85
Amount	—	422.08	2205	4646.8	5445	11883.8				

Source: composed by the authors

Hence, there is of adding of vegetable fats in the raw material at the stage of homogenisation, pasteurisation, and squashing. The study of fatty acid composition indicators of the fat phase allowed ones to identify the product adulteration more objective, even in the conditions of the technological process. It is certainly valuable in the conditions of product certification. Analysing the data on the statistical stability and reproducibility assessment, we can conclude that in order to implement the principles of compliance-certification in the State Budget Institution of YaO YaGIKSPP it is necessary to create prerequisites for the development and implementation of software and statistical complexes for monitoring of production processes.

Conclusion

Thus, compliance certification will become increasingly relevant for companies, including not only large businesses, but also small and medium-sized ones. It is also an issue of gradual development of anti-corruption legislation, changes in other areas, sanctions, requirements, and restrictions in a rapidly changing world.

Therefore, in order to maintain the status of consumer confidence and full transparency of activities, organisations in the field of conformity assessment also have to implement a compliance system in their work. The implementation of compliance certification will allow consumers to be sure of high quality, competitiveness, and safety of the products.

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AUTHORS' CONTRIBUTION

Sofya A. Tsareva – conceptualization, project administration, writing – original draft.
Yana V. Denisova – validation, writing – review & editing.
Alexandra I. Semenova – data curation
Varvara A. Selezneva – formal analysis

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Non-tariff regulation in the Eurasian Economic Union: current state and ways for improvement

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Abstract. The paper analyses non-tariff regulation within the framework of the Eurasian Economic Union (EAEU). The paper considers the current state of this regulation within the EAEU member states and identifies the main directions for improving this system. The author draws attention to the problems and challenges faced by the EAEU member states in implementing non-tariff regulation. The author proposes specific measures to improve this practice. The author uses a comparative analysis of the regulatory framework for non-tariff regulation of the Eurasian Economic Community (EurAsEC), the EAEU, and the Russian Federation as a research method. As a result of the analysis, the author identified the main issues of non-tariff regulation within the EAEU, including the divergence of approaches to non-tariff regulation in certain member states, the negative impact of non-tariff regulation on intra-regional trade volumes, and the restrictive effect of NTM measures on capital and labour flows within the union. The paper concludes on specific approaches to improving the mechanism of non-tariff regulation in the EAEU. These include increasing the transparency and accessibility of data, transparency of information directly and indirectly related to the subjects of foreign trade transactions between economic entities of the EAEU member states, harmonisation of the regulatory and legal framework of the EAEU member states to minimise discrepancies in the legal sphere between the EAEU member states. It also includes the implementation of a set of measures to develop interstate standardisation and national standard unification. The EAEU unified technical regulations were proved to have an effective impact on trade not only in intra-union value chains, but also in international production chains outside the EAEU. The practical significance of the study includes the development of measures aimed at improving non-tariff regulation within the EAEU.

Keywords: non-tariff regulatory measures, non-tariff measures classification, technical barriers, prospects for the development of the net tariff measures system.

JEL codes: F42, F15, F13

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Introduction

The role of customs and tariff foreign trade regulation is declining in the modern world. It eventually leads to the non-tariff restrictions. Today, non-tariff measures (NTMs) regulating foreign trade are very effectively applied not only in industrially developed countries, but also in developing countries. On average, up to 15% of imported to Europe goods are subject to non-tariff measures of foreign trade regulation (Pantak, 2021). The application and destination of non-tariff regulation measures for foreign trade has its own features, both in Russia and in other cooperating countries.

In a broad sense, non-tariff regulation is a set of administrative and economic measures exceeding the limits of customs-tariff policy and used as tools for foreign trade regulation. The purpose of these measures is related to the security policy and protectionism. A wide range of different protectionist tools is used, from low restrictive barriers for foreign trade to trade bans. At the same time, non-tariff regulation is not only restrictive measure; it implements non-tariff measures to stimulate and support foreign trade activities, aimed at implementing the state foreign trade policy. The role of non-tariff regulation in the context of the decreasing average level of the customs tariff and the need to ensure national security is growing.

Non-tariff regulatory measures are, in general, the important tools for protecting national interests and ensuring the safety and quality of goods on the world market. However, their application should be implemented taking into account all possible consequences and in accordance with international rules and norms.

The purpose of this study is to reveal the features and trends concerning the non-tariff regulation of intra-regional trade flows of EAEU countries under the current conditions, as well as identify possible ways

to improve non-tariff tools of foreign trade regulation in the Eurasian Economic Union.

The relevance of this issue involves foreign trade activities currently occupying a leading place in the trade policy of all states. This policy has a huge impact on the world economy. Therefore, public authorities apply various forms and methods of trade restrictions affecting national and domestic exports and imports.

Many national and international authors are engaged in the study of non-tariff regulation measures. For example, E.L. Andreeva and P.V. Ilyasov (2021), K.O. Mostovich (2021) analyse the issues of improving non-tariff regulation measures within the EAEU, and identify ways to solve them. These authors also study the methodological approach to assessing the impact of non-tariff regulation measures on EAEU imports (Ilyasov & Andreeva, 2023). P.V. Ilyasov (2023) in his studies considers the effects of non-tariff measures on the EAEU economy, and evaluates the improvement mechanism effectiveness of import non-tariff regulation in the EAEU. S.S. Fadeeva and E.V. Shchelkunova (2022) describe in detail the role and place of non-tariff regulation methods in the EAEU foreign economic activity. A.O. Zyk (2021) demonstrates the EAEU trade regimes in terms of non-tariff regulation in trade and economic relations with third countries. In particular, the paper (Zyk, 2021) considers examples of conditions included in the EAEU Agreements with the Socialist Republic of Vietnam, the Islamic Republic of Iran, the People's Republic of China, the Republic of Singapore, and Serbia. A.V. Pantak (2021) studies the role and purpose of non-tariff regulation measures in foreign trade. He considers the inherent absence of their own non-tariff measures for the export of goods as one of the main problems for the EAEU countries. Also, A.D. Egorova (2023) assesses the non-tariff measures of the EAEU countries' regulation of foreign trade relations, and considers non-tariff regulation in terms of Law.

The study of non-tariff regulation measures is difficult because they vary from country to country, change over time, and are not classified properly. The scale of NTMs, unlike tariffs, is difficult to measure and requires special methods to quantify. Therefore, the extent of the NTMs' impact, as well as protectionism, on international trade and the countries that are parties to regional trade agreements (RTAs) is a difficult task to quantify.

Main part

Non-tariff measures currently dominate the regulation of world trade due to the reduction of customs tariffs as a result of the GATT/WTO, and the tariff tools inability to meet all the requirements of modern foreign trade regulation.

The non-tariff regulation of foreign trade of any civilised state striving for sustainable development is necessary due to the aspiration (Kirillov et al., 2020):

1) to ensure national and economic security;

2) to protect domestic manufacturers of the industries, agriculture, and other national economy spheres;

3) to secure the life and preserve the population health;

4) to ensure the protection of animals and plants;

5) to reduce the negative impact of certain goods and materials being transported across the border on the environment;

6) to protect the cultural patrimony of the nation;

7) not to violate international obligations.

