STRATEGIC LABOR MARKET MANAGEMENT: COMPARATIVE ANALYSIS OF NORDIC COUNTRIES AND RUSSIAN FEDERATION REGIONS

Lappeenranta–Lahti University of Technology LUT

Master's Programme in Industrial Engineering and Management

2022

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ABSTRACT

Lappeenranta–Lahti University of Technology LUT

Your school: LUT School of Engineering Science

Your degree programme: Industrial Engineering and Management

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Strategic Labor Market Management: Comparative analysis of Nordic countries and Russian Federation Regions

Master's thesis

2022

106 pages, 37 figures, 7 tables and 26 appendices

Examiner: Professor, Leonid Chechurin

Keywords: labor market, labor productivity, production function, Denmark, Finland, Iceland Norway, Sweden, Yamalo-Nenets Autonomous Okrug, Republic of Tatarstan, Tver Oblast, Oryol Oblast, Karachay-Cherkess Republic, Republic of North Ossetia.

The labor potential of society as a whole is the direct engine of progress, and the engine of countries. Effective strategic labor market management should be aimed at increasing labor productivity and gross domestic product in order to maintain life support systems at the proper level for the population.

This research includes evaluation of hourly labor productivity for five Nordic countries (Denmark, Finland, Iceland Norway and Sweden) and six Russian Federation subjects (Yamalo-Nenets Autonomous Okrug, Republic of Tatarstan, Tver Oblast, Oryol Oblast, Karachay-Cherkess Republic, Republic of North Ossetia – Alania) during 2006-2020. Analysis showed that there is a huge difference between Russian regions and Nordic countries. Moreover, correlation and regression analysis of the influence of factors on labor productivity showed that investments in fixed assets in Nordic countries have more influence on labor productivity than in Russian regions.

Furthermore, Cobb-Douglas Production Function for Norway, Finland, the Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan for 2006-2020 is designed. Additionally, recommendations for improving the labor market management system at the regional level are developed.

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1 Introduction

The labor potential of society as a whole is the direct engine of progress, and the engine of countries. All the forces of the state should be aimed at increasing labor productivity and gross domestic product in order to maintain life support systems at the proper level for the population. Accordingly, low labor productivity is a deterrent, which in the future may become the risk of a serious crisis.

Accordingly, the following research is aimed at analyzing the labor market of the regions, labor productivity and production function. This part of the research includes a statement of the research background, research problem, research gap, research aim, research questions, scope of the research and structure of the research.

1.1 Background

Today, the world is on the verge of a new, fourth industrial revolution ("Industry 4.0"), which will lead to the complete automation of most production processes, and, as a result, an increase in labor productivity, economic growth and competitiveness of its leading countries. For Russia, Industry 4.0 represents a chance to change its role in global economic competition, but the Russian economy is not yet using its full potential. Based on the foregoing, the relevance of the topic of the following research by the fact that in modern conditions Russia needs the development of labor, human potential, a key factor in the "Concept of long-term socio-economic development of the Russian Federation for the period up to 2030" (Decree of the Government of the Russian Federation, 2018). In order to implement this Concept, a person must be considered as a single carrier of labor potential; for this, both complex and systematic approaches to the study of labor processes are used.

1.2 Problem statement, research gap and research aim

When stating the problem of the research, we will pay attention to the experience of the Nordic countries. At the moment, the Nordic countries are in the top lines of the rankings on

completely different indicators, including: the level of economic development, innovation activity, the quality of education, health and social protection. Labor productivity in the Nordic countries is also higher than in other countries. According to the Organization for Economic Cooperation and Development (OECD) data for 2020, productivity in Norway per hour of gross domestic product (at current prices) amounted to 93.1 US dollars, in Denmark – 81 US dollars. For comparison, the Comparative indicator of labor productivity in the Russian Federation for 2020 was $29.3. Here follows the insistence that the average number of hours worked in Russia is relatively higher than world standards - 1976 hours. For example, in Denmark in 2020, fewer were detained - 1381.9 hours, in Norway – 1382.5 hours (OECD, 2020).

In addition, the Nordic countries have minimal values for the level of development, thanks in large part to Norway, Sweden, Finland, Denmark and Iceland. Factors that in many cases determine the high level of development of labor relations in industry.

Modern literature has many articles on strategic labor market management, labor productivity and production functions. However, our search has not retrieved any papers on correlation and regression analysis of dependence of labor productivity on investments and fixed assets and average salaries in Russian regions and Nordic countries. Furthermore, at the moment, in the literature, there are no designed production function for the Republic of Tatarstan and the Yamalo-Nenets Autonomous Okrug. Moreover, we have not found any articles on evaluation of the labor productivity of Republic of Tatarstan, Yamalo-Nenets Autonomous Okrug, Tver Oblast, Oryol Oblast, Karachay-Cherkess Republic and Republic of North Ossetia for 2006-2020 with its comparison with the labor productivity of Nordic countries.

Thus, the main aim of the research is development of recommendations for improving the labor market management system at the regional level based on a quantitative analysis of the Nordic countries and subjects of the Russian Federation.

To complete the study the following intermediate tasks are set up:

1. Theoretical analysis of strategic labor market management, its features and instruments.

2. Theoretical analysis of labor productivity, literature review of relevant calculation methods of labor productivity.
3. Theoretical analysis of production function, literature review of relevant designing methods of production function.
4. Evaluation of labor productivity of Russian regions.
5. Evaluation of labor productivity of Nordic countries.
6. Comparative analysis of labor productivity in Russian regions and Nordic countries.
7. Econometric analysis of the influence of factors on labor productivity in Russian regions.
8. Econometric analysis of the influence of factors on labor productivity in Nordic countries.
9. Designing of production function for Norway, Finland, Yamalo-Nenets Autonomous Okrug and Republic of Tatarstan
10. Development of recommendations for improving the labor market management system at the regional level.

1.3 Research questions

Research questions follow the flow of logic of the intermediate aims, in order to achieve the main research aim. Therefore, here are three research questions have been formulated to structure the study:

Q1. What theories on the strategic labor market management are known in the literature?

Within the framework of this research question, we have studied what is the Strategic Labor Market Management, its features and the instruments. In addition, addition, there are definitions and essence of the labor productivity are studied and literature review on labor productivity evaluation methods is provided. Moreover, within the framework of this research question, the definition and essence of the Production Function are studied. Also, the approaches of different authors to the building of the production function in modern theory are analyzed.

Q2. What is the Labor productivity in the Russian Federation subjects and the Nordic countries?

This research question includes analysis of average annual number of employed people, real and nominal gross domestic product of the Nordic countries and the Russian Federation regions. In addition, the results of evaluating the labor productivity of the Nordic countries and the Russian Federation regions are presented and comparative analysis of results is provided.

Q3. What is the Production Function of the Russian Federation subjects and the Nordic countries?

Within the framework of this research question, the econometric analysis of the influence of factors on labor productivity in the Russian Federation regions and Nordic countries is conducted. In addition, the production function for two Nordic countries (Norway and Finland) and two regions of the Russian Federation (Yamalo-Nenets Autonomous Okrug and Republic of Tatarstan is designed. Additionally, recommendations for improving the labor market management system at the regional level are developed.

1.4 Scope of the research and delimitation

As we mentioned previously, the main aim of the research is development of recommendations for improving the labor market management system at the regional level based on a quantitative analysis of the Nordic countries and subjects of the Russian Federation.

Within the quantitative analysis, in this research, we are evaluating and analyzing the labor productivity, conducting correlation and regression analysis for five Nordic countries (Finland, Sweden, Norway, Denmark and Iceland) and six Russian Federation subjects (Yamalo-Nenets Autonomous Okrug, Republic of Tatarstan, Tver Oblast, Oryol Oblast, Karachay-Cherkess Republic, Republic of North Ossetia – Alania); designing the production function for Norway, Finland, the Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan. Nordic countries have been selected as world leaders in labor productivity. Russian Federation subjects chosen based on the rating of the Russian Federation subjects for 2021 by the tension level in the labor market, compiled by the Russian Federal State Statistics Service (Rosstat). The duration of the sample is 15 years (2006-2020).

1.5 Structure of the research

The structure of this research follows the flow of logic of the defined research questions by keeping the same sequence of the work.

Chapter 2 includes the literature review of main theoretical aspects of models used in this research.

Chapter 3 is the evaluation of labor productivity in Russian Federation subjects and Nordic countries and comparative analysis of results.

Chapter 4 defines the capital- and labor-intensive regions using the econometric analysis of the influence of factors on labor productivity in the Russian Federation regions and Nordic countries. In addition, chapter 4 includes the design of the Cobb-Douglas Production Function for two Nordic countries (Norway and Finland) and two regions of the Russian Federation (Yamalo-Nenets Autonomous Okrug and Republic of Tatarstan). Furthermore, chapter 4 includes possible recommendations for improving the labor market management system at the regional level.

These recommendations can be applied in Republic of Tatarstan's labor market or in the labor markets of other subjects of the Russian Federation in order to increase labor productivity, assets and GDP of the regions.

2 Theoretical basis of Strategic Labor Market Management

This part of the research includes the study of what is the Strategic Labor Market Management, its features and the instruments. In addition, there are definitions and essence of the labor productivity are studied and literature review on labor productivity evaluation methods is provided.

Moreover, this part of the research includes the study of definition and essence of the production function and literature review on methodologies of the designing of the production function.

2.1 The definition, features and instruments of the Strategic Labor Market Management

The transition to a market economy has led to a radical change in all industrial relations, including labor relations. The main essence of a market economy is that it assumes the creation of interconnected markets system for consumer goods, capital and labor, where each of these components performs a special function.

First, to understand what Strategic Labor Market Management is, we must define what the labor market is. Many authors defined the labor market in different ways, for instance, Aliev, Gorelov and Ilyina (2016, p. 66) give such definition: “In a broad sense, the labor market is a system of labor, socio–economic and legal relations that align the interests of employers and employees in order to ensure the normal reproduction of labor force and the effective use of employed workers labor”.

In addition, there is a good definition of the labor market in a narrow sense, given by Kadermyatova (2015, p. 13). “The labor market is considered as a system of relations between employers and employees regarding the satisfaction of the demand for labor of the former and the needs for employment of the latter”.

In 2020, Drozdov O.A., Yakovleva, E.B., Veredyuk, O.V., Bazzhina, V.A. and Mavrina, I.A. determining the following distinctive features of the labor market:

1. The relatively long interaction duration between the seller and the buyer. Since in many consumer markets (except for goods that have a warranty period and warranty service, and expensive products that are sold on credit), the contact duration between the seller and the buyer is fleeting and, as a result, there is a transfer of ownership rights to the object of trade, then in the labor market, the interaction of the seller and the buyer (employee and employer) has as the duration the amount of time that is prescribed in the employee's employment contract. The interaction duration between the seller and the buyer is one of the main conditions for the constant reproduction of acts of purchase and sale of labor services.

2. An important role that of some non-monetary factors in the labor market, which include the prestige and degree of complexity of work, occupational safety for the employee's health, working conditions, the moral and psychological climate and the prevailing emotional background in the team, the availability of guarantees of job retention and professional advancement on the career ladder, etc.

3. Certain influence exerted by various institutional structures on the labor market, including: trade unions and entrepreneurs unions, labor legislation, the state policy of employment and vocational training and training, etc. This impact is primarily due to the fact that employees, i.e., labor services sellers occupy a considerable share of the population, and employment is the source of their income and well-being, the appropriate level of which is a certain condition for stability and the absence of social tension in society as a whole (Drozdov *et al.,* 2020).

The existence of labor as a mechanism requires the presence of certain elements that would determine its structure and infrastructure. Such elements as the subjects of the labor market, legal norms, socio-economic programs, the market mechanism form its structure. And the totality of various employment centers, recruitment agencies, including the system of state and non-state institutions for employment promotion, training and retraining of employees, is its infrastructure.

If we consider the categories of the population in relation to the labor market, according to Gorshenina (2017), we can distinguish two parts of the population:

- the economically active part (labor force) – the part of the population directly involved and actively participating in economic activity, being of working age and having real physical abilities to work and perform economic activities. This population group is divided into employed and unemployed in the country's economy. By and large, it is this part of the population that makes up the labor market, which, in turn, determines its existence.

- economically inactive share of the population – the part of the population that does not perform any economic functions either because of being of working age or because of inability to do it for physical reasons – disabled. They do not participate in the economic processes, and therefore they are not considered as part of the labor market (Gorshenina, 2017).

According to Aliev, Gorelov and Ilyina (2016), the main elements of the labor market, as well as the elements of the mechanism of its functioning, include the aggregate labor supply, the aggregate labor demand, the cost and price of labor, competition and the reservation of labor.

The aggregate supply covers all categories of the able-bodied population applying for employment, including hired labor from among the economically active population. Aggregate demand refers to the general need for paid employment in the economy and is determined by the number and structure of jobs that exist in the economy and require filling. These components in their unity determine the capacity of the aggregate labor market. (Aliev, Gorelov & Ilyina, 2016)

Labor supply and demand regulation, the equilibrium labor price fixing, that promotes full employment, determine the market mechanism of the labor market itself. The labor price in economic theory is the level of wages at which the demand for labor and its supply are equal. The labor force price and the number of employees of the professional group who will be employed is determined by the intersection point of the supply and demand curves. This relationship between supply and demand in the labor market is shown in Figure 1.

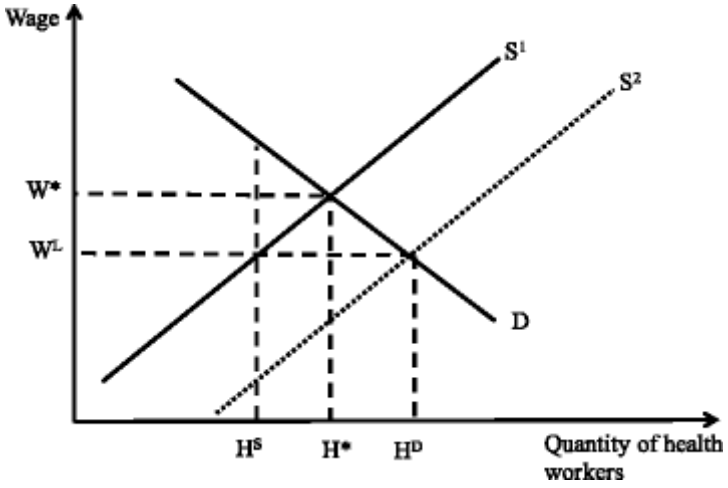

Figure 1. Demand D and supply S in the labor market (adapted from Aliev, Gorelov & Ilyina, 2016)

Thus, we have defined what the labor market is, now we can concern the Strategic Labor Market Management definition. There is a good definition given by Schmidt, Willness, Jones and Bourdage (2018, p. 572). Strategic labor market management "is such management that relies on human potential as the basis of the region, orients production activities to consumer needs, responds flexibly and makes timely changes in the region that meet the challenge from the environment and allow achieving competitive advantages, which together makes it possible for the region to survive in the long term, while achieving their goals".