The issue of non-tariff measures in the state foreign trade regulation in recent years is increasingly on the agenda of national and international economic organisations. The report of the World Trade Organisation on NTMs, large-scale studies by the Eurasian Development Bank, the European Commission together with the International Trade Centre, individual experts, as well as UNCTAD's systematisation of NTMs, and the development of NTM databases as part of the Trade Analysis Information System (TRAINS) and Integrated Trade Intelligence Portal (I-TIP) databases on international trade show a clearly increased interest in issues related to non-tariff measures.

The definition of non-tariff measures is extensive. Therefore, a detailed classification is necessary to identify and distinguish the various forms of non-tariff measures.

Non-tariff measures of trade regulation are consolidated in complex normative legal acts, which are

issued by various controlling state authorities, etc. However, the measures of trade tariff regulation in terms of customs tariffs facilitate the procedure of their application and quantitative analysis (Kuleshov, 2014).

Furthermore, non-tariff trade measures include all measures different from customs tariffs significantly affecting international trade. Therefore, the number of measures available to be classified definitively is quite high.

The development of a comprehensive international classification of non-tariff trade measures is a necessary step to solve the above-mentioned problems. On the one hand, it allows ones to systematise the information received on non-tariff trade measures, and, on the other hand, structure the collection and analysis of such information.

Non-tariff regulation of foreign trade activities in Russia and the Eurasian Economic Union (EAEU) corresponds with the established international practice of their application. However, changes in the external conditions of trade and economic cooperation and geo-economic environment create new challenges to the organisation, structural arrangement, and regulation of foreign trade flows.

The current Eurasian Economic Union has developed on the basis of international agreements. Its system of foreign trade regulation is based on commonly accepted methods of customs tariff and non-tariff regulation.

The classification of common non-tariff regulation measures against third countries within the Eurasian Economic Union and the Russian Federation differs in a number of respects from the classification schemes of GATT-WTO[1] and UNCTAD[2]. Hence, it is worth special attention.

Table 1 presents the main categories including effective common non-tariff restrictions in the Customs Union within the Eurasian Economic Community. Those are currently effective in the Eurasian Economic Union and the Russian Federation.

The actual Customs Code of the Eurasian Economic Union[3] defines terms revealing the concepts of measures to protect the domestic market, prohibitions, and restrictions in foreign trade activities (Kuleshov, 2014):

- Clause 20 Article 2: measures for the domestic market protection – special protective, anti-dumping, compensatory measures, and other measures for the domestic market protection, established in accordance with the Agreement on the Union[4], imposed on goods originating in third countries, and imported into the customs territory of the Union;

- Clause 10 Article 2: prohibitions and restrictions – measures of non-tariff regulation, including those unilaterally imposed in accordance with the Agreement on the Union, measures of technical regulation, sanitary, veterinary-sanitary, and quarantine phytosanitary measures, measures of export control, including measures for military products, and radiation requirements established in accordance with the Agreement on the Union and (or) the legislation of the Member States, applied in respect of goods moved across the customs border of the Union.

Thus, the classification of non-tariff regulation measures presented in Table 1 is limited to the consideration of only original economic measures. Consequently, non-tariff measures of state regulation of foreign trade activity do not cover all administrative barriers other than tariffs. They are limited to measures of economic nature only, based on the current customs legislation in the Customs Union, including the Russian Federation.

[1] *World Trade Organization – Integrated Trade Intelligence Portal. Available at: http://i-tip.wto.org/goods/Forms/ProductViewNew.aspx?mode=search (accessed 11.09.2023)*

[2] *International Classification of Non-Tariff Measures // Unctad 2019 edition of Trade - Available at: https://unctad.org/system/files/official-document/ditctab2019d5_ru.pdf https://unctad.org/system/files/official-document/ditctab2019d5_ru.pdf. (accessed 17.10.2023).*

[3] *Customs Code of the Eurasian Economic Union (ed. of 29.05.2019, amended on 18.03.2023) (Annex N 1 to the Agreement on the Customs Code of the Eurasian Economic Union). Available at: http://www.consultant.ru/document/cons_doc_LAW_215315/ (accessed 29.10.2023).*

[4] *The Agreement on the Eurasian Economic Union (Signed in Astana 29.05.2014) (ed. of 24.03.2022) (with amendments and additions, entered into force from 03.04.2023). Available at: https://www.consultant.ru/document/cons_doc_LAW_163855/ (accessed 01.11.2023).*

In addition to economic measures, the Eurasian Economic Union and the Russian Federation have a large number of other administrative restrictions aimed at regulating foreign trade activities. They, according to the current terminology of the customs legislation of the Customs Union, should be classified as prohibitions and restrictions.

The analysis of prohibitions and restrictions presented in Table 2 shows there are common restrictions and rules of their application for most restrictions on foreign trade activities within the Eurasian Economic Union. However, restrictions related to export control and military products are established on the basis of the member states national legislation.

Table 2 shows that various restrictive measures imposed on goods other than tariffs in accordance with the customs legislation of the Eurasian Economic Union and the Russian Federation relate to prohibitions and restrictions. In turn, non-tariff regulation measures are only a part of these restrictions. This circumstance should be taken into account by participants in foreign trade activities, since all customs procedures, except for release for domestic consumption and export, assume that goods are placed under customs procedures without the application of non-tariff regulation measures.

Table 1 – Classification of common non-tariff regulation measures within the Eurasian Economic Union and the Russian Federation

NTMs in the CU within the framework of the EAEC	NTMs in the Eurasian Economic Union	NTMs in the Russian Federation
Economic measures		
Prohibitions or quantitative restrictions	Prohibition of import and (or) export of goods	Quantitative restrictions established by the Government of the Russian Federation in exceptional cases provided for by international treaties of the Russian Federation
The exclusive right to export and (or) import certain types of goods	Quantitative restrictions on the import and (or) export of goods	Non-discriminatory application of quantitative restrictions
Licensing in the field of foreign trade in goods	The exclusive right to export and (or) import goods	Quota allocation
Monitoring the export and (or) import of certain types of goods	Automatic licensing (supervision) of export and (or) import of goods	Licensing in the field of foreign trade in goods
	Permissive procedure for the import and (or) export of goods	The exclusive right to export and (or) import certain types of goods
	Licensing in the field of foreign trade in goods	Special protective measures, anti-dumping measures and countervailing measures

Source: Ilyasov, 2023; The Agreement on the Eurasian Economic Union, 2014; Kuleshov, 2014

Table 2 presents the prohibitions and restrictions within the Eurasian Economic Union and the Russian Federation.

Table 2 – Classification of prohibitions and restrictions within the Eurasian Economic Union and the Russian Federation

Prohibitions and restrictions in the Eurasian Economic Union	Prohibitions and restrictions in the Russian Federation
Non-tariff regulation measures	Non-tariff regulation measures

Prohibitions and restrictions in the Eurasian Economic Union	Prohibitions and restrictions in the Russian Federation
Measures to protect the domestic market: special protective, anti-dumping, countervailing measures	Monitoring the export and (or) import of certain types of goods
Measures to protect the domestic market on a bilateral basis, including with regard to imports of agricultural goods	Special protective measures, anti-dumping measures and countervailing measures
Technical regulation measures	Pre-shipment inspection
General exceptions	Measures affecting foreign trade in goods and introduced based on national interests
Sanitary measures	Prohibitions and restrictions on foreign trade in services and intellectual property
Veterinary and sanitary measures	Technical regulation measures
Quarantine phytosanitary measures	Sanitary measures
	Veterinary and sanitary measures
	Quarantine phytosanitary measures
	Export control measures
	Measures regarding the export and (or) import of military products

Source: composed by the author

The EAEU had some challenges within the framework of non-tariff regulation (Andreeva & Ilyasov, 2021). Major groups of issues can be distinguished as follows:

1. The problem of divergence of non-tariff regulatory measures (NTMs) between the EAEU member states. There is still a possibility for the EAEU member states to independently establish national non-tariff regulation measures. The divergence of NTMs between countries causes the increasing of trade costs. Regulations developed in the EAEU countries on the application of NTMs have different terminology. It causes significant complications in the work, and serious challenges for international traders who need to comply with country-specific requirements for goods and production processes.