Kyazimov (2017) defines the objects and the subjects of strategic labor market management. According to the author, the objects of strategic labor market management are organizations, strategic business units and functional areas of the organizations.

The subjects of strategic labor market management are:

- Problems that are directly related to the general goals of the region;
- Problems and solutions related to any element of the region, if this element is necessary to achieve the goals, but is currently absent or insufficient.
- Problems associated with external factors that are uncontrollable (Kyazimov, 2017).

When we concern the strategic labor market management, it is necessary to understand the essence of such management. Schmidt, Willness, Jones and Bourdage (2018, p. 581) state that strategic labor market management should answer the following questions:

- What is the current state of the labor market?
- In what position should it be in 3, 5, 10 months?
- How to achieve the desired result?

According to (Kashepov *et al.*, 2018), the main instruments of strategic labor market management are strategic analysis, strategic planning, organization of choice and implementation of the strategy, strategic control.

"Strategic analysis is the process of studying the activity of the labor market and the environmental factors that affect its position and competitiveness" (Zanoni, 2011, p. 4).

"Strategic planning is one of the functions of management, which is the process of choosing goals and ways to achieve them. Strategic planning provides the basis for all management decisions, the functions of organization, motivation and control are focused on the development of strategic plans" (Simerson, 2011, p. 25).

The author defines such stages of the process of strategic planning in the regional labor market:

– Definition of the mission and goals of the region;
– Analysis of the environment, including the collection of information, analysis of the strengths and weaknesses of the region, as well as its potential opportunities based on the available external and internal information;
– Choice of strategy;
– Implementation of the strategy;
– Evaluation and monitoring of implementation.

The last but not the least instrument used in Strategic Labor Market Management is Strategic control. "It is a tool that allows you to timely detect failures and errors in the implemented

strategy, as well as develop and implement corrective measures aimed at ensuring the achievement of the set goal" (Simerson, 2011, p. 243).

Thus, we can conclude that the labor market includes such basic elements as subjects of the labor market, legal norms and socio-economic programs, and the market mechanism itself, showing the relationship between labor supply and demand. Moreover, effective strategic labor market management can increase the number of employees, reduce the unemployment rate and, as a result, increase economic growth. This requires the use of instruments of the strategic labor market management, which are strategic analysis, strategic planning, organization of choice and implementation of the strategy and strategic control.

2.2 The essence and calculation methods of Labor Productivity

One of the most important quantitative goals of effective strategic labor market management is Labor Productivity. In this paragraph, we are studying the definitions and essence of the labor productivity and conducting literature review on labor productivity evaluation methods.

D. Scott Sink (1985) defined productivity as organizational system performance: "productivity is the ratio between the amount of products produced by a given organizational system (goods, services, cars, reports, boats, university graduates, inventions, new products, etc.) and the amount of costs used in the same organizational system to produce these products (energy – gas electricity, etc.; labor – direct and indirect costs, managerial, linear, staff workers, etc.; materials – steel, plastic, paper, fasteners, wood, etc.; capital – land, buildings, equipment, cash, investments, etc.)".

Bengt Karlöf (2005) defined the "total productivity": "The total productivity of a company can be defined as the quotient of dividing the value of the goods produced by the company by the total cost of resources that were needed to produce these goods. This allows you to compare the internal use of resources with the market valuation of products. The concept of efficiency is often used as a synonym for overall performance".

Thus, we can define labor productivity as one of the indicators of economic efficiency of production, characterizing the degree of efficiency of labor use in the process of production activity and measured by the ratio of the result of production activity and labor costs:

$$LP = \frac{R}{C} \quad (1)$$

where *LP* – labor productivity, *R* – result of production activity, *C* – labor costs.

As we see from the above ratios, labor productivity can be measured by the products number (work volume) produced by an employee per unit of time (hour, shift, quarter, year) or the time amount spent on the production of a production unit (to perform certain work).

According to Randolph and Ralph (2017, p. 156), there are such factors affecting the efficiency of the use of labor resources and labor productivity:

- condition of fixed assets;
- production technologies or processes;
- quality of management;
- climate in the team;
- working conditions and remuneration.

Moreover, the authors also identified the main factors of labor productivity growth. They can be conditionally divided into two groups: technical & technological and organizational & managerial.

Technical and technological factors of labor productivity growth are the introduction of new technologies, increasing the level of equipment. Technical and technological improvement of processes allows to reduce labor intensity and increase production. This group of factors is usually considered as the leading and determining the rest (Randolph and Ralph, 2017).

Organizational and managerial factors play a coordinating role. When technical and technological factors and reserves of labor productivity growth are connected, it is necessary to increase the level of management and organization of personnel management. In

particular, when introducing new technologies, it is necessary to ensure the training of employees and the development of a motivation system for working in new conditions (Randolph and Ralph, 2017).

We provided our systematic literature review to address the question: “What are the methods of calculating labor productivity?” Accordingly, the purpose of our systematic literature review was to understand what is already known in the field of current research (Table 1).

Table 1. Statistics on systematic literature review protocol

Database	**Keywords used**	**Search in (abstract, full text, keywords or else)**	**Time interval**	**Number of hits**	**Number of relevant**
Scopus	"labor productivity" AND Europe OR Russia	Title, abstract, keywords	2015-2022	32	8
Elsevier	"labor productivity" AND Europe OR Russia	Title, abstract, keywords	2015-2022	11	0
Springerlink	"labor productivity" AND Europe OR Russia	Whole text	2015-2022	27	0
Total:				**70**	**8**

The starting material was sources such as Scopus, Elsevier and Springerlink. We used keywords "labor productivity”, “Europe” and “Russia”. Total result of the search for relevant papers was 70. We chose eight of them for review as relevant articles.

As we can see, various approaches and methods of calculating labor productivity have been formed in practice. Mikheeva (2016) calculated labor productivity as the ratio of gross value added (GVA) in comparable prices to the average annual number of employees in the Russian regions for 1997-2012. Herzog-Stein, Lindner and Sturn (2018) defined labor productivity as the ratio of GVA and the total number of labor hours. The research was provided for the German labor market during the Great Recession. Moreover, Nagaeva and Popodko (2019) and Rasure (2020) measured labor productivity as the hourly output of a country's economy. Specifically, authors divided the real gross domestic product (GDP) produced by the total number of labor hours. Markhaichuk, Panshin and Chernov (2022) calculated labor productivity of the Russian regions for 2018, dividing the gross regional product (GRP) by person employed in the regional economy.

Stundziene and Baliute (2022) defined labor productivity for 27 European countries during the 1995–2018. The methodology authors used includes three approaches: calculation of apparent labor productivity (GVA per person employed), wage-adjusted labor productivity (labour productivity by average personnel costs) and turnover per person employed. Hart (2022) calculated labor productivity of United Kingdom during the Great Depression and the Great Recession using two ways. First, he found out productivity per worker, i.e., real output divided by employment. Secondly, he measured hourly productivity, which is real output divided by labor hours. Nevertheless, Hart has argued that hourly productivity is more superior way to calculate labor productivity.

Table 2 shows the conclusions based on the findings of most common methods of calculating labor productivity.

Table 2. Most common methods of calculating labor productivity

Calculation method	**Authors**
Ratio of GDP/GVA to the average annual number of employees	Mikheeva (2016); Stundziene & Baliute (2022); Markhaichuk, Panshin & Chernov (2022); Hart (2022)
Ratio of GDP/GVA to the total number of labor hours	Herzog-Stein, Lindner & Sturn (2018); Nagaeva & Popodko (2019); Rasure (2020); Hart (2022)

Therefore, we can conclude that the measuring of labor productivity is a relevant approach in the quantitative analysis of countries' economies. Why is it important to measure the labor productivity? High labor productivity is one of the important elements of high living standards. The higher the labor productivity, the greater the number of goods and services produced over the same time period. As productivity increases, people start to purchase more goods and services for more convenient prices.

Moreover, according to Eckardt, Lepak and Boselie (2018), the factors driving the productivity increase are physical assets, new technologies, and human assets. Calculating labor productivity provides an assessment of the overall impact of these key trends. Thus, we can state that economic growth is ensured by increasing labor productivity and capital, i.e., the country's assets. Usually, these factors are used in the building of production

functions for a good visual demonstration of the country's economy condition. Therefore, in the next paragraph we have studied the theory of Production Function and how it could be used for strategic labor market management improvement.

2.3 The theory of Production Function

The concept of the Production Function was formed at the turn of the XIX and XX centuries as one of the manifestations of economics mathematization and the formation of neoclassical analysis (Cobb and Douglas, 1928). In modern theory, there are many author's approaches to the design of the production function. However, first of all, it is important to study the definition and essence of the Production Function.

According to Felipe and McCombie (2013), we can define the production function as the relationship between the used resources amount (production factors) and the maximum possible output volume that can be achieved provided that all available resources are used in the most rational way.

Gorbunov (2013) defined that the production function expresses the functional relationship between the main observable and measurable input indicators and the scalar output indicator. The input indicators correspond to the selected production factors. According to him, the only output indicator is the output value, measured in the simplest case of the one product production (for example, coal) by a natural indicator (weight) and in the general case – the cost of gross output.

It is also possible to consider relative values of indicators, i.e., elementary indices of costs of factors and output relative to their values in a certain base period. Such a PF will be called an Index Production Function (Gorbunov, 2013). Indexes are dimensionless values, thus, the index PF represents the relationship of the selected indicators in relative values. Switching to Index PF facilitates the tasks of constructing them for specific objects based on relevant statistical information.

There are the following properties of the production function:

1. There is a limit in production increase that can be achieved with an increase of one resource and the constancy of other resources. If, for example, in agriculture to increase the amount of labor with constant amounts of capital and land, sooner or later there comes a time when output ceases to grow.

2. Resources complement each other, but within certain limits their interchangeability is also possible without reducing output. Manual labor, for example, can be replaced by the use of more machines, and vice versa.

3. The longer the time period, the more resources can be reviewed. In this regard, there are instantaneous, short and long periods. Instantaneous period is the period when all resources are fixed. A short period is a period when at least one resource is fixed. A long period is a period when all resources are variable (Cobb and Douglas, 1928).

At the next stage, we studied the different authors approaches on how the production function should look like. The most famous function was proposed by the Swedish economist Knut Wicksell (1851-1926) for an abstract production facility. Wicksell suggested that the output measured by the value of Y is uniquely determined by the fixed capital used K (the value of fixed assets) and labor L (working time or wages), i.e., it is a function of $Y = F(K,L)$. Moreover, he proposed a specific function $F(K,L) = AK^{\alpha}L^{\beta}$, the parameters of which should provide mathematical properties of the output function consistent with the economic sense. A special case of Wicksell function when $\alpha + \beta = 1$ and it looks like $AK^{\alpha}L^{1-\alpha}$, was applied by American researcher-economist Paul Douglas and mathematician Charles Cobb for the study of the used capital and labor amount influence on the output volume in the manufacturing industry of the USA in the period 1899-1922 (Cobb and Douglas, 1928).

Cobb and Douglas approach laid the foundation for economic and mathematical modeling, which is still significant nowadays. The Wicksell function became known in the literature as the Cobb–Douglas function.

Thus, the two-factor production function representation has been and remains the main one in the theory and applications of the production function method.

According to Klenton (2021), it is important to consider a production facility that produces products measured by an indicator and uses fixed assets (fixed capital), the cost of which is equal to labor (working time or total salary). The relationship between these indicators is set by the production function:

$$Y = F(K,L) \tag{2}$$

where Y – product, K – capital, L – labor.

The above production function suggests that the producer can replace labor with capital and capital with labor, leaving output unchanged (Klenton, 2021). For example, in agriculture in developed countries, labor is highly mechanized, i.e., there are many machines (capital) per worker. On the contrary, in developing countries the same volume of production is achieved through a large amount of labor with little capital. This makes it possible to construct the isoquant (Figure 2).

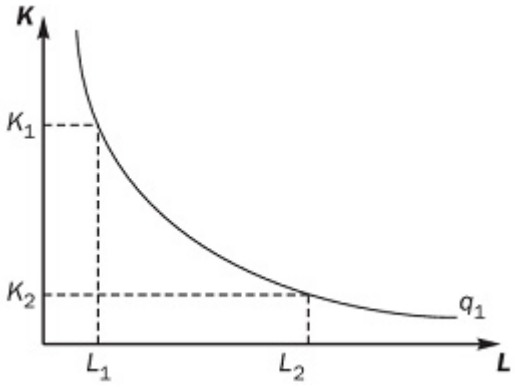

Figure 2. Production function isoquant. (adapted from Klenton, 2021)

We have to mention that the economic meaning of the production function imposes restrictions on the mathematical properties of the function. The production function cannot have a positive slope, as shown in Fig. 1.2.

We provided our systematic literature review to address the question: “What are the methods of building production function?” Accordingly, the purpose of our systematic literature review was to understand what is already known in the field of current research (Table 2).

Table 3. Statistics on systematic literature review protocol

Database	**Keywords used**	**Search in (abstract, full text, keywords or else)**	**Time interval**	**Number of hits**	**Number of relevant**
Scopus	"production function" AND Europe OR Russia	Title, abstract, keywords	2015-2022	27	7
Elsevier	"production function" AND Europe OR Russia	Title, abstract, keywords	2015-2022	9	0
Springerlink	"production function" AND Europe OR Russia	Whole text	2015-2022	31	0
Total:				**67**	**7**

The starting material was sources such as Scopus, Elsevier and Springerlink. We used keywords "production function", "Europe" and "Russia". Total result of the search for relevant papers was 67. We chose seven of them for review as relevant articles.

Cobb and Douglas production function is applied by many authors in their research nowadays as well. Druzhinin and Prokopyev (2018) built a Cobb and Douglas production function for 8 EU countries, in order to define the distinctive features for each. As a result, they identified two groups with different levels of capital-labor ratio, where the Nordic countries have much higher labor productivity than the Baltic countries. Krutova (2019) calculated the production function for Finland in 2004-2016, aimed at determining how the immigrants contribute to Finland's productivity, welfare and income. Leviäkangas and Kauppila (2020) built a Cobb and Douglas production function for Australia and Finland, in order to determine whether investments in information and communication technologies increase the labor productivity. Phale, Fanglin, Mensah, Omari-Sasu and Musah (2021) calculated the production function for Southern African Development Community countries on the basis 1998-2018, aimed at determining the relationship between knowledge-based economy pillars and economic growth. As a result, authors identified that the strongest correlation is between innovation component, which includes education and skills, and economic growth. Varvařovská and Staňková (2021) built a production function based on data from 27 European Union countries for 2016-2019, in order to identify whether the involvement of "green energy" increase the labor productivity. Lema, Masresha and Neway (2022) calculated the production function based on data from 385 farm households in

Ethiopia, aimed at determining the technical efficiency of barley production. Kang (2022) built an extended Cobb and Douglas production function based on data from 109 countries for 2000-2020, in order to determine whether there is a correlation between energy trilemma and economic growth. Extended option included three elements such as energy security, energy equity and environmental sustainability.

Thus, we can conclude that Cobb and Douglas production function is still relevant nowadays. This approach could be applied to determine the relationship between various economic factors and economic grow, labor productivity, etc. The results, obtained from this analysis, could become as a basis for several recommendations for different labor markets of the regions, in order to increase labor productivity, assets and GDP of the regions.

Conclusions on the chapter: based on the considered theoretical aspect of the labor market management, the following was established.

Labor market includes such basic elements as subjects of the labor market, legal norms and socio-economic programs, and the market mechanism itself, showing the relationship between labor supply and demand. Moreover, effective labor market management can increase the number of employees, reduce the unemployment rate and, as a result, increase economic growth. This requires the use of instruments of the strategic labor market management, which are strategic analysis, strategic planning, organization of choice and implementation of the strategy and strategic control.

Labor productivity is the one of the indicators of economic efficiency of production, characterizing the degree of efficiency of labor use in the process of production activity and measured by the ratio of the result of production activity and labor costs. This approach is important in the quantitative analysis of countries' economies, since high labor productivity is one of the important elements of high living standards. The higher the labor productivity, the greater the number of goods and services produced over the same time period. As productivity increases, people start to purchase more goods and services for more convenient prices.

Production function is the relationship between used resources amount (production factors) and the maximum possible output volume that can be achieved provided that all available resources are used in the most rational way. The most common variation of production function is Cobb and Douglas approach, which laid the foundation for economic and mathematical modeling. This approach could be applied to determine the relationship between various economic factors and economic grow, labor productivity, etc. The results, obtained from this analysis, could become as a basis for several recommendations for different labor markets of the regions, in order to increase labor productivity, assets and GDP of the regions.

3 Labor Productivity in Russian federation subjects and Nordic countries

This chapter includes analysis of average annual number of employed people, real and nominal gross domestic product of the Nordic countries and the Russian Federation regions. In addition, the results of calculating the labor productivity of the Nordic countries and the Russian Federation regions are presented and comparative analysis of results is provided.

3.1 Labor Productivity in the Russian Federation subjects

High labor productivity is one of the important elements of high living standards. The higher the labor productivity, the greater the number of goods and services produced over the same time period. As productivity increases, people start to purchase more goods and services for more convenient prices.

Methodology

Based on the Herzog-Stein, Lindner & Sturn (2018), Nagaeva & Popodko (2019), Rasure (2020) and Hart (2022) articles, we chose ‘Ratio of GDP to the total number of labor hours’ as a most effective approach for calculating the labor productivity. The following initial data were taken from the official statistics of the Federal State Statistics Service (Rosstat) to calculate the labor productivity:

1. Gross regional product, rubles.
2. Gross regional product physical volume index, %
3. Average annual number of employed.
4. Annual hours worked per employed (h).

Given statistics on the gross regional product have been adjusted in accordance with gross regional product physical volume index, and the real gross regional product was calculated in order to make more representative research. 2015 was taken as the base year, thus, the prices are constant 2015. Thus, chosen methodology for calculating the labor productivity based on the following equation:

$$LP = \frac{GDP}{TNLH} \quad (3)$$

where *LP* – labor productivity, *GDP* – real gross domestic product, *TNLH* – total number of labor hours.

Hence, total number of labor hours is calculated according to the following equation:

$$TNLH = AHWPE \times AANE \quad (4)$$

where *TNLH* – total number of labor hours, *AHWPE* – annual hours worked per employed, *AANE* – average annual number of employed.

Based on the results of these calculations, it is possible to determine the real labor productivity of each region for each year. Further, having received the real labor productivity, we can work with this information, conduct a comparative and quantitative analysis of regions in recent years.

As the objects of research, we chose regions based on the annual rating of the federal subjects of the Russian Federation for 2021 according to the tension level in the labor market compiled by the Russian Federal State Statistics Service (Regions of Russia, 2021). This rating is presented in Table 4.

Table 4. Rating of the Russian Federation subjects by the tension level in the labor market for 2021 (adapted from FSSC data)

No	**Regions**	**Average score**
1	Yamalo-Nenets AO	1,8
2	Saint-Petersburg	5,8
3	Republic of Tatarstan	8
4	Moscow	10,3
...		
51	Tver Oblast	40,5
52	Oryol Oblast	41
…		
82	Karachay-Cherkess Republic	77,8
83	Republic of North Ossetia	80,8

Data for analysis were gathered for the last 15 years, 2006-2020. Tables with the values of the above variables are given in the Appendix.

Results

At the first stage, before analyzing the calculated indicators, it is necessary to assess the current situation in the regions (Figure 3).

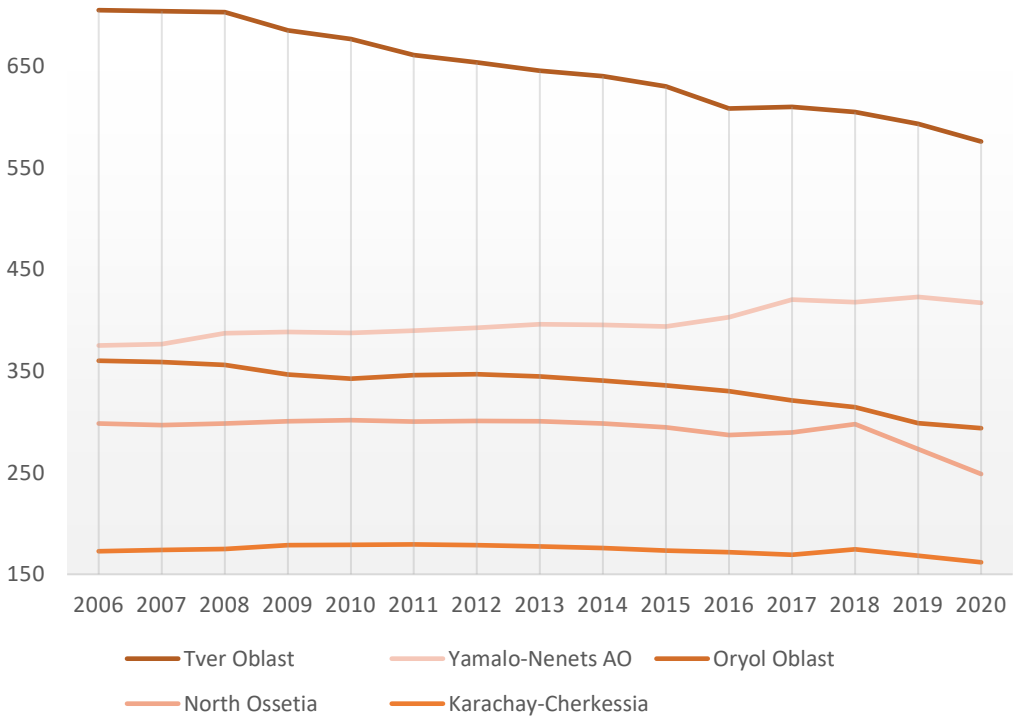

Figure 3. Average annual number of employed people in the Russian regions (thousands of people)

According to the chart, we come to the conclusion that in most regions the annual number of employed people is decreasing during whole analyzed period. The only region, where the number of employees has increased, is the Yamalo-Nenets Autonomous Okrug. In 2020, 417 thousand people were employed there. Moreover, we can see the strong decline in all the regions in 2020, it caused by restrictions imposed due to the COVID-19 pandemic. The same situation in the Republic of Tatarstan (Figure 4).

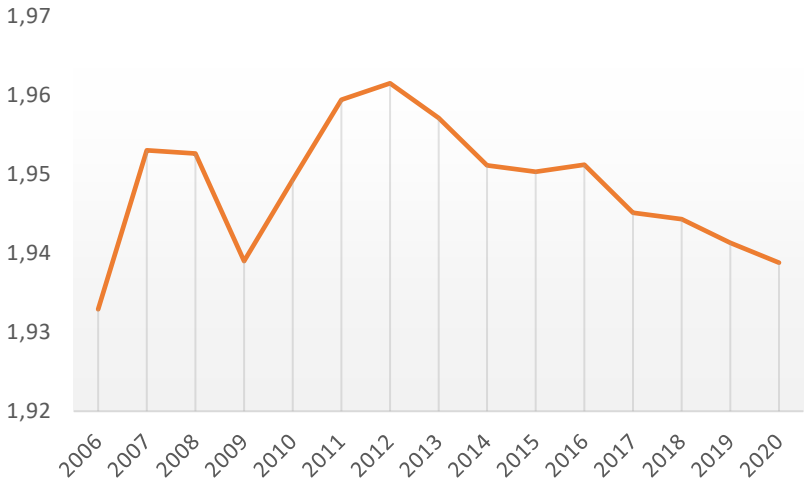

Figure 4. Average annual number of employed people in the Republic of Tatarstan (millions of people)

Since 2012, the number of employed people is gradually declining here. In 2020, 1.9 million people were employed in the Republic of Tatarstan. Nevertheless, it must be noted that the republic has the largest labor force among the analyzed regions, which is an undoubted competitive advantage.

The dynamics of the following indicator – nominal gross regional product – is shown in Figure 5. We can see that nominal gross regional product is growing in all regions throughout the analyzed period.

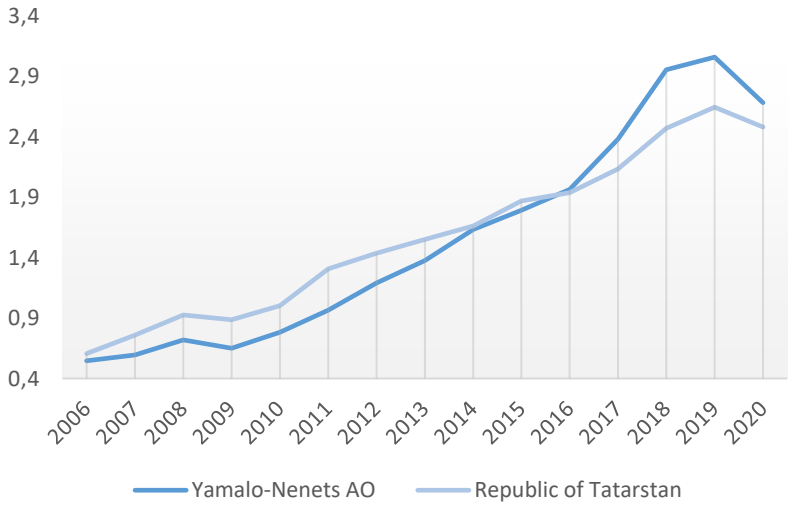

Figure 5. Nominal GRP of the Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan (trillion rubles)

Moreover, from 2016 to 2019, there is a sharp increase in GRP in the Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan, as a result, YNAO overtook the Tatarstan in 2017, and it is still the leader. In 2020, there are 2.7 trillion rubles produced in Yamalo-Nenets AO and 2.5 trillion in the Republic of Tatarstan.

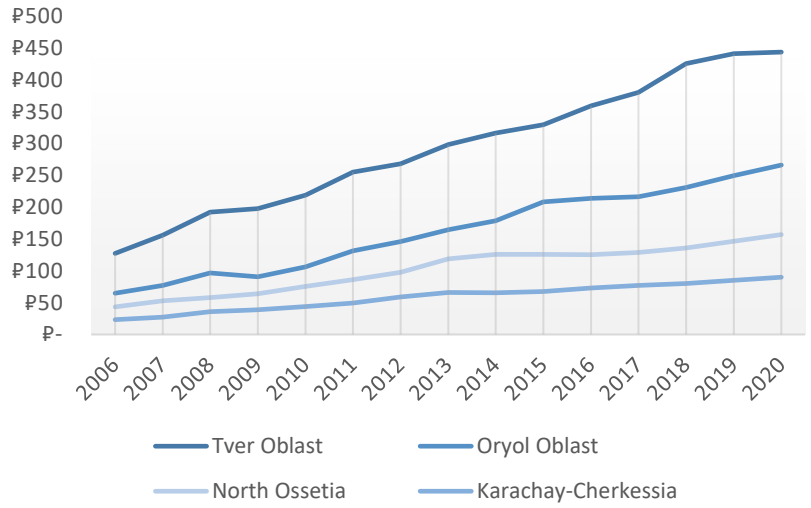

Figure 6. Nominal GRP of the Russian regions (billion rubles)

In other regions we can observe the same situation – nominal gross regional product is growing during whole analyzed period (Figure 6).

However, in order to make more accurate statistical research, in this research we calculated the real gross domestic product. This allows to provide more representative comparative analysis of the regions. The results of our calculations are shown in Figure 7.