Both EAEU and national standards are currently operational. The latter are developed by the national standardisation body. Each EAEU member state can use these standards, but they are more actively used in the country where the standard was developed, especially when they are published only in the local language. Although the national standard is public available, it is more difficult for foreign market participants to apply it than domestic market participants, and in some cases the costs of adaptation are prohibitive.

The heterogeneity of national standards covering the same topic but developed by different countries results in additional costs. Market participants must respond by duplicating processes to meet the different requirements of standards. Reasonable policies promoting regulatory convergence should be pursued to achieve government regulatory objectives without limiting economic development.

2. The problem of lost trade. According to official data, more than 500 thousand certificates of conformity and more than 5 million declarations of conformity have been issued for serially produced products within the EAEU. This is quite a significant number of documents. NTMs hinder trade both within the Union and imports from third countries. Assessments by the Eurasian Development Bank (EDB) show NTMs account for 15% of intra-union trade flows value. Many costs arise from process redundancies, such as retooling production cycles for different market specifications. When these are eliminated, firms can serve more markets with existing or even lower resource utilisation. Previously utilised resources are reallocated to other activities where they can be used more productively. Reducing the actual costs associated with serving foreign markets provides lower prices, which in turn leads to increased demand and increased resource utilisation.

Experts of the EDB Centre for Integration Studies (EDB CIS) identified NTMs as having a significant

negative impact on trade. The report considers a number of scenarios for reducing NTMs and the corresponding effect. In the baseline scenario, in the medium term, Belarus would benefit most from lowering barriers: its real GDP would increase by 2.8% and well-being by 7.3%, cumulatively. In Kazakhstan, well-being will grow by 1.3%, while real GDP growth will be 0.7%. The effects for Russia are less significant: well-being will grow by 0.5% cumulatively, and real GDP by 0.2%.

3. The issue of the limiting effect of technical barriers. The significant limiting effect of technical barriers in the EAEU member states can be explained by the GOST system of standards inherited from the USSR. GOST standards often impose mandatory requirements on products. However, in Western countries only voluntary standards are used. There may be less risks to human, animal or plant life and health.

By 2020, the EAEU has done a lot of work to establish a unified system of technical regulation. Forty-eight technical regulations have been established, covering almost 85% of products, and uniform rules and procedures for conformity assessment are in place. Up to 80% of standards used in the EAEU are similar to international standards used. For example, the EU has directives and regulations. The similarity of standards would eliminate barriers to trade between member states and third countries. However, mutual recognition of certificates and declarations of conformity issued on the basis of international standards has not yet been implemented.

The Eurasian Economic Commission (EEC) identified 59 barriers in the EAEU internal market in 2020. 11 barriers are obstacles to the free movement of goods, services, capital, and labour within the framework of the Union's internal market functioning. Indeed, they do not comply with Union Law. 13 barriers are exceptions (exceptions (derogations) stipulated by the Union law on non-application by a Member State of the general rules of the internal market functioning). 35 barriers – restrictions (obstacles to the free movement of goods, services, capital, labour within the framework of the Union internal market functioning causes by the absence of legal regulation of economic relations, the development of which is provided for by Union Law). Analysis of the register of exemptions, restrictions and barriers in the EAEU has shown obstacles in the field of technical regulation to be the most common type of obstacles in the EAEU domestic market, accounting for 22%.

Experts highlight the following main directions for improving non-tariff regulation in the EAEU member states in order to promote integration and competitiveness that supports their sustainable economic development as well as global integration (Andreeva & Ilyasov, 2021):

1. Promoting mechanisms to increase transparency and accessibility.

Increased transparency requires the collection of comprehensive and comparable data on NTMs based on international classification. OECD work has shown that increased transparency can be sufficient to reduce trade costs. Transparent information is also necessary for any negotiations aimed at achieving harmonisation and mutual recognition and thus strengthening trade.

Access to these data should be public in order to reduce information costs. The interface providing access to databases should be user-friendly. The existence of available, clearly defined, and consistently applied regulatory requirements increases predictability and certainty for participants in international trade. Nowadays, it is formidable in interconnected world characterised by the international fragmentation of production within global value chains.

Platforms for public-private interaction on regulatory and procedural issues require strengthening and promotion of dialogue platforms. For example, ePing, a publicly available online tool developed by the UN Department of Economic and Social Affairs (UNDESA) and the International Trade Centre (ITC). It facilitates the tracking of notifications and timely response to them. The launch of such a service in the EAEU could solve a serious problem in tracking more than 4,500 TBT (technical barriers to trade) and SPS (sanitary and phytosanitary measures) notifications annually. If parties to international trade are aware of the changes, they can submit comments and take advantage of opportunities for discussion and co-operation.

2. Harmonisation of the regulatory and legal framework of the EAEU Member States.

It is necessary to minimise divergence in the field of NTMs between the EAEU Member States. Reasonable policies are required to promote regulatory convergence, rather than elimination, to achieve state

regulatory goals without restricting economic development. Regulatory co-operation between the EAEU Member States should be supported with converging regulatory requirements, establishing clear rules for the formation of a modern standards base, and the implementation of common mandatory product requirements. A growing body of evidence on this topic, including recent OECD assessments, suggests reducing regulatory heterogeneity can decrease the trade costs associated with NTMs. The costs and benefits of reducing differences in some regulatory approaches have been identified through OECD work. The evidence shows strong positive effects on bilateral trade flows when countries co-operate to reduce unnecessary trade costs associated with measures such as SPS and TBT.

3. Comprehensive measures for the development of interstate standardisation.

The development of interstate standardisation is among the most important tasks of establishment the unified system of EAEU technical regulation. It is necessary to replace outdated GOST standards with modern international standards; to implement the best practices of developed countries. National standards block trade in Eurasian value chains, while international standards promote trade. EAEU technical regulations have a greater impact on trade in intra-union value chains. Indeed, international standards have a positive impact on EAEU trade with third countries. Thus, technical regulations reduce information asymmetry between market participants in the value chains of the single Union market. International standards are the tools of global communication with international trading partners.

Conclusion

The main task in modern conditions is to adapt the mechanism of non-tariff regulation to the current conditions of international trade within the framework of the EAEU functioning. The NTM mechanism needs to be revised in order to minimise compliance costs and increase the efficiency of implementation processes. If the regulatory and procedural requirements related to NTMs are made more accessible, the awareness of FEA participants will increase, with a simultaneous reduction of costs and time-related costs. Information costs will be reduced through increased transparency. Resources previously used to serve redundant NTM processes are reallocated to other more productive economic activities. Reducing NTM trade costs can affect domestic production in two ways: through efficiency gains and resource savings, and through cost reductions leading directly to lower prices. Effective market integration also requires the resolution of non-tariff measures. Various analysis methods based on relevant data will allow ones to quantify the impact of NTMs in the EAEU and identify potential benefits from the optimisation and convergence of regulatory requirements. Uniform rules for the circulation of goods in the internal market of the EAEU contribute to the elimination of unnecessary non-tariff barriers, improvement of competitiveness, and development of the export potential of goods and services produced in the EAEU.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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Blockchain technology use in economic practice

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Abstract. This paper discusses the application and impact of blockchain in economic models. An economic model is a group of relations, rules, and models reflecting economic relations in society. They are formed at the stage of production activity formation, exchange, consumption of economic goods. It allows one to focus on the main elements of the system and their interrelationships. The economic model has many classifications and patterns applied in macroeconomics. Blockchain is a computer paradigm represented by a chain of consecutive blocks. This technology is based on peer-to-peer networks. According the model, trust to the participants is embedded at the level of the protocol, which initially builds economic relations between the participants. The use of distributed registry technologies in a wide range will effectively expand economic models.