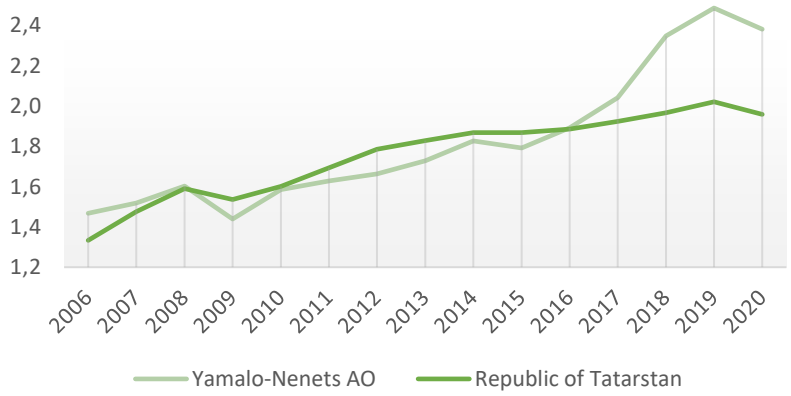

Figure 7. Real GRP of the Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan (trillion rubles, constant 2015)

We can observe huge difference between the real gross regional product and nominal gross regional product that we analyzed previously. The highest level of the real indicator is 2.021 trillion rubles in the Republic of Tatarstan and 2.486 trillion rubles in the Yamalo-Nenets AO, while the nominal indicator for the same year amounted to 2.6 trillion and 3.1 trillion rubles, respectively, which is 70% less. Thus, we conclude that the nominal gross regional product of these regions has increased by 300-400% over 15 years, while the real gross regional product has increased by only 47-62%.

Moreover, an interesting fact is that due to sharp increase of the real GRP in 2017-2019, Yamalo-Nenets AO's GRP has become very detached from the Republic of Tatarstan. In just two years, there has been an increase of 21.8%. Perhaps, this may be caused by rising prices for natural gas, which accounts for a significant share of the Yamalo-Nenets AO's export incomes. In 2020, it was 98.9%.

There is the same difference in the real gross regional product and nominal gross regional product in other regions (Figure 8).

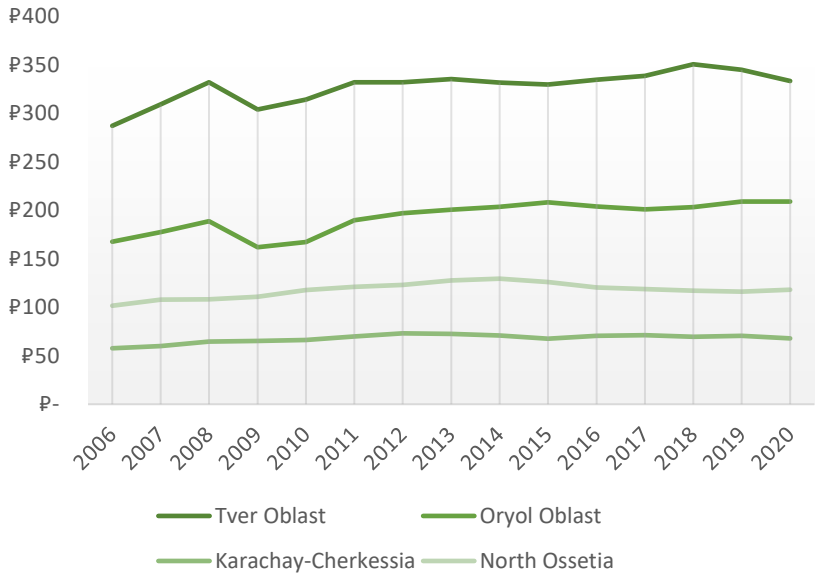

Figure 8. Real GRP of the Russian regions (billion rubles, constant 2015)

The middle and lagging regions demonstrate very weak increase in their real gross regional product. For example, the highest GRP growth is observed in the Oryol Oblast and the Karachay-Cherkess Republic – only 24.8% in 15 years.

Analyzing the dynamics, we come to conclusion that the gross regional product of all subjects of the Russian Federation has been gradually increasing until 2019. In 2020, it has declined, which was caused by economic restrictions imposed due to the COVID-19 pandemic, which particularly affected the oil and gas producing regions, since world prices of these resources have dropped significantly.

After analyzing the initial data, we can proceed to the analysis of the obtained results of calculating labor productivity, which are presented in Figure 9.

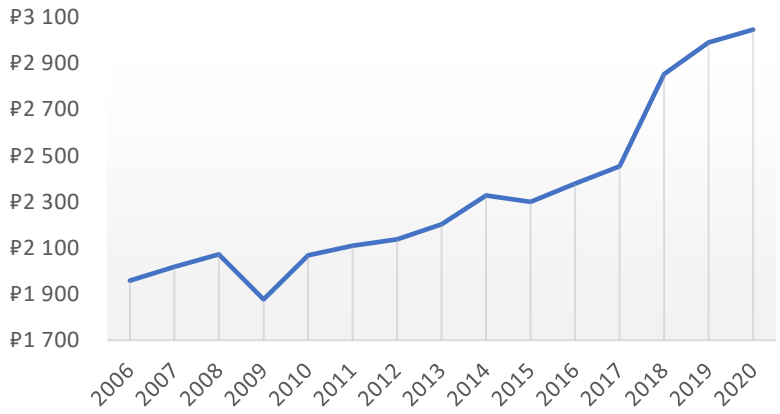

Figure 9. Real labor productivity of the Yamalo-Nenets AO (rubles/h)

The chart shows that Yamalo-Nenets Autonomous Okrug is the obvious leader in the labor productivity among the analyzed regions. As of 2020, every employed person here produces an average of 3 047 rubles per hour.

The second leader in labor productivity among the analyzed regions is the Republic of Tatarstan (Figure 10).

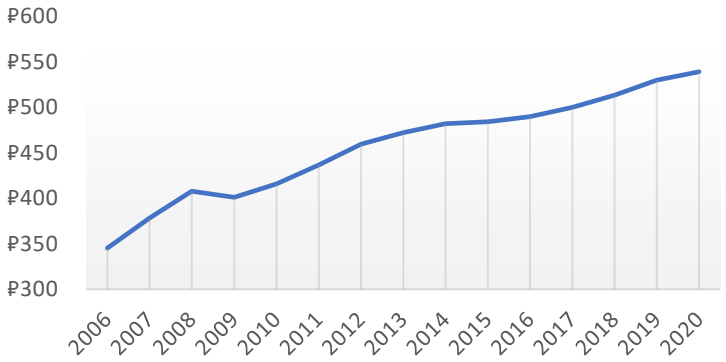

Figure 10. Real labor productivity of the Republic of Tatarstan (rubles/h)

In 2020, each employed person here produces an average of 539 rubles per hour. Obviously, this is much lower than labor productivity in the Yamalo-Nenets Autonomous Okrug. The reason for this may be that the Yamalo-Nenets Autonomous Okrug receives huge revenues from export of the natural gas. In 2020, the share of mining in the industry structure of gross value added here amounted to 71.3%, while in the Republic of Tatarstan the same indicator amounted to 21.1%.

Labor productivity dynamics in other regions shown in Figure 11.

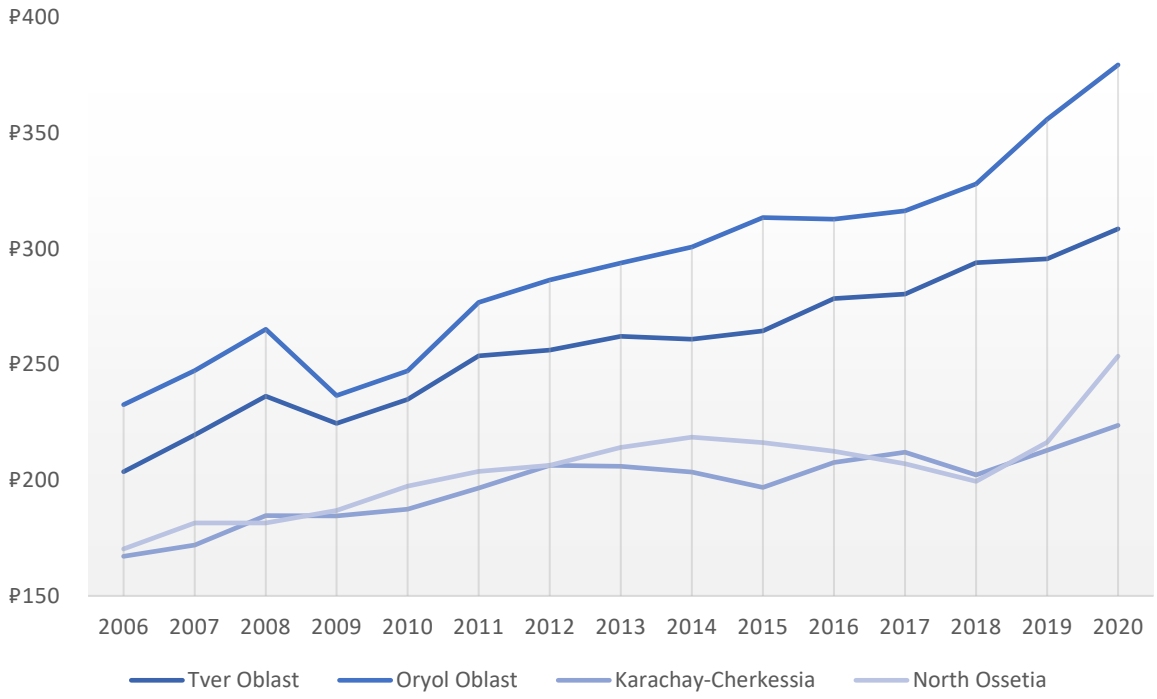

Figure 11. Real labor productivity of the Russian regions (rubles/h)

Now we clearly see how big the gap is between the oil and gas producing regions and others. Labor productivity of the Republic of Tatarstan exceeds them by almost two times, labor productivity of the Yamalo-Nenets AO – by 9 times.

Thus, we can compile the rating of the Russian Federation regions by the real labor productivity for 2020 (Table 5).

Table 5. Rating of the Russian Federation regions by the labor productivity for 2020 (calculated according to the FSSS data)

No	Region	Labor Productivity (rubles/h)
1	Yamalo-Nenets Autonomous Okrug	3 046.68
2	Republic of Tatarstan	539.00
3	Oryol Oblast	379.44
4	Tver Oblast	308.59
5	Republic of North Ossetia – Alania	253.59
6	Karachay-Cherkess Republic	223.69

Here is the objective leader – Yamalo-Nenets Autonomous Okrug. Labor productivity of this region is higher than all the others combined. Also, there is an objective outsider – Karachay-Cherkess Republic, which labor productivity is almost close the minimum wage in the Russian Federation.

Analyzing the dynamics of labor productivity, we come to conclusion that, on average, it gradually increases during the whole period. The only recessions we can observe in 2009, which caused by the Global Financial Crisis of 2007–2008. This especially affected the mining regions – the Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan – labor productivity in these regions decreased by 4-11%.

Moreover, an interesting fact is that economic restrictions imposed due to the COVID-19 pandemic did not significantly affect the real labor productivity of the regions. In 2020, the only regions where there is a decrease in labor productivity are the Republic of Tatarstan and Tver Oblast. In other regions there is an increase (Yamalo-Nenets Autonomous Okrug, Oryol Oblast and Republic of North Ossetia) or there are no significant changes (Karachay-Cherkess Republic). This can be explained by the fact that even if the real gross regional product has declined in all the regions, the real labor productivity has received an impulse due to a reduction in the annual number of employed people and decrease in the annual hours worked per employed.

Thus, based on the above, we come to conclusion that according to all the analyzed indicators, there is a strong preponderance of development towards the leading regions among the subjects of the Russian Federation. In other words, the indicators of the middle

regions are quite close to the indicators of outsider regions, and the leading group has come off quite strongly – this trend is often found in the modern world.

Based on the above, we can argue that it is possible to differentiate the regions of the Russian Federation rather than according to the classical principle of three groups: developed, middle and lagging, but according to the principle of two: developed and lagging. This hypothesis undoubtedly makes us think about the need for managerial decisions to eliminate this "gap" between the subjects of the Russian Federation in order to increase the labor productivity of lagging regions, in the absence of mining, investigate for the other sources of income, optimize and increase them etc.

3.2 Labor Productivity in the Nordic countries

North Europe is a relatively small territory with a population of just over 27 million people. This territory includes countries such as Norway, Sweden, Finland, Denmark and Iceland.

At the moment, Nordic countries are at the top of the rankings for completely different indicators, including: the level of economic development, innovation activity, quality of education, health and social protection.

In addition, Nordic countries demonstrate minimal levels of corruption, therefore, Norway, Sweden, Finland, Denmark and Iceland occupy leading positions in the human development index and the international happiness index. These factors undoubtedly determine the high level of development of labor market in the region.

The following initial data were taken from the official statistics of the World Bank, OECD and official statistics websites of countries to calculate labor productivity:

1. Nominal gross domestic product, US dollars.
2. Real gross domestic product, constant 2015 US dollars.
3. Average annual number of employed.
4. Annual hours worked per employed (h).

Data for analysis were gathered for the last 15 years, 2006-2020. Tables with the values of the above variables are given in the Appendix.

At the first stage, before analyzing the calculated indicators, it is necessary to assess the current situation in the regions (Figure 12).

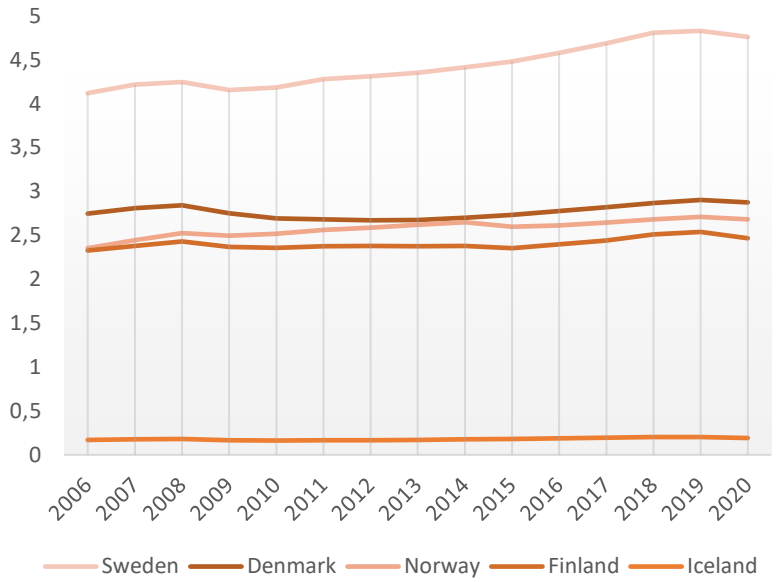

Figure 12. Average annual number of employed people in the Nordic countries (millions of people)

The chart shows that we can divide the Nordic countries into 3 groups:

1. Largest labor force – Sweden (4.76 million people).
2. Middle labor force – Denmark, Norway and Finland (2.87, 2.68 and 2.47 million people respectively).
3. Smallest labor force – Iceland (192.8 thousand people).

Analyzing the dynamics, we come to conclusion that, annual number of employed people of the Nordic countries varies quite similarly. In general, this indicator has not increased significantly. The highest growth rate is observed in Sweden – 17% over 15 years, in other countries such indicator equals only 7-11%. The most noticeable increase is observed in 2015-2019.

Moreover, there are only two significant declines – in 2009 and 2020. The first is caused by Global Financial Crisis, the second by economic restrictions imposed due to the COVID-19 pandemic.

The dynamics of the following indicator – nominal gross domestic product – is shown in Figure 13.

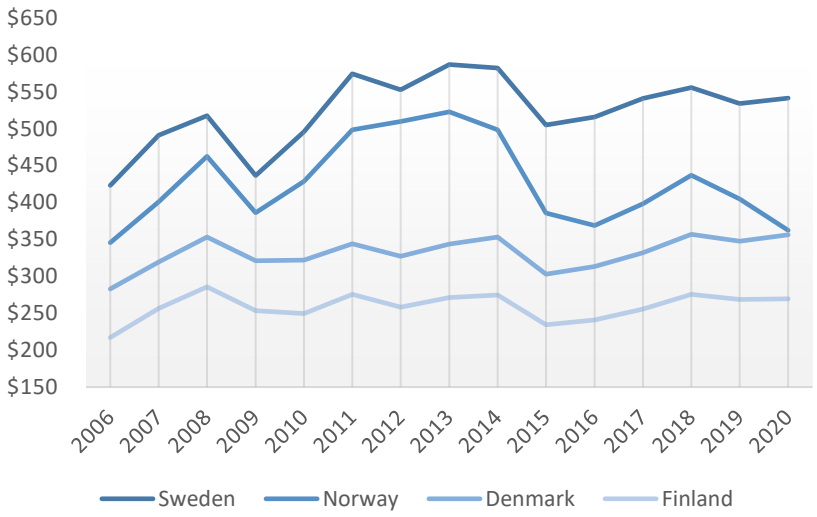

Figure 13. Nominal GDP of the Nordic countries (billion USD)

We can observe that the nominal gross domestic product has not increased significantly in the Nordic countries over the past 15 years.

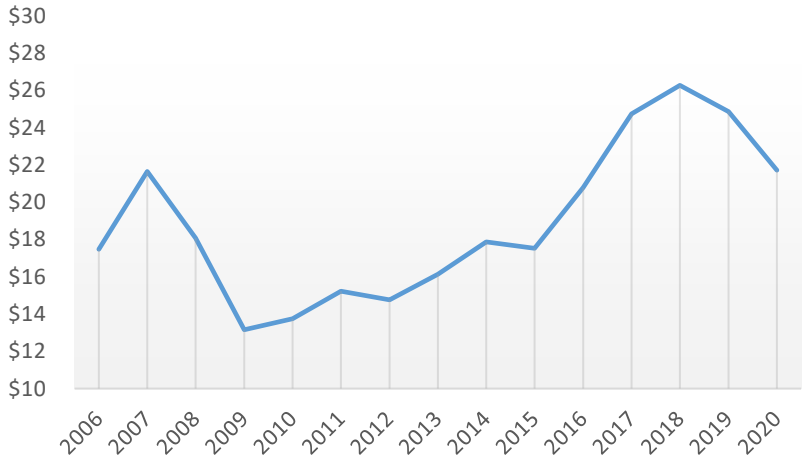

Figure 14. Nominal GDP of Iceland (billion USD)

Moreover, we can state again that the Nordic countries are developing in a very similar way, the same changes occur in the same years. There are three noticeable declines – in 2009, 2015 and 2019. Moreover, an interesting fact is that in 2020, the only country where nominal GDP has declined is Norway. Perhaps, it caused by that world energy prices have fallen

significantly due to the COVID-19 crisis, because Norway is the mining country – in 2020, the share of crude petroleum and petroleum gas in the export revenues of this country amounted to 62%.

However, within the comparative analysis it is more representative to use the real gross domestic product. The first observation that we have to mention is that in the Nordic countries there is not such a huge difference between the nominal and real gross domestic product as it observed in the Russian regions. This fact shows us how low the inflation is in these countries. Moreover, we can observe that the real GDP is less volatile, than the nominal one.

The dynamics of real gross domestic product is shown in Figure 15.

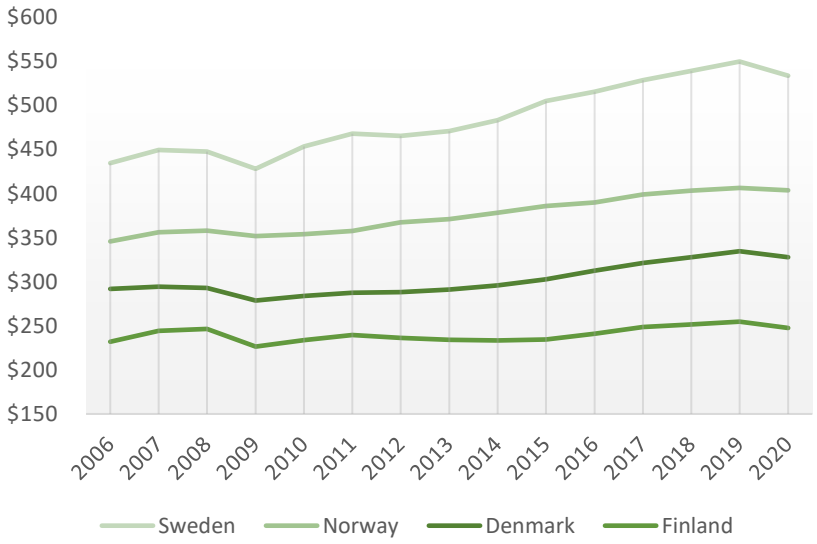

Figure 15. Real GDP of the Nordic countries (billion USD, constant 2015)

The first observation that we have to mention is that in the Nordic countries there is not such a huge difference between the nominal and real gross domestic product as it observed in the Russian regions. This fact shows us how low the inflation is in these countries (Figure 16). Moreover, we can observe that the real GDP is less volatile, than the nominal one.

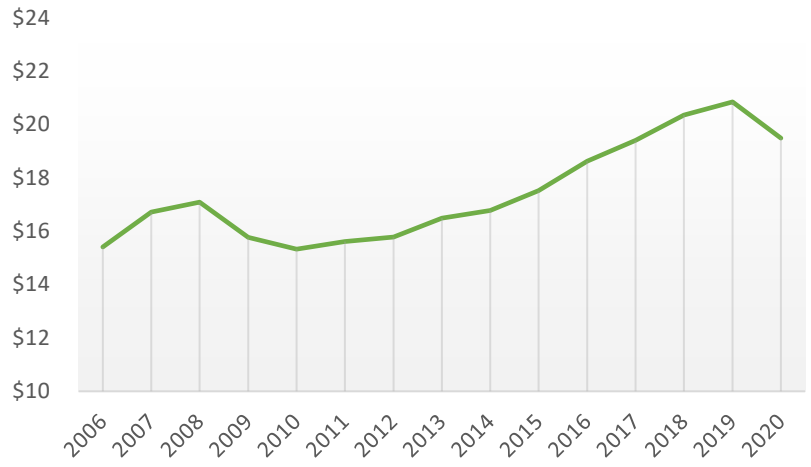

Figure 16. Real GDP of Iceland (billion USD, constant 2015)

In addition, based on these charts, we can compile the rating of the Nordic countries by the real GDP for 2020:

1. Sweden with the real GDP amounted to 533.612 billion dollars.
2. Norway – 403.553 billion dollars.
3. Denmark – 327.738 billion dollars.
4. Finland – 247.607 billion dollars.
5. Iceland – 19.491 billion dollars.

There is an interesting fact, that Sweden produces more than mining Norway, even if the largest share in the Swedish economy is in the service sector – 71%.

Analyzing the dynamics, we can observe that the real gross domestic product in the Nordic countries has not increased significantly. The highest growth rate is observed in Iceland – 35.27% over 15 years, followed by Sweden with the GDP growth rate of 26.5%, Norway – 17.55%, Denmark – 14.64% and Finland – 9.75%.

After analyzing the initial data, we can proceed to the analysis of the obtained results of calculating labor productivity, which are presented in Figure 17.

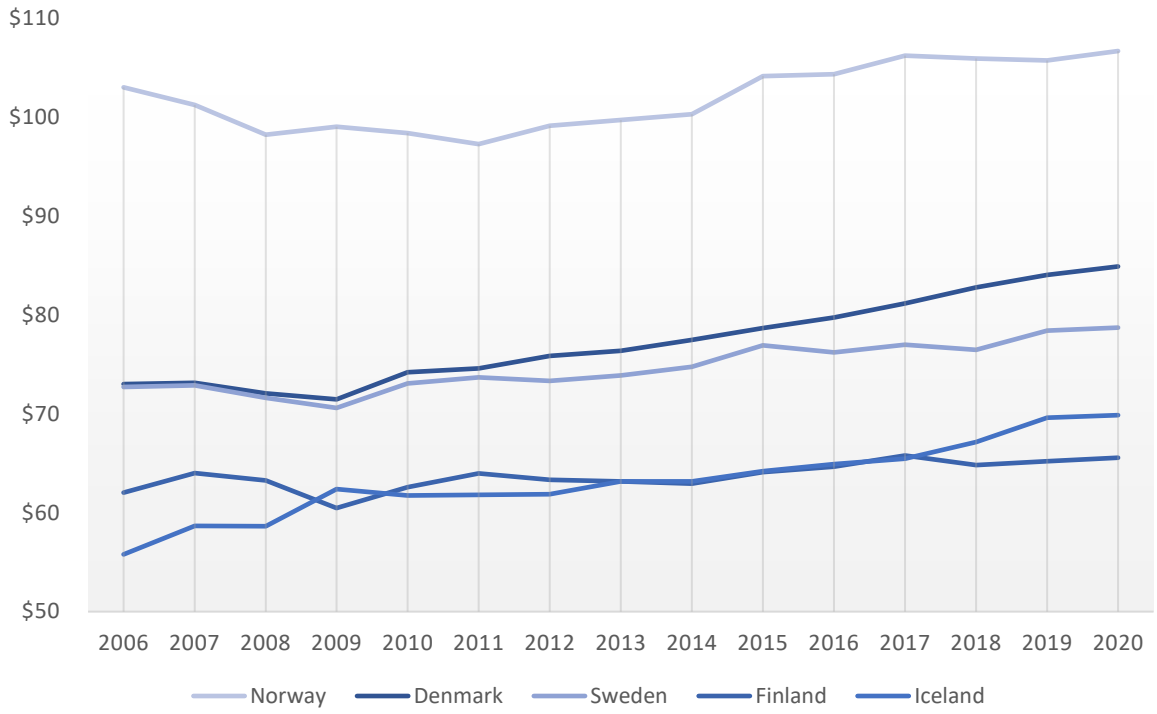

Figure 17. Real labor productivity of the Nordic countries (USD/h)

The chart shows that Norway is the obvious leader in the labor productivity among the Nordic countries. In 2020, every employed person here produced an average of 107 US dollars per hour. Thus, Norway's labor productivity is 25.9% ahead of its closest pursuer – Sweden. The reason for this may be that Norway is the only Nordic country that receives high revenues from the export of crude petroleum and petroleum gas. In 2020, the share of energy resources in the export revenues of this country amounted to 62%. Consequently, we are once again observing how significant is the mining industry for the economies of the countries.

In addition, an interesting fact is that the only noticeable decline in the labor productivity of the Nordic countries was observed in 2008-2009, which is obviously caused by the Global Financial Crisis of 2007–2008. In 2020, the economic restrictions imposed due to the COVID-19 pandemic did not reduce productivity, but only slowed the growth.

Thus, we can compile the rating of the Nordic countries by the real labor productivity for 2020 (Table 6).

Table 6. Rating of the Nordic countries by the real labor productivity for 2020 (Calculated: according to the OECD data)

No	Region	Labor Productivity (USD/h)
1	Norway	106,7
2	Denmark	84,9
3	Sweden	78,7
4	Iceland	69,9
5	Finland	65,6

Analyzing the dynamics, we can observe that the real labor productivity in the Nordic countries has not increased significantly. The highest growth rate is observed in Iceland – 25.23% over 15 years, followed by Denmark with the real labor productivity growth rate of 16.3%, Sweden – 8.27%, Finland – 5.69% and Norway – 3.56%. Consequently, we observe interesting phenomena: even if the real labor productivity of Norway is the highest among the Nordic countries, the growth rate of the real labor productivity is the lowest.

Moreover, an interesting fact is that none of the Nordic countries has demonstrated a decrease of the real labor productivity in 2020 due to economic restrictions imposed as a result of the COVID-19 pandemic. This can be explained by the fact that even if the real gross regional product has declined in all the regions, the real labor productivity has received an impulse due to a reduction in the annual number of employed people and decrease in the annual hours worked per employed.

Thus, based on the above, we come to conclusion that according to all the analyzed indicators, all the Nordic countries are developing within the framework of quite similar trends. The real gross domestic product and real labor productivity in these regions has not increased significantly over the past 15 years.

In addition, we conclude that the mining industry is significant for the economies of the Nordic countries as well, since the highest labor productivity is observed in Norway, where crude oil and petroleum gas account for the largest share of export revenues. However, the gross domestic product of the Sweden is higher than the oil and gas producing Norway, even if the largest share in the Swedish economy is in the service sector – 71%.

Nevertheless, based on our calculations, we come to conclusion that the average labor productivity in the Nordic countries is relatively high – 81.1 dollars per hour, therefore we state that these countries are the world leaders in this indicator and other countries could use their experience in order to improve the performance of the economies.

3.3 Comparative analysis of the Labor Productivity in the Russian Federation subjects and the Nordic countries

For a more comparable analysis, we have developed two approaches on how to compare the labor productivity in the Russian Federation subjects and the Nordic countries. First, the labor productivity indicators in the regions were adjusted taking into account purchasing power parity (PPP). The prices used in the calculations are current US dollars.

Thus, the results of our adjusted labor productivity indicators presented in Figure 18.