Keywords: blockchain, distributed data ledger technology, decentralisation, distributed data, digital technology, information technology, digitalisation.

JEL codes: O33, G29

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Introduction

This research paper is based on both Russian and foreign researches in the field of blockchain technology, and distributed data registries application in various industries. Among them we can mention the following:

1. https://www.tadviser.ru/
2. https://www.finam.ru/

Over the past decades, the next stage in the development of the economy will be a step towards digitalisation and distributed economic systems both in the scientific and economic environment. The new economic paradigm – the introduction of blockchain and distributed ledger systems – will be followed by an undeniable increase in efficiency in all economic models (Aksenov, Kuprikov & Saakyan, 2018), which can fully impact the development of economic patterns and structures.

Notably, with the beginning of the fourth industrial revolution, one can see the active introduction of distributed registries. The one of the most popular of this technology, blockchain, began to penetrate not only into economic relations, but also in recent years even into the socio-economic environment (Safiullin, Sharapov & Elshin, 2021). The introduction of such technologies becomes a useful tool for further forecasting and development of economic models in the Russian Federation. However, despite all the positive aspects of using this technology, there are certain risks that need to be controlled and regulated by the government of major countries.

The purpose of the paper is to investigate the types of distributed ledger technologies (DLT), their application, and efficiency in economic models.

Main part

In this paper authors considered various research sources and articles. At the first stage of the research

the authors study different types of distributed ledger technologies. At the second stage of the research the authors give an assessment of the application efficiency of such technologies for economic models.

The current economy is a post-industrial one. However, it concerns other appropriate names, reflecting some aspects of the coming changes in economic models. Networking is often used and referred to it. This undoubtedly characterises one of the many key technologies may emerge in this period of economic development.

Blockchain is not fundamentally new technology. Nevertheless, the use of blockchain network operating model consists of various tools, technologies, and paradigms combining to form a logical and secure structure for distributed data storage. In fact, it can be compared to a large ledger, on the page of which transactions between two users are displayed and recorded. Everything recorded in this ledger remains and cannot be deleted by any of the transaction participants or other interested parties (Kuzmenkova, 2022).

Privacy is blockchain core capability. Transactions are conducted on decentralised databases, provide the transaction anonymously, instantaneous, and without the involvement of special persons or regulators. The introduction of such distributed data ledger technology requires a complete study of the market and economic sectors, and a complete analysis of the infrastructure's readiness for the new stage of economic development.

At the moment, solutions based on DLT (distributed ledger technologies), blockchain technology is the most well-known one, are used in decentralised information storage. It is also used to ensure efficient and fast electronic document flow, multiply the speed of data exchange, increase the overall security and level of trust of Internet users in the use of information systems and business processes (Stukalin, 2019).

Currently, there are several blockchain concepts (see Table 1).

Table 1 – Blockchain Concepts

Operation	Centralized	Decentralized	Distributed
Governance/Business Model	Centrally Controlled	Community Controlled	Autonomous
Stability/Resilience	Unstable	Bounded Stability	Stable
Scalability	Large Throughput/ Small Number of Nodes	Small Throughput/ Medium Number of Nodes	Infinite
Speed of Enterprise Development	Fast	Medium	Very Slow
Architecture Evolution/ Diversity	Permissioned/Private	Hybrid	Permissionless/Public
Tokenization	No	Possibly	Yes
Trust Control	High Traditional/Low Algorithmic	Medium Traditional/ Medium Algorithmic	Low Traditional/High Algorithmic

Source: composed by the authors

Table 1 shows advantages and disadvantages of each concept. They can include different architectural management, business model, and implications. But despite the risks, by the business community data, 84% have started working with blockchain technology, and 62% have announced their own blockchain initiatives, according to research by PricewaterhouseCoopers (PwC)[1].

PwC surveyed economic leaders from 15 countries and found that 84% are adapting blockchain technology to their business processes. At the same time, 62% of respondents have launched their own blockchain projects, but only 25% of companies have reached the stage of launching a pilot version of a blockchain network. It is also reported that representatives of almost all known sectors of the economy are

[1] *Blockchain is already here. What's your next move? Available at: https://www.pwc.com/kz/ru/publications/publications-new/blockchain-in-business.html. (accessed 14.10.2023).*

trying to move their businesses to blockchain.

According to MarketsandMarkets[2], the global blockchain technology market is expected to reach $ USD 39.7 bn by 2025, with an annual growth rate of 67.3%.

A Deloitte study[3] shows that 53% of organisations have implemented blockchain technology reported improved productivity and efficiency.

A large number of companies are already successfully using blockchain technology in finance, healthcare, logistics, energy, retail, etc. For instance, JPMorgan Chase and Santander banks use blockchain to process international payments; Walmart uses blockchain to track and monitor grocery deliveries.

Originally created for the Bitcoin cryptocurrency, use of blockchain technology is is increasingly being applied to achieve its potential. DLT demonstrates visibility and transparency of the entire transaction to all consumers and owners of certain business processes.

Table 2 – Areas of research on blockchain technologies and DLT

Rank	Technologies	Effects	Significance index	Dynamism level	Timing of mass implementation
1	Non-interchangeable tokens	Uniqueness	1.00	Fast growing	1-2 years
2	Cryptoassets	Safety	0.89	Fast growing	2-3 years
3	Decentralised applications	Efficiency and transparency	0.42	Fast growing	3-5 years
4	Smart contracts	Safety	0.28	Fast growing	2-3 years
5	Distributed hash tables	Safety	0.20	Growing	3-5 years
6	Digital tokens	Uniqueness	0.17	Growing	3-5 years
7	Tokenised assets	Uniqueness	0.15	Fast growing	2-3 years
8	Smart property	Safety	0.12	Stable	3-5 years
9	Decentralised Autonomous System (DAS)	Efficiency and transparency	0.11	Growing	3-5 years
10	Open source blockchain platforms	Efficiency and transparency	0.03	Growing	3-5 years

Source: composed by the authors

Moreover, cryptoassets and tokenisation are among the listed research areas of blockchain and DLT in the financial transactions segment, including NFT's non-interchangeable tokens.

Conversion to NFT (№1) all legal and other significant documents, as well as other files, will be digitally unique, preventing falsifications. The range of technology applications will be used not only in supply chain security. It will also be widely demanded in stock markets and in the insurance, medical, creation of unique digital attributes, which will have value equally to the physical analogue. Now non-interchangeable tokens are on a downward trend after the Bitcoin and Ethereum market crashes. Major NFT marketplaces are downsizing (OpenSea). In contrast, Disney and Dapper Labs will launch their mobile platform on the Flow blockchain. Payment system PayPal filed a patent to create its NFT-marketplace[4].

Public sector implementations are important. The government system itself combines both centralised

[2] *Blockchain Market by Component (Platforms and Services), Provider (Application, Middleware, and Infrastructure), Type (Public, Private, and Hybrid), Organization Size (SMEs and Large Organizations), Application, and Region – Global Forecast to 2027. Available at: https://www.marketsandmarkets.com/Market-Reports/blockchain-technology-market-90100890.html (accessed 14.10.2023).*

[3] *Available at: https://www2.deloitte.com/kz/ru/pages/strategy-operations/solutions/blockchain-services-and-solutions.html (accessed 14.10.2023).*

[4] *#NFT. Available at: https://forklog.com/tag/nft-news (in Russian) (accessed 14.10.2023).14.10.2023).*

structure responsible for management and service delivery, and a segmented and largely disconnected organisational system capable of sharing data.

This technology facilitates a number of time-consuming tasks for the government in various areas. They include tax collection, issuing benefits, registering and re-registering citizens by identifying, and assigning unique identifiers to them.

Crypto-assets (№2) represent the process of supplanting fiat currency and other securities, replacing them with another type of financial value. They will be electronic money, digital currencies, cryptocurrencies, and tokenised assets. The regulators (Central Banks) are in charge of the development and implementation of this technology; they have launched projects to issue national digital currencies.

The digitalization of Russia's national currency began in 2020. Eventually, the ruble will have a unique identification token for access – the money will be stored in the Bank of Russia. By March 2023, the first preparation stage for the use of the digital ruble and the introduction of a third money form in Russia was completed (Safiullin, Abdukayeva & Elshin, 2019). The mass introduction of the digital ruble in 2025 was announced in autumn 2023. The VTB bank has provided prototypes of withdrawing such kind of money through ATMs and transfers to other people. Implementation of digital ruble also has negative consequences for banks. Losses may amount to 8-10% of net profit (45-95 bn rubles). A study of the educational platform Moscow Digital School[5] (the part of Ultimate Education) revealed possible risks when introducing the digital ruble into mass circulation. Among them are insufficient preparing the population to use the new currency, problems with data protection, loss of bank clients, etc. More than 78% of respondents noted insufficient preparation of the population, and more than 50% highlighted problems with data protection during transactions in the new form of national currency. In addition, almost half of the respondents (47.5%) fear the loss of some customers by banks due to transactions will be performed not by the bank itself, but by the Central Bank of the Russian Federation. Since 15 August, the digital ruble has been tested with the participation of 13 banks and a limited number of their clients[6].

Tokenized assets (№7) allow the rights to financial securities and shares to be digitally secured. There are a number of advantages to adopting such technologies. However, there are challenges that may slow the active adoption of blockchain technology and DLT. Among them are the emerging debate on the application of such solutions to various systemically important structures of states and enterprises, the emphasis on computing power, and the weighty investments in infrastructure for scalable digital assets[7].

Table 3 – Areas of blockchain applications in various fields

Rank	Technologies	Effects	Significance index	Dynamism level	Timing of mass implementation
1	Supply chain and logistics monitoring systems	Transport and logistics	1.00	Fast growing	1-2 years
2	NFT applications	Creative industries	0.83	Fast growing	1-2 years
3	IoT - applications with decentralized data management	Trade, telecoms and communications	0.75	Growing	1-2 years
4	Digital platforms for real estate transactions	Real estate transactions	0.62	Growing	3-5 years

[5] *MDS expert Maria Telegina on the new – digital – ruble. Available at: https://mosdigitals.ru/media/ekspert-mds-mariya-telegina-o-novom-tsifrovom-ruble. (accessed 14.10.2023).*

[6] *Digital ruble. Available at: https://www.rbc.ru/crypto/tags/?tag=%D0%A6%D0%B8%D1%84%D1%80%D0%BE%D0%B2%D0%BE%D0%B9%20%D1%80%D1%83%D0%B1%D0%BB%D1%8C. (accessed 14.10.2023).*

[7] *Top 10 blockchain technologies. Available at: https://www.finam.ru/publications/item/top-10-blokcheyn-tekhnologiy-20230705-1254/. (accessed 14.10.2023).*

Rank	Technologies	Effects	Significance index	Dynamism level	Timing of mass implementation
5	Electronic voting system	Telecoms and communications	0.61	Growing	1-2 years
6	Anti-money laundering systems	Finances	0.53	Growing	2-3 years
7	Cryptocurrency exchanges	Finances	0.52	Growing	2-3 years
8	Platform for cross-border deliveries	Trade, finance	0.51	Fast growing	2-3 years
9	Personal identifiers on the blockchain (DIDs)	Information technology, telecoms and communications	0.31	Growing	3-5 years
10	Copyright royalty tracking system	Trade	0.27	Growing	3-5 years

Source: composed by the authors

E-voting systems (№5) are increasingly used by states to conduct remote elections (Australia, Belgium, France, Estonia, etc.). In Russia, the blockchain voting system was used for the first time in the 2019 elections. In March 2022, a law unifying the rules and procedures for remote electronic voting was adopted: citizens can now vote via the Internet or a special mobile application.

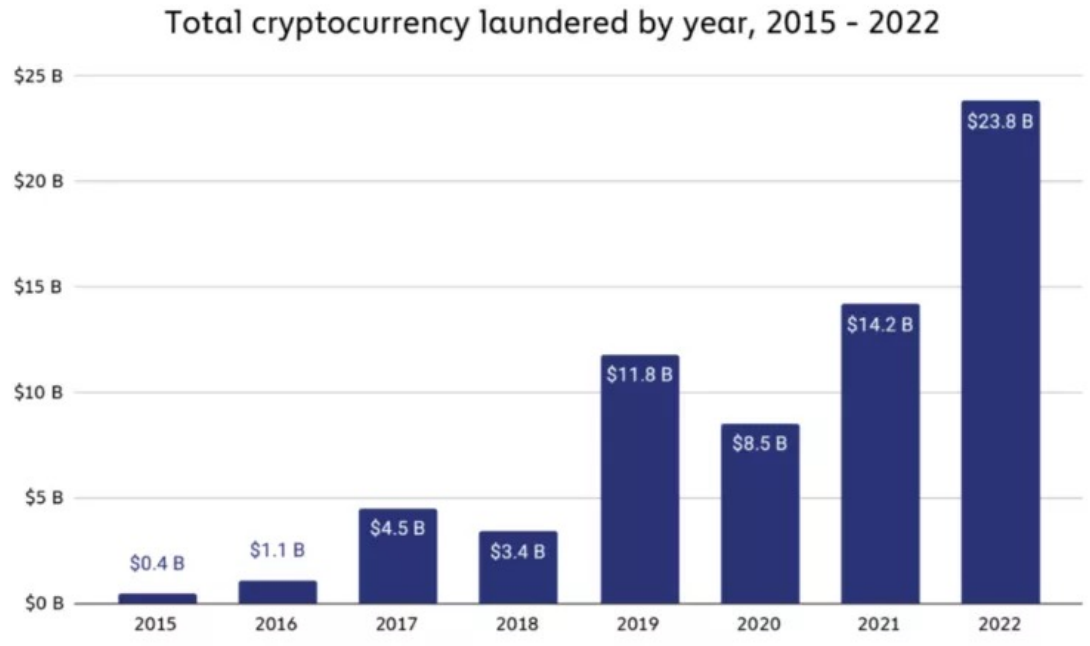

Figure 1. Volumes of laundered cryptocurrency by year

Source: "Bitcoin's share is minimal": how money is being laundered through blockchain today, 2023[8]

Anti-money laundering systems (№6) is one of the important issues in the modern world. Cryptocurrencies were used to legalise $ USD 23.8 bn in 2022, 68% more than in the previous year. The main recipient of criminal funds were centralised exchanges (CEX) – about 50% of the total "dirty" cryptocurrency

[8] *Available at: https://forklog.com/exclusive/dolya-bitkoina-minimalna-kak-segodnya-otmyvayut-dengi-cherez-blokchejn. (accessed 14.10.2023).*

turnover for the year[9]. Trading platforms provide a direct opportunity to convert digital assets into fiat money. For example, P2P serves as an almost perfect tool for fraudsters. Anti-Money Laundering (AML) systems and a host of measures such as KYC, freezing user assets, tracking transactions, and liaising with law enforcement are now in use.