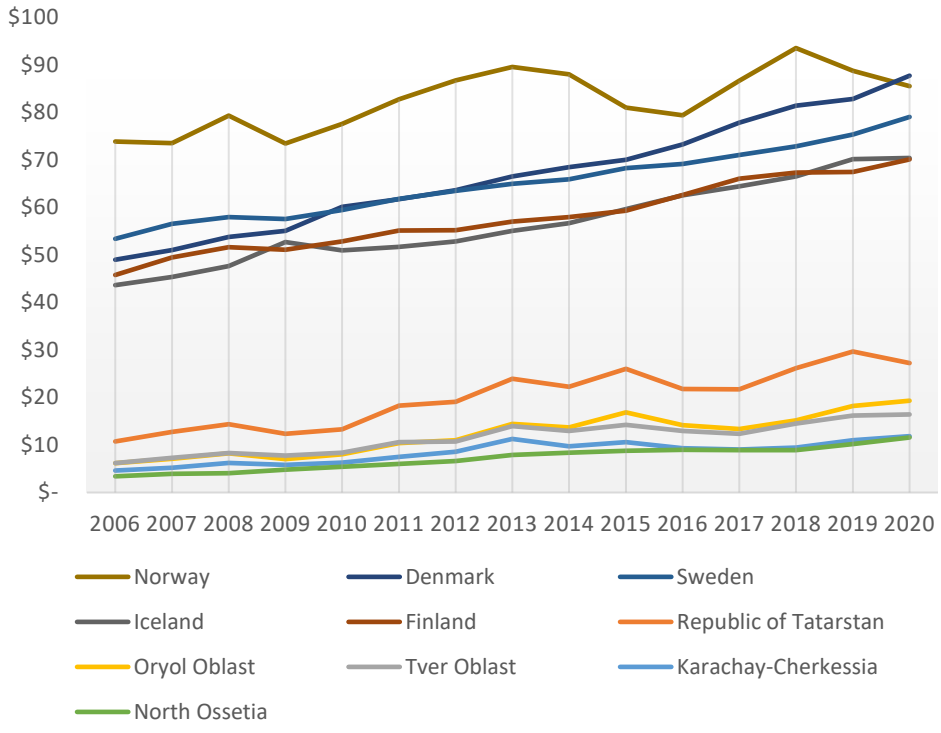

Figure 18. Labor productivity in the Nordic countries and the Russian Federation subjects (USD/h, current prices, PPP)

The chart shows that even if the labor productivity indicators were adjusted using purchasing power parity current prices, there is a still huge difference in the labor productivity between

the Nordic countries and the Russian Federation subjects. The average labor productivity in the Nordic countries is 78.6 US dollars per hour, while the average labor productivity the Russian regions is 38.4 US dollars per hour.

In 2020, the most productive country in North Europe is Denmark. Each employed person here produces an average of 87.7 US dollars per hour, while the most productive region of the Russian Federation among those presented is the Republic of Tatarstan, where each employed person produces an average of 27.3 US dollars per hour.

However, there is an interesting fact that the labor productivity of the Yamalo-Nenets Autonomous Okrug has become very detached from all of the analyzed regions (Figure 19).

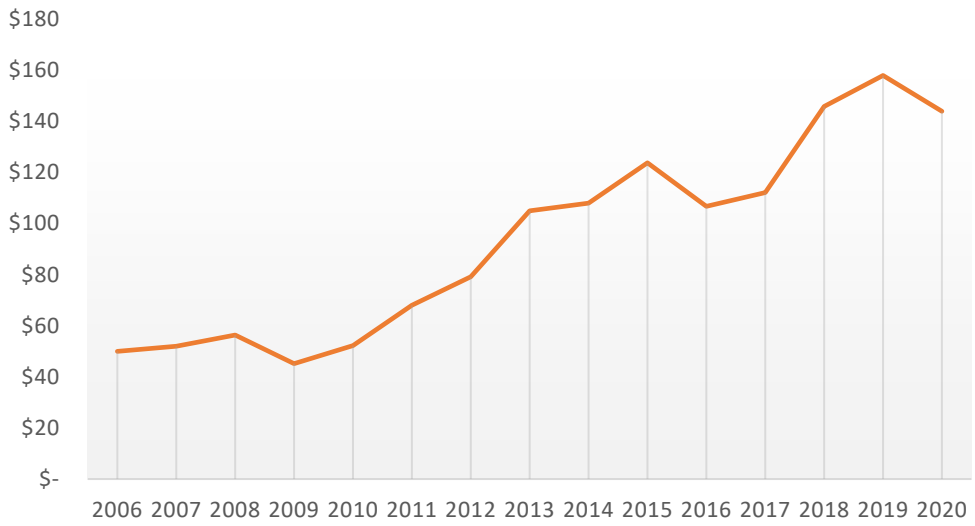

Figure 19. Labor productivity in the Yamalo-Nenets Autonomous Okrug (USD/h, current prices, PPP)

According to the current prices adjusted using PPP, each employed person in the Yamalo-Nenets Autonomous Okrug produces an average of 144 US dollars per hour, which is 64% higher than Denmark, the most productive country in Northern Europe. Consequently, we can state again that this may be caused by rising prices for natural gas, which accounts for a significant share of the Yamalo-Nenets AO's export incomes.

In 2020, the country with the lowest productivity in North Europe is Finland. Each employed person here produces an average of 70.1 US dollars per hour, while the lowest-producing

region of the Russian Federation is the Republic of North Ossetia – Alania, where each employed person produces an average of 11.6 US dollars per hour.

Analyzing the dynamics, we come to conclusion that the Global Financial Crisis of 2007–2008 affected almost all the analyzed regions. In 2009, the only regions where the labor productivity increased were Denmark, Iceland and the Republic of North Ossetia. Additionally, in 2014 and 2016, we observe a decrease in the labor productivity in the Russian regions, which is explained by the weakening of the ruble exchange rate as a result of the complication of the foreign economic situation. Furthermore, there is an interesting fact that the COVID-19 pandemic crisis affected only oil and gas producing countries. We can observe that in 2020, the labor productivity of Norway, Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan decreased by 8.8%, 8.1% and 3.7% respectively. Perhaps this is caused by the fact that world energy prices have fallen significantly due to the economic restrictions imposed as a result of the COVID-19 pandemic.

In addition, we observe that for a long time, Norway has been the only leader in the labor productivity in the North Europe. Only in 2016, as a result of the decline in indicators, other Nordic countries closely approached Norway, moreover, in 2020 Denmark even outstripped Norway in terms of the labor productivity. In the Russian Federation Yamalo-Nenets Autonomous Okrug was the only leader in the labor productivity over the past 15 years.

The second approach we developed and implemented to provide the comparable analysis is based on ‘Labor productivity to Salary Index’. This index calculated for each analyzed region for 2006-2020 as ratio of hourly labor productivity to hourly average salary. The prices used in the calculations are constant 2015 rubles for the Russian Federation subjects and constant 2015 US dollars for the Nordic countries. The results of our calculations presented in Figure 20.

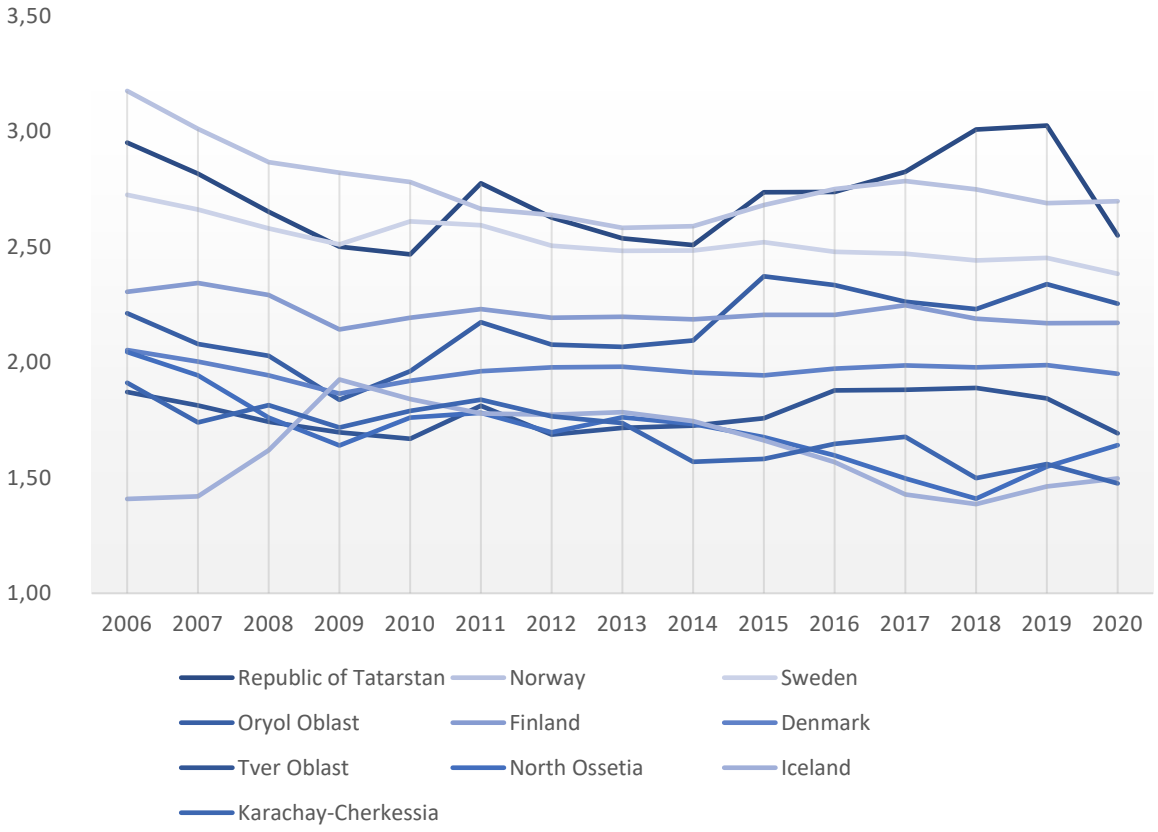

Figure 20. Labor productivity to Average salary Index of the Russian Federation subjects and the Nordic countries

The explanation of this chart is that the higher the index the greater the difference between the labor productivity and the average salary. Consequently, there are two possible reasons for this, that either the labor productivity in the region is relatively high, or average salary is relatively low. Accordingly, if the index is close to 1, it shows that the labor productivity and the average salary indicators are very close to each other, which means that either the labor productivity in the region is relatively low, or average salary is relatively high.

Thus, we can observe that there is a relatively high gap between the labor productivity and the average salary in the Republic of Tatarstan. Consequently, we can state that employees in this region receive relatively low salaries.

Nevertheless, the region with the highest Labor productivity to Average salary Index is the Yamalo-Nenets Autonomous Okrug (Figure 21).

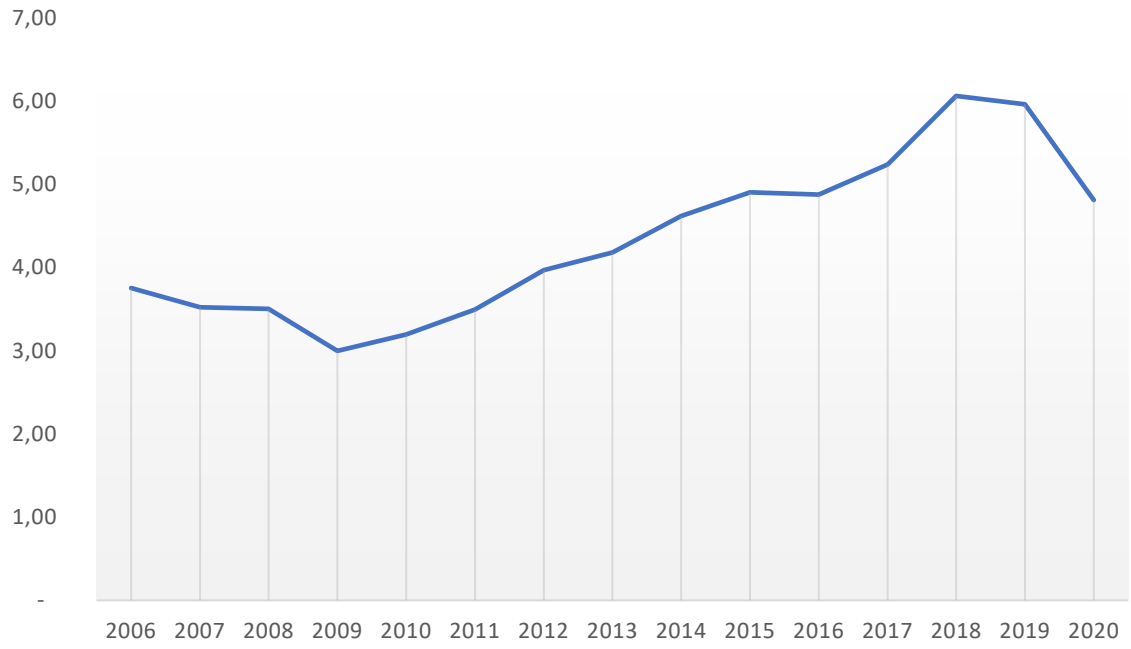

Figure 21. Labor productivity to Average salary Index of the Yamalo-Nenets Autonomous Okrug

We can observe that in 2020, the labor productivity in the Yamalo-Nenets Autonomous Okrug is 4.8 times higher than the average salary. Consequently, we can state that the labor productivity if this region is relatively the highest among the analyzed regions, on the other hand, it is possible that employees in the Yamalo-Nenets Autonomous Okrug receive relatively low salaries.

Thus, based on the above, we come to conclusion that according to all the analyzed indicators, there is a huge difference in the labor productivity between the Nordic countries and the Russian Federation subjects. The average labor productivity of the Nordic countries is two times higher than in the Russian Federation subjects. However, there is the only Russian region, which labor productivity has become very detached from all of the analyzed regions, is the Yamalo-Nenets Autonomous Okrug. Each employed person in this region produces an average of 144 US dollars per hour, which is 64% higher than Denmark, the most productive country in Northern Europe. Thus, we can conclude that this may be caused by rising prices for natural gas, which accounts for a significant share of the Yamalo-Nenets AO's export incomes.

Conclusions on the chapter: based on the analyzed indicators, the following was established.

Calculation of the labor productivity in the Russian Federation subjects showed that there is a strong preponderance of development towards the leading regions among the subjects of the Russian Federation. In other words, the indicators of the middle regions are quite close to the indicators of outsider regions, and the leading group has come off quite strongly – this trend is often found in the modern world. Based on the above, we can argue that it is possible to differentiate the regions of the Russian Federation rather than according to the classical principle of three groups: developed, middle and lagging, but according to the principle of two: developed and lagging. This hypothesis undoubtedly makes us think about the need for managerial decisions to eliminate this "gap" between the subjects of the Russian Federation in order to increase the labor productivity of lagging regions, in the absence of mining, investigate for the other sources of income, optimize and increase them etc.