Digital platforms for Real Estate Transactions (№4). On 21 June 2022, there was published a report on blockchain ability to tokenise real estate and trade transactions similar to cryptocurrencies by incorporating smart contracts into blockchain platforms[10]. There are several regulatory and administrative challenges in implementing real estate tokenisation on blockchain as of June 2022. If implemented, this could greatly simplify and speed up the process of buying, receiving dividends, and the financial benefits of owning property around the world. Another use case for blockchain that experts believe could help the real estate sector grow is the issuance of no-objection certificates (NOCs), and other compliance certificates that can be registered using blockchain technology. This will promote trust and transparency.

Conclusions

Therefore, having conducted a study on the application of blockchain in economic models, the authors found the following:

1. The use of blockchain systems has great potential in all spheres of life – for large companies, businesses, and government.

2. The application of distributed ledger technology (DLT) is revolutionising the economic environment by prioritising reliability, openness, and decentralized transaction chains.

3. The application of blockchain technology prevents money laundering.

4. Digital identification will be of equal value to its physical tax. Any owner will have ownership not only on the physical level but also on the digital one.

5. Converting important legal documents to a non-interchangeable token will be important in an environment where counterfeiting is actively fought.

6. The technologies described in this paper have a major impact on the economy of states. These technologies also providing new opportunities for criminal offences related to economic money laundering and fraud. In order to prevent potential risks, governments must be able to regulate the use of blockchain and distributed ledger technology.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTION

Alexander S. Pryakhin – writing – original draft
Maxim S. Komarov – writing – review & editing
Oksana V. Kosnikova – conceptualization, project administration

[9] *ForkLog – a media company in the field of cryptocurrencies, blockchain and artificial intelligence. Available at: https://forklog.com/exclusive/dolya-bitkoina-minimalna-kak-segodnya-otmyvayut-ndengi-cherez-blokchejn. (accessed 14.10.2023).*

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The issue of correlation between «digitalisation» and «humanisation» of the economy in the epoch of the great evolutionary breakthrough as the era of humanity transition to noospheric development

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For an epigraph

From an interview with the «Father of Cybernetics» Norbert Wiener for «United States News and World Report»

February 24, 1964.

«Question. Is there a tendency to program [nuclear war]?

Answer. There is a trend, and the stupidity of the upper classes amazes me. The automaton has a property that was once endowed with magic. It can give you what you are asking for, but it won't tell what should you asking for.

We've heard speeches claiming we need to design machine systems telling us when to press a button. But we need systems that can tell us what will happen if we press a button in a variety of circumstances, and – most importantly – tell us when not to press this button!

Question. Do you think it's possible for machines to declare war and doom humanity?

Answer. If we let them. Of course, they won't declare war unless we set them up in advance.

Question. Dr. Wiener, does a person change the environment beyond the ability to adapt to it?

Answer. This is question No. 1. A person undoubtedly changes it extremely much, and whether he does it beyond his ability, we will find out it soon enough. Or we won't find it out – we'll no longer exist».

The first thesis

One of the fundamental contradictions of the modern era is global «digitalization» of the economy, management, and processes in society. Its rapid development is taking place simultaneously with the rapid development of the first phase of the Global Environmental Catastrophe for more than 30 years. Essentially, the market-capitalist system has transformed into a system of global ecological self-destruction. Nature, i.e. the Biosphere and the Planet Earth as superorganisms with their own homeostatics, de facto, in the form of processes of Global Ecological Catastrophe, has set Ecological Limits to global capitalism, the world market, the system of private capitalist property, economic colonialism, which appear, starting from the second half of the XX century, as a system of global imperialism of the world financial capitalocracy.

The coming Era of the Great Evolutionary Turning Point appears at the same time as the Era of the environmental degradation of the global imperialist system. It is the Era of the Ecological Collapse of the market, capitalism, and liberalism. The war of the West against Russia in Ukraine has as its goal the fragmentation of Russia, the establishment of the USA power over its natural resources with the simultaneous destruction of the Russian people as a «consolidator» and state (historical) «builder» of Russian civilisation.

The second thesis

The law of the capitalism stability or imperialism stability, as a system, is the law of dehumanization. It causes growing alienation from human essence and nature. This dehumanization has been especially active over the past 30 years. Indeed, it proceeds against the background of simultaneous processes of the first phase of the Global Environmental Catastrophe, in the countries of the «metropolis» of global imperialism system – the United States, the Great Britain, France, Germany, etc. Moreover, it includes the family crisis, the appearance of LGBT, the construction of digital-machine models of human transformation, and the acceptance of human multigenderism by Western society. All mentioned above completely disregard the «biological nature of man», derivative laws, etc., including «post-modernism» and «trans-humanism.»

We observe the market inherent dehumanization of man in «market Russia». According to S.A. Mikheev, participated in V.R. Solovyov's TV show, Russia ranks world 1st in terms of the number of abortions – 450 thousand abortions per year, i.e. 450 thousand murders of children in the womb.

Moreover, the issue of capitalist alienation of man was revealed by K. Marx and F. Engels. But 150 years later, it became catastrophic one. Hence, the digitalization of the market capitalist economy, relations between citizens and the state, public institutions, and following algorithmization, of the «inner worlds» of people and their thinking only increases the fundamental contradiction between man and nature. It strengthens the inadequacy of human quality to the current imperative of his ecological survival in the XXI century, i.e. it is a factor in accelerating the ecological death of mankind in the XXI century. Indeed, it is quite possible, especially according to a number of signs of endoecological poisoning processes, until the middle of the XXI century.

The third thesis

The necessary attributes of the XXI century economy in terms of mankind ecological survival strategy is the transition to a controlled, human-dimensional (planned market at a transitional stage), noospheric economy. It could become the foundation of socio-natural evolution scientific management.

Indeed, it is necessary to realize that the developed economy became intelligence-intensive, knowledge-intensive and education-intensive more than half a century ago. Therefore, it requires the abolition of private property and the management of economic development for the long run. Moreover, modern historical agenda is the transition of society mostly to a «scientific and educational society» than to a «digital society».

We developed the concept of a scientific and educational society; it is included in the author's scientific and ideological system – «Noospherism». According to the concept of scientific and educational society, science acts as a productive social force, and the basis for scientific management of socio-natural evolution. Additionally, education is the «basis of the basis» of spiritual and material reproduction, reproduction of the economy and society.

All above correlates with the law of sustainable development of the society (the antipode to the law of sustainability of capitalism, or the global system of imperialism of the world financial capitalocracy, originated in the United States, then in the Great Britain). This particular law advanced development of human quality, the quality of public intelligence, and the quality of educational systems as a whole.

Indeed, there is an issue of humanity survival strategy in the 21st century.

The mankind functioning in the era of the global environmental crisis in the XX century, and not earlier, is associated with a leap in the energy power. In order words, the world economy impact (the world economy and, accordingly, the world market) on living matter and homeostatic mechanisms of the Biosphere and Earth increases by an average of 7 orders of magnitude, i.e. in 10 million times.

According to Karl Marx, culture developing spontaneously (the law of supply and demand equilibrium in the market as an example of spontaneous development) leaves a desert behind.

The entire history of mankind, starting with the Neolithic revolution, is a «spontaneous history», i.e. a history consuming negentropy produced by the Biosphere, and produces entropy (or «desert», according to K. Marx), is a low-energy spontaneous history.

The mankind functioning in the period of global environmental crisis and in the first phase of a

Global Environmental Catastrophe in the middle of the XX century indicates the rate of entropy production approached the rate of production of negentropy by the Biosphere as Megasystem of Life on Earth (the laws of E. Bauer – V.I. Vernadsky). Moreover, it is against the background of a leap in the energy sector of humanity's global economic impact on Nature.

The apparent incompatibility of the natural regulators of development – the market, private property, the entire market capitalist economic system on Earth – and the large social energy sector conceal the law of intellectual, information, and energy balance discovered by the author. This law is formulated by the author as follows:

- the greater in energy power the social system's (society's, mankind's) economic impact on the living matter and homeostatic mechanisms of the Biosphere and Planet Earth as superorganisms, the greater the anticipation (foresight) of possible negative ecological consequences, and, accordingly, the greater the anticipation of scientific management of socio-natural (Socio-Biospheric) evolution by the intelligence (public intelligence) of this system.

It means the Ecological Limits were provided by world capitalism, world market, and the entire Elemental History. The Ecological Limits were indicated by the mankind entering the Era of the Great Evolutionary Breakthrough. However, the beginning of this Era started with the first phase of the Global Ecological Catastrophe in 80s-90s of the XX century).

This author's conclusion is indirectly supported by provisions or forecast formulated by the USA and European scientists. For instance, the American environmental economist B. Commoner in the book «The Closing Circle» in the early 70s of the XX century concluded as follows: technologies based on private property destroy the key asset of mankind – the ecosphere. In the autumn of 1991, in a Report to the World Bank, written by R. Goodland, G. Daly, and S. El-Serafi et al., a warning to humanity proclaimed: the economy's market mechanism of development has exhausted itself in the earth's filled ecological niche, which humanity occupies.

The imperative of transition from «prehistory», i.e. «spontaneous history», to «true history», which the author interprets as «controlled history», which was formulated by K. Marx, linking «true history» with communism, is now again facing mankind. However, nowadays the «imperative» presented to mankind by Nature in the form of the survival imperative. Nevertheless, the «true» or «controlled» history acquires a noospheric scale, i.e. it can be realised in the future only as a scientifically controlled socio-natural evolution.

In this context, the achievements in the field of computer mathematics, software, digitalisation, acquire a true ontological basis, a true «space» for their implementation and become one of the mechanisms of mankind's survival. Especially, in terms of the logic of mankind's transition to the noospheric paradigm of history, scientifically controlled Socio-Biospheric evolution (in compliance with the requirements of laws and restrictions, reflecting the action of homeostatic mechanisms of the Biosphere and Earth).

The fourth thesis

According to Karl Marx, communism is the abolition of private property... and thereby the genuine appropriation of the essence of human by human and for human ... basically, the real resolution of the contradiction between human and nature.» This definition of Marx's communism is a development of the issue of genuine human emancipation posed by him as his liberation from money cult (from turning «money» into human «god»), and from haggling. All above K. Marx formulated in his article «On the Jewish Question» in 1843, and published in 1844.

Moreover, the challenge of the human economic dimensionality, socio-economic development, and the human digitalisation dimensionality is an issue of launching the processes of humanising of history, economy, politics, and all social institutions. In the XXI century, this issue has the character of a Noospheric human revolution.

But the issue is extremely challenging nowadays. All Spontaneous history of mankind (spanning about 100-120 centuries, and, accordingly, about 500-800 generations of people) contains the inertia of people's and peoples' lives. People only concern with their own survival, the exploitation of the other people, or nature,

including the wars, robbery, and violence. For instance, over the past 5,000 years there were about 4,557 wars. Indeed, by the end of the XX century, Nature had set a Limit to this Spontaneous History, with its colossal inertia.

Russian Breakthrough of mankind to socialism in the form of the Great October Socialist Revolution (by analogy with the Great French Revolution, the author proposed to call it the Great Russian Socialist Revolution) in 1917 was simultaneously a breakthrough to a new, unprecedented paradigm of history. It should be the controlled history. And it was realized in the USSR, especially in «the era of Stalin.» In his book «Stalin», written on the impressions of his visit to the USSR in the early 30s, the French writer Henri Barbusse explicitly emphasised the planned socialist economy in the USSR. This phenomenon began national managed economy and managed socio-economic development.

In his book «Stalin's Economy», published in Russia in 2014, V.Y. Katasonov repeated A. Barbusse's assessments. He emphasised the socialist planned economy, exactly as «Stalin's economy», i.e. anti-cost, profitless, based on the criterion of technological cost reduction, could exist in the presence of «higher supra-economic goals». According to him, the economy acts only as a mechanism for achievement of these goals. Additionally, he highlighted the issue of «Stalin economy» revitalisation in modern Russia. However, there should be set the new «higher supra-economic goals», since the «market» is leading Russia to destruction. Moreover, the conclusion of V.Y. Katasonov is consistent with the author's theoretical conclusions, given by him in 2013 in his monograph «Market genocide of Russia and the strategy of overcoming the historical impasse».

Indeed, Katasonov's imperative is combined with the above-mentioned noospheric imperative, and the imperative of Russia's Victory in the war with the West (SMO in Ukraine), and has acquired a globally ontological and prognostic content.

Russia is the Eurasian, communal, and coldest (on its territory the average annual average temperature is «-5.50 C») country. Therefore, Russia has the highest energy cost of the economy and society reproduction (i.e. with the largest energy consumption for the society's life reproduction according to natural and climatic conditions). Hence, Russia plays the dominant role of the law cooperation, civilization, etc. Thus, Russia is the only multiethnic cooperation in the world. It is the cooperation of about 200 nations, nationalities, ethnicities, and ethnogroups. Thereby, Russia is the center of the global stability or instability, the «civilization of Truth», the peacemaking civilization, the «historical predictor». I claim the definition of «historical predictor», as the place where the major historical events are taking place. Moreover, it indicates the course of human history.

Exactly, Russia was the first country in the following areas:

- It was the first to make a Socialist Breakthrough in the history of mankind; became the world's first socialist power, and the socialist cooperation of the nations – the Union of Soviet Socialist Republics.
- It was the first to make a Space Breakthrough for mankind, launching Yuri Alekseevich Gagarin on April 12, 1961 into the nearest space.
- It was the first proposed to make a Noospheric Breakthrough in the form of the doctrine developed by V.I. Vernadsky on the transition of the Biosphere into the Noosphere. On the basis of this doctrine (the «Vernadsky revolution» in the scientific worldview according to N. Polunin and J. Grinevald) in Russia, a world-class Russian Noospheric Scientific School has developed.