Calculation of the labor productivity in the Nordic countries showed that all the Northern Europe countries are developing within the framework of quite similar trends. The real gross domestic product and real labor productivity in these regions has not increased significantly over the past 15 years. Moreover, we can state that there is not such a huge difference between the nominal and real gross domestic product as it observed in the Russian regions. This fact shows us how low the inflation is in these countries. In addition, we conclude that the mining industry is significant for the economies of the Nordic countries as well, since the highest labor productivity is observed in Norway, where crude oil and petroleum gas account for the largest share of export revenues. However, the gross domestic product of the Sweden is higher than the oil and gas producing Norway, even if the largest share in the Swedish economy is in the service sector – 71%. Nevertheless, based on our calculations, we come to conclusion that the average labor productivity in the Nordic countries is relatively high – 81.1 dollars per hour, therefore we state that these countries are the world leaders in this indicator and other countries could use their experience in order to improve the performance of the economies.

Thus, we come to conclusion that Russian Federation subjects should increase their labor productivity, implementing managerial decisions to eliminate this "gap" from the labor productivity of the Nordic countries. This could be implemented taking into account the successful experience of the Nordic countries in order to increase the standard of living, gross domestic product and economic growth.

4 Production Function of Russian Federation subjects and Nordic Countries

This chapter includes the econometric analysis of the influence of factors on labor productivity in the Russian Federation regions and Nordic countries. In addition, in this part of the research, we have designed the production function for two Nordic countries (Norway and Finland) and two regions of the Russian Federation (Yamalo-Nenets Autonomous Okrug and Republic of Tatarstan). Then, we have developed the recommendations for improving the labor market management system at the regional level.

4.1 Econometric analysis of the influence of factors on labor productivity in the Russian Federation subjects

This part of the research is an econometric analysis on how labor productivity interacts with other indicators that are not taken into account in its internal analysis.

Methodology

Accordingly, for a comprehensive assessment, it is necessary to conduct a correlation and regression analysis showing the relationship between different indicators. In order to do this, as independent variables (X1 and X2) that could potentially have an impact on the real labor productivity of the regions (Y), the following initial data were taken from the official statistics of the Federal State Statistics Service (Regions of Russia, 2021):

1. Investments in fixed assets, million rubles (X1).
2. Average monthly nominal accrued salary, rubles (X2).

In order to conduct a comparable analysis, investments in fixed assets have been adjusted in accordance with investments in fixed assets physical volume index, and the real investments in fixed assets were calculated. Given data on average monthly nominal accrued salary have been adjusted in accordance with the real monthly accrued salary index and the real average monthly salary was calculated. 2015 was taken as the base year, thus, the prices are constant 2015.

Further, for unification, calculated labor productivity indicators were transformed into Labor Productivity index: the ratio of labor productivity of the region to the average value for all regions. Next, on the correlation chart, the average indicator of the regions for 15 years was presented.

Data for analysis were gathered for the last 15 years, 2006-2020. Tables with the values of the above variables, correlation matrices and regression analysis results are given in the Appendix.

Results

Thus, we have conducted the correlation and regression analysis for each region. In each figure in this paragraph first chart shows the dependence of labor productivity (Y) on investments in fixed assets (X1), second – dependence of labor productivity (Y) on average monthly salary (X2). Results for the Yamalo-Nenets Autonomous Okrug shown in Figure 22.

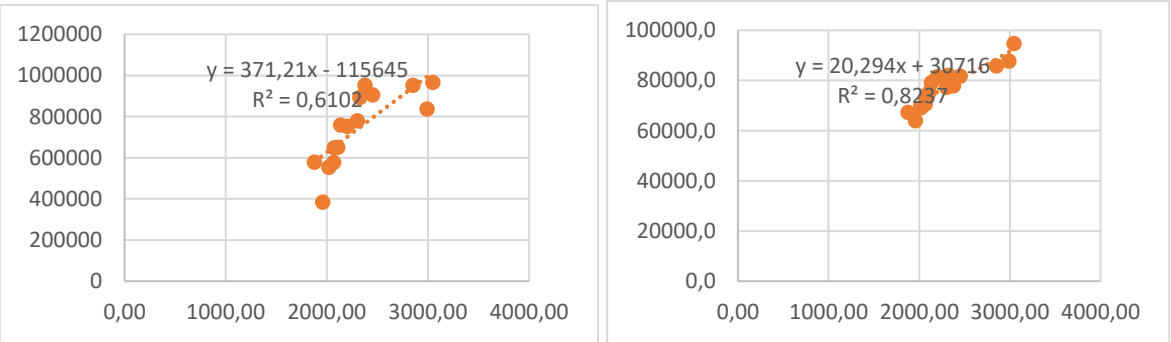

Figure 22. Dependence of labor productivity on investments in fixed assets and average monthly salary in the Yamalo-Nenets Autonomous Okrug

The correlation matrix shows that correlation between Y and X1 is 0.78, according to the Chaddock scale, it means that there is a strong level of correlation between the labor productivity and the investments in fixed assets in the Yamalo-Nenets Autonomous Okrug.

The correlation between Y and X2 is 0.91, thus, we come to conclusion that there is a very strong correlation between the labor productivity and the average monthly salary in the Yamalo-Nenets Autonomous Okrug.

For more accurately determine the relationship between the variables Y and X, it is necessary to evaluate the regression equation obtained, the value of the determination coefficient R-squared, the statistical significance (Student's t-test) and check the overall quality of the model according to the Fisher criterion.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 82.5%, thus, we come to conclusion that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 shows that X1 is statistically insignificant, because t-statistic value is less than the t-critical, and X2 is statistically significant (since t-critical for the selected model is 2.131). Nevertheless, checking the overall quality of the model according to the Fisher criterion shows that the quality of the model is good, because F-statistic value is greater than the F-critical (since F critical is 3.68) (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in the Yamalo-Nenets Autonomous Okrug, the relationship between the labor productivity and the investments in fixed assets is strong. Thus, this region is capital intensive.

Results for the Republic of Tatarstan presented in Figure 23.

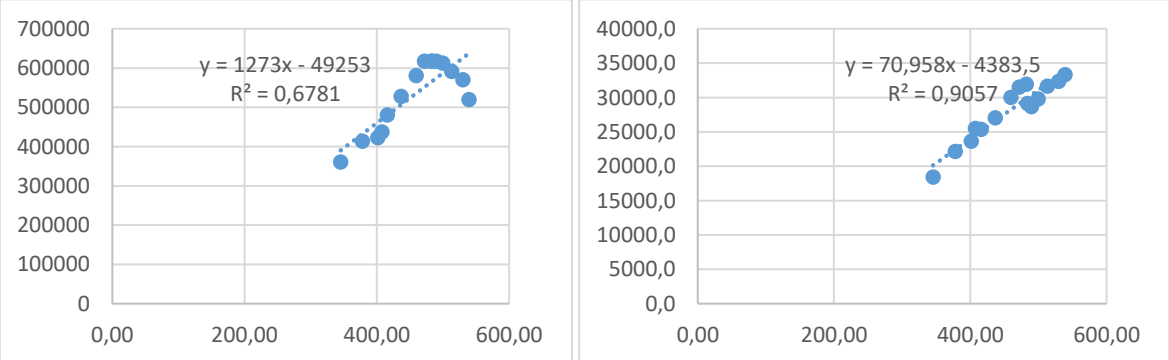

Figure 23. Dependence of labor productivity on investments in fixed assets and average monthly salary in the Republic of Tatarstan

The correlation matrix shows that correlation between Y and X1 is 0.82, according to the Chaddock scale, it means that there is a strong level of correlation between the labor

productivity and the investments in fixed assets in the Republic of Tatarstan. The correlation between Y and X2 is very high, 0.95, consequently, we come to conclusion that there is a very strong correlation between the labor productivity and the average monthly salary in the Republic of Tatarstan.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 90.6%, thus we come to conclusion that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 shows that X1 is statistically insignificant, because t-statistic value is less than the t-critical, and X2 is statistically significant. Nevertheless, checking the overall quality of the model according to the Fisher criterion shows that the quality of the model is good, because F-statistic value is 57.97 (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in the Republic of Tatarstan, the relationship between the labor productivity and the investments in fixed assets is strong. Thus, we conclude that this region is capital intensive.

Results for the Tver Oblast shown in Figure 24.

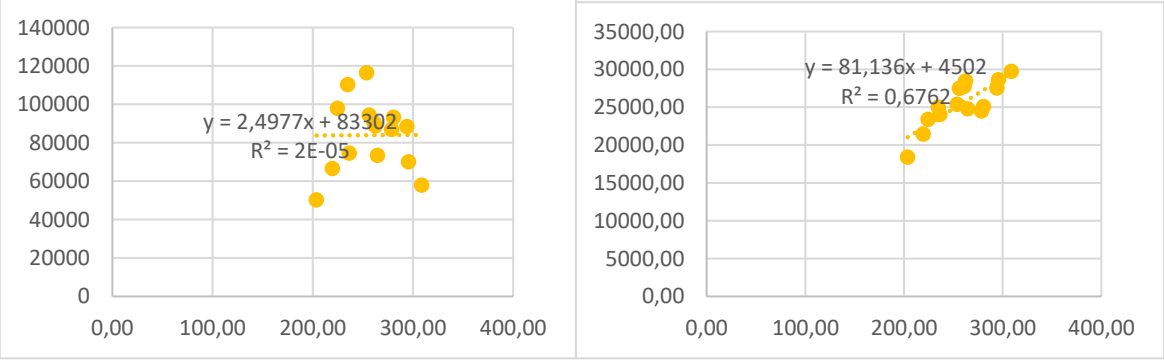

Figure 24. Dependence of labor productivity on investments in fixed assets and average monthly salary in the Tver Oblast

The correlation matrix shows that correlation between Y and X1 is 0.004, according to the Chaddock scale, it means that there is no correlation between the labor productivity and the investments in fixed assets in the Tver Oblast.

The correlation between Y and X2 is 0.82, consequently, we come to conclusion that there is strong correlation between the labor productivity and the average monthly salary in the Tver Oblast.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 71.5%, thus, we come to conclusion that that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 shows that X1 is statistically insignificant, because t-statistic value is less than the t-critical, and X2 is statistically significant. Nevertheless, checking the overall quality of the model according to the Fisher criterion shows that the quality of the model is good, because F-statistic value is 15 (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in the Tver Oblast, there is no dependency of the labor productivity on the investments in fixed assets. Thus, we conclude that this region is labor intensive.

Results for the Oryol Oblast presented in Figure 25.

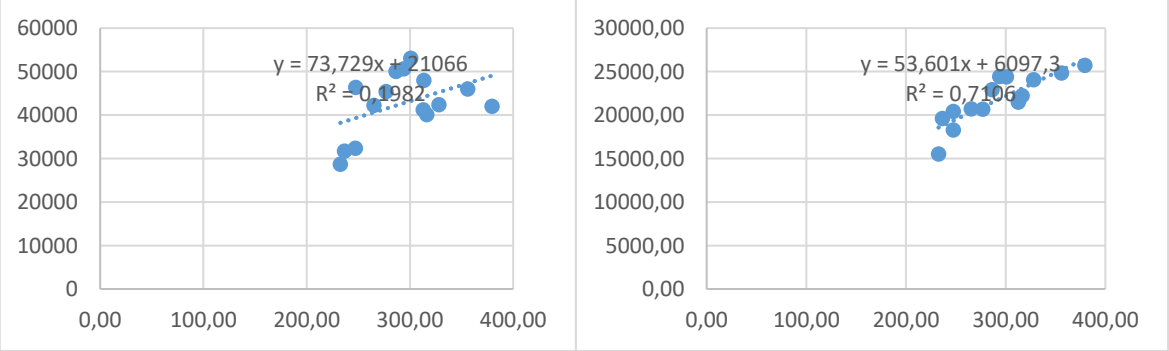

Figure 25. Dependence of labor productivity on investments in fixed assets and average monthly salary in the Oryol Oblast

The correlation matrix shows that correlation between Y and X1 is 0.44, according to the Chaddock scale, it means that there is a weak correlation between the labor productivity and the investments in fixed assets in the Oryol Oblast.

The correlation between Y and X2 is much higher, 0.84, consequently, we conclude that there is a strong correlation between the labor productivity and the average monthly salary in the Oryol Oblast.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 72.1%, thus we come to conclusion that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 shows that X1 is statistically insignificant, because t-statistic value is less than the t-critical, and X2 is statistically significant. Nevertheless, checking the overall quality of the model according to the Fisher criterion shows that the quality of the model is good, because F-statistic value is greater than the F-critical (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in the Oryol Oblast, the relationship between the labor productivity and the average monthly salary is stronger than between the labor productivity and the investments in fixed assets. Thus, this region is labor intensive.

Results for the Karachay-Cherkess Republic shown in Figure 26.

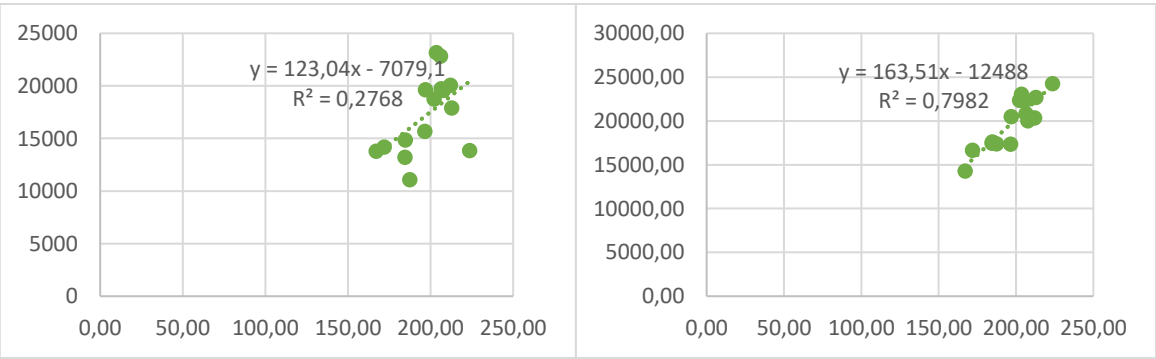

Figure 26. Dependence of labor productivity on investments in fixed assets and average monthly salary in the Karachay-Cherkess Republic

The correlation matrix shows that correlation between Y and X1 is 0.52, according to the Chaddock scale, it means that there is a moderate correlation between the labor productivity and the investments in fixed assets in the Karachay-Cherkess Republic.