The Great Evolutionary Breakthrough Era started the transition of the entire humanity to Noosphere Ecological Spiritual Socialism, to the completion of the Socialist Human Revolution, which took place in the USSR, but was not completed.

In fact, A. Peccei, the first director of the Club of Rome, wrote about the importance of «human revolution» as a basic condition for solving ecological problems on Earth back in the 70s of the XX century in his book «Human Qualities». However, he did not realise the incompatibility between capitalism and the market and its imperative for 'human revolution'.

The one of the reasons for the collapse of the USSR was the information and value war waged by the United States and West against the USSR. The other reason was the «alienation» of the Soviet people's consciousness, the cult of «foreign clothes», the temptation of consumer philistinism.

Nevertheless, in the XXI century, the completion of the «human revolution», i.e. the realisation of the imperative to dignify the human mind to the level of noospheric mind – or, in other words, to the level of «Mind-for-Biosphere, Earth, Cosmos» – requires a strategy for the survival of mankind on Earth.

Therefore, the Epoch of the Great Evolutionary Turning Point appears as «The Genera of Real Reason» and «The Genera of Real Humanity», overcoming the prevailing market-commodity, capitalist alienation of man from his essence, nature, and his noospheric vocation.

And to lead this Noospheric Breakthrough of mankind is again destined to Russia, as a «co-operative civilisation». In the world, against the background of the first phase processes of the Global Environmental Catastrophe, the «dictatorship of the limits of nature» has been established. Along with the End of Natural History came the End of the dominance of the Law of Competition and the Market. The transition to a controlled socio-natural evolution means a simultaneous transition to the dominant role of the Law of Cooperation, to the planetary cooperation of peoples-ethnic groups, to the Noospheric Union of Civilizations, to a World without Wars and Violence.

It is worth remembering the Socialist Breakthrough from Russia in 1917 was symbolised by the Peace Decree written by Lenin and proclaimed by the Soviet state first in the world.

Currently, Nature and imperative of the ecological survival of mankind demand it. One of the author's works, published recently, is called «Nature versus Capital and the Market.»

The fifth thesis

Hence, the human being's overcoming the commodity-market alienation from his essence, himself, and his noospheric vocation, i.e. the human being's emancipation, which K. Marx thought about 180 years ago in his article «To the Jewish Question», but already as a noospheric emancipation of the human being with simultaneous transition to the noospheric-socialist organisation of society and economy reproduction. Nowadays, on the agenda of the XXI century there is an issue of the continuation of human existence on Earth and in the Universe, or the ecological death in the «captivity of market-capitalist illusions, the cult of selfishness, pleasures, the pursuit of profit and wealth».

In 1918, N.A. Berdyaev remarked as follows: «selfish interest conceals madness.» The «digitalization» of the «selfish, ecologically insane world» only intensifies the madness and accelerates the process of ecological destruction. The «insane» «digitalization» destroys the human intellect, forms a «fragmented mind». This kind of mind is not capable of concentration, generalization of knowledge, and management of complex systems.

Moreover, the collective Mind of mankind has encountered the «Barrier of Complexity», the need for a noosphere-paradigm revolution in science, education, and culture. In the late 90-s, N.N. Moiseev noted this phenomenon in his monograph «Parting with Simplicity».

Indeed, «digitalization», as it is staged in the world and in Russia, is a simplification of the human intellect itself, replacing the complexity of the real world in which a person lives with a «virtual», «simple», «digitized world».

It conceals a disregard and ignoring the laws of evolution. We have developed a new noospheric paradigm of universal evolutionism, combining the Darwinian (author – Charles Darwin), Kropotkin (author – P.A. Kropotkin), and Bergovian (author – L.S. Berg) paradigms. We designated this paradigm by the term «noo-cosmo-nomogenesis».

In accordance with neo-cosmo-nomogenesis, any progressive evolution accompanied by an increase in the complexity of evolving systems is subject to the action of two metalaws: (1) the metalaw of a Shift from the dominant law of competition and the mechanism of natural selection to the dominant law of cooperation, and the mechanism of intelligence (as an anticipatory feedback); and (2) the metalaw of Intellectualization or «Enlightenment» evolution.

The Epoch of the Great Evolutionary Turning Point is the Epoch of mankind's transition to History on the basis of the Law of Cooperation and Public Intelligence (collective governing mind), i.e. the Epoch of the «noospheric Mind» birth.

The human dimension of history is transformed into a noospheric human dimension.

The «natural intelligence» occurred on Earth, in the Biosphere evolutionarily, as a result of the meta-law action of the «enlightenment» of progressive evolution. In this case, there is «enlightenment» of the Biosphere evolution, and then the mankind social evolution.

The «artificial intelligence» designed by the human» natural intelligence» projectively never «achieve the quality» of its creator intelligence – the «natural intelligence» of Human created evolutionarily. There is an evolutionary prohibition. It is not understood by those who are engaged in digitalization and the construction of «myth-fantasies» about artificial intelligence, and future replacement of their creator – human-intelligence by «artificial intelligence».

«Digitalization», as a private materialization of mathematical algorithms and models discovered by the «left hemisphere part» of human intelligence, is designed to increase the efficiency of this particular «part», and the effectiveness of management.

The fetishization of «digitalisation» and «artificial intelligence» causes increased alienation of human, his ecological conflict with the world, including a «digital-anthropogenic collapse». Accordingly, humanity is in a state of a Global Intellectual Black Hole, i.e. it is «late» in its awareness and adequate response to the processes of the first phase of the Global Environmental Catastrophe by 25-50 years. And «digitalization» has also contributed to this Global Intellectual Black Hole, as a form of «digital» alienation of the human intellect from its essence and vocation. The «language of numbers» («language of quantity») is quite «poor». As a «language» designed projectively; it will never achieve the level of the «language of words», i.e. the verbal language appeared evolutionarily in the process of anthropogenesis.

The challenge of realising digitalisation limitations, the revival of the national scientific school of «hybrid intelligence», the immediate restoration of ergonomics, which studies the interaction of the human psyche and intellect with the computer, display, «world of digital languages» and, in general, with the «virtual world», is the controversial issue of «humanising» digitalisation and the digital world.

There is an additional issue concerning the strategy of total digitalisation of Russian society. It is considered by some «narrow minds» in the state administration system. This is national security. The total digital bureaucratisation serves as a basis for the growth of «risks» to be used in the «digital-information war» of US imperialism against Russia. It could be happened through the US stealing of «digital information», and transmission it to its combat satellites to adjust the use of «point defeat» systems.

In case the world war reaches the «phase of nuclear war», one of the first objects of mass destruction (through the use of electromagnetic radiation – EMR) will be the system of remote communication, computers, power grids, radio networks, remote mobile communications, etc. Therefore, it is necessary to maintain a «paper management» system in reserve and train the personnel managing it.

A thorough study of this issue is required.

In conclusion, we would like to repeat the most important imperative for the current stage of Russia's development: the main goal of Russia's educational policy should be the establishment of a scientific and educational society in Russia, and a dramatic transition to improving the quality of fundamental education, training of personnel of the noosphere formation, including managers.

A noospheric revolution in science and education has already started in Russia. On the agenda is the upcoming noosphere-oriented synthesis of science and power.

According to the author, the challenge of the ratio – «digital dimension» and «human dimension» – of the Russian economy is obvious. It follows from the 5 theses presented.

The report is devoted to the 160th anniversary of the greatest human Genius, Vladimir Ivanovich Vernadsky.

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