The correlation between Y and X2 is much higher, 0.89, consequently, we conclude that there is a strong correlation between the labor productivity and the average monthly salary in the Karachay-Cherkess Republic.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 79.9%, thus we come to conclusion that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 shows that X1 is statistically insignificant, because t-statistic value is less than the t-critical, and X2 is statistically significant. Nevertheless, checking the overall quality of the model according to the Fisher criterion shows that the quality of the model is good, because F-statistic value is greater than the F-critical (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in the Karachay-Cherkess Republic, the relationship between the labor productivity and the average monthly salary is stronger than between the labor productivity and the investments in fixed assets. Thus, this region is labor intensive.

Results for the Republic of North Ossetia presented in Figure 27.

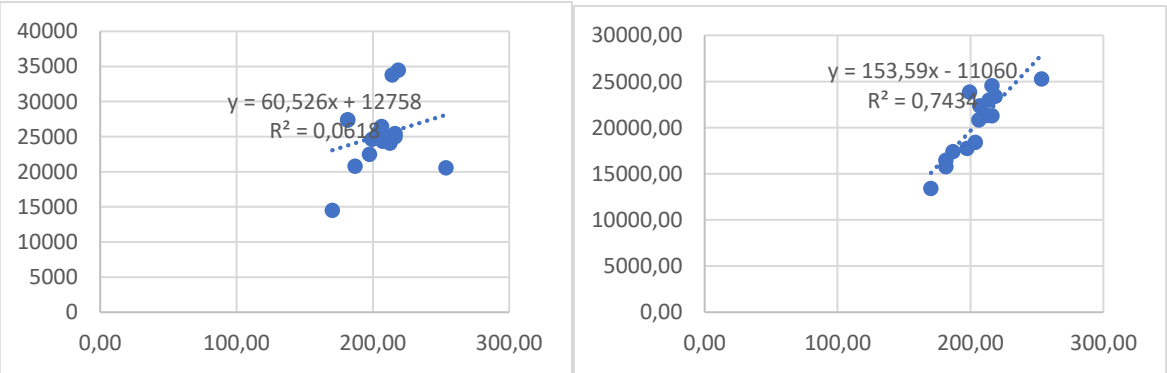

Figure 27. Dependence of labor productivity on investments in fixed assets and average monthly salary in the Republic of North Ossetia – Alania

The correlation matrix shows that correlation between Y and X1 is 0.25, according to the Chaddock scale, it means that there is a negligible correlation between the labor productivity and the investments in fixed assets in the Republic of North Ossetia – Alania.

The correlation between Y and X2 is much higher, 0.86, consequently, we conclude that there is a strong correlation between the labor productivity and the average monthly salary in the Republic of North Ossetia.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 75.4%, thus we come to conclusion that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 shows that X1 is statistically insignificant, because t-statistic value is less than the t-critical, and X2 is statistically significant. Nevertheless, checking the overall quality of the model according to the Fisher criterion shows that the quality of the model is good, because F-statistic value is greater than the F-critical (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in the Republic of North Ossetia – Alania, the relationship between the labor productivity and the average monthly salary is stronger than between the labor productivity and the investments in fixed assets. Thus, we can conclude that this region is labor intensive.

Thus, based on the above, we come to conclusion that there are two capital intensive regions in the Russian Federation: Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan. This may be caused by the fact that these regions are oil and gas producing, therefore, they own significant fixed assets, that ensure high labor productivity indicators in the subjects. Furthermore, there are four labor intensive regions: Tver oblast, Oryol Oblast, Karachay-Cherkess Republic and the Republic of North Ossetia – Alania. Consequently, we come to conclusion that these regions do not own enough fixed assets to ensure the high labor productivity, therefore, the only possible way to increase it is to optimize salaries and wages.

4.2 Econometric analysis of the influence of factors on labor productivity in the Nordic countries

The following initial data were taken from the official statistics of the OECD, in order to design the production function and determine the relationship between the labor productivity (Y) and the capital (X1) and labor (X2) costs (OECD, 2021):

1. Investments in fixed capital, million USD (X1).
2. Average monthly salary, USD (X2).

In order to provide a comparable analysis, we gathered the prices constant 2015 USD. Data for analysis were gathered for the last 15 years, 2006-2020. Tables with the values of the above variables, correlation matrices and regression analysis results are given in the Appendix.

Thus, we have designed the production function for each country. Production function for Denmark shown in Figure 28.

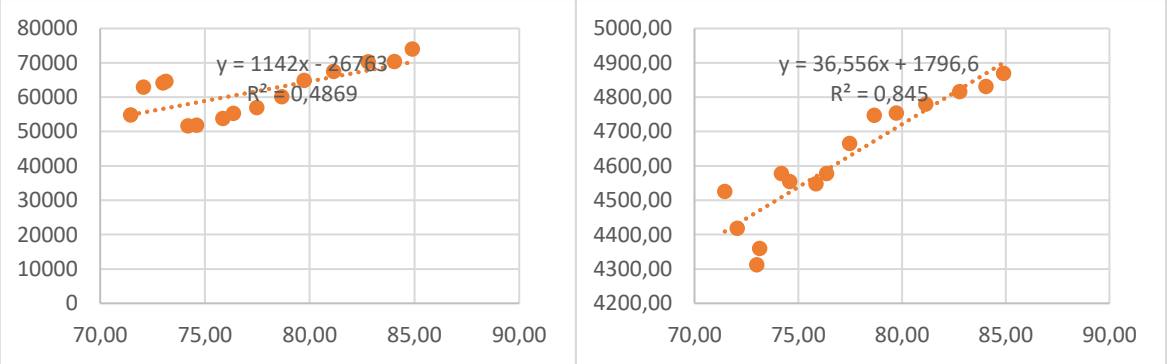

Figure 28. Dependence of labor productivity on investments in fixed assets and average monthly salary in Denmark

The correlation matrix shows that correlation between Y and X1 is 0.69, according to the Chaddock scale, it means that there is a moderate correlation between the labor productivity and the investments in fixed assets in Denmark.

The correlation between Y and X2 is much higher, 0.91, consequently, we conclude that there is a strong correlation between the labor productivity and the average monthly salary in Denmark.

For more accurately determine the relationship between the variables Y and X, it is necessary to evaluate the regression equation obtained, the value of the determination coefficient R-squared, the statistical significance (Student's t-test) and check the overall quality of the model according to the Fisher criterion.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 93.6%, thus we come to conclusion that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 and checking the overall quality of the model according to the Fisher criterion shows that the selected criteria are statistically significant, because t-statistic value is greater than the t-critical, and the quality of the model is good, because F-statistic value is greater than the F-critical (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in Denmark, the relationship between the labor productivity and the average monthly salary is stronger than between the labor productivity and the investments in fixed assets. Thus, we can conclude that this region is labor intensive.

Results for Finland presented in Figure 29.

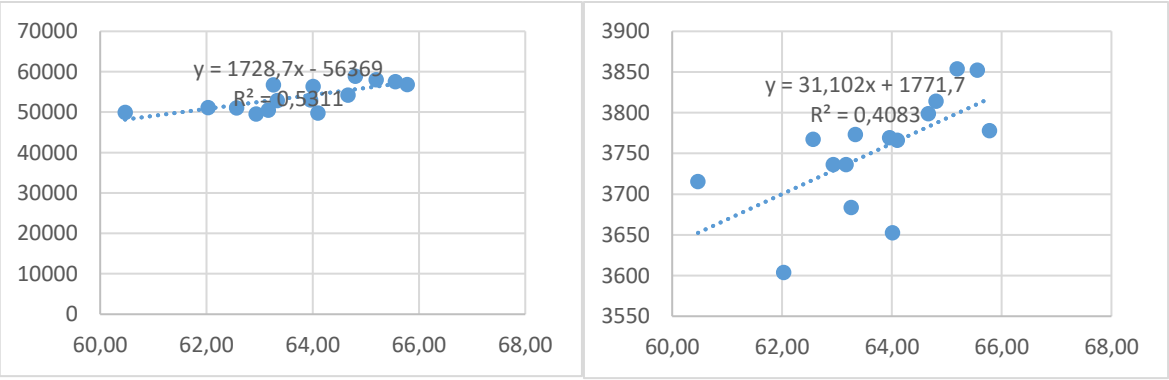

Figure 29. Dependence of labor productivity on investments in fixed assets and average monthly salary in Finland

The correlation matrix shows that correlation between Y and X1 is 0.73, according to the Chaddock scale, it means that there is a strong level of correlation between the labor productivity and the investments in fixed assets in Finland. The correlation between Y and X2 is little lower – 0.63, consequently, we come to conclusion that there is a moderate correlation between the labor productivity and the average monthly salary in Finland.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 67.7%, thus, we come to conclusion that in order to properly evaluate the statistical significance of factors X1 and X2, we have to provide the Student's t-test.

Evaluating the statistical significance of criteria X1 and X2 and checking the overall quality of the model according to the Fisher criterion shows that the selected criteria are statistically significant, because t-statistic value is greater than the t-critical, and the quality of the model is good, because F-statistic value is greater than the F-critical (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in Finland, there is no significant difference between the labor productivity dependency on the investments in fixed assets and the labor productivity dependency on the average monthly salary. Thus, we cannot make any conclusions on either this region capital intensive or labor intensive.

Results for Iceland shown in Figure 30.

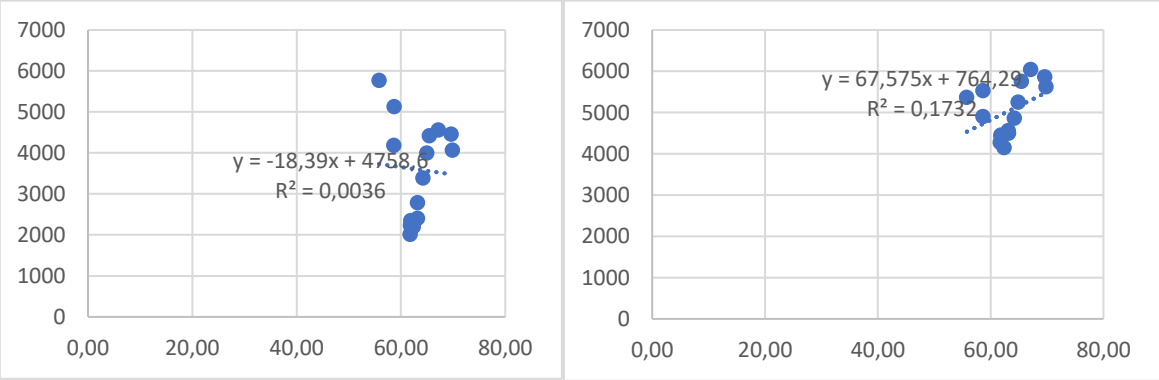

Figure 30. Dependence of labor productivity on investments in fixed assets and average monthly salary in Iceland

The correlation matrix shows that correlation between Y, X1 and X2 is 0.33 and 0.42 respectively, which, according to the Chaddock scale, means that there is a weak correlation between the labor productivity and both the investments in fixed assets and the average monthly salary in Iceland.

Nevertheless, analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain the labor productivity by 82.6%, consequently, we come to conclusion that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 and checking the overall quality of the model according to the Fisher criterion shows that the selected criteria are statistically significant, because t-statistic value is greater than the t-critical, and the quality of the model is good, because F-statistic value is greater than the F-critical (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in Iceland, there is no strong correlation between the labor productivity and both the investments in fixed assets and the average monthly salary. Thus, we cannot make any conclusions on either this region capital intensive or labor intensive.

Results for Norway presented in Figure 31.

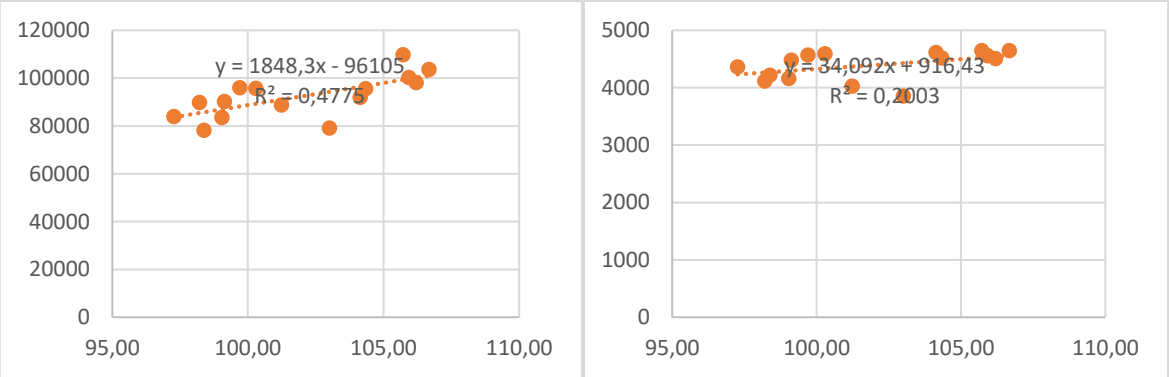

Figure 31. Dependence of labor productivity on investments in fixed assets and average monthly salary in Norway

The correlation matrix shows that correlation between Y and X1 is 0.69, according to the Chaddock scale, it means that there is a moderate correlation between the labor productivity and the investments in fixed assets in Norway.

The correlation between Y and X2 is little lower, 0.45, consequently, we come to conclusion that there is weak correlation between the labor productivity and the average monthly salary in Norway.

However, analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by only 49.9%, thus we come to conclusion that the factors X1 and X2 are not enough, and there are 50.1% of other factors affecting on the labor productivity in Norway. Such factors could be the world oil and gas prices volatility, since the largest share in the export revenues of Norway is energy resources, which amounted to 62%.

Evaluating the statistical significance of criteria X1 and X2 shows that X1 is statistically significant, because t-statistic value is greater than the t-critical, and X2 is statistically insignificant. Nevertheless, checking the overall quality of the model according to the Fisher criterion shows that the quality of the model is good, because F-statistic value is 5.97, which is greater than the F-critical, which is 3.68 (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in Norway, the relationship between the labor productivity and the investments in fixed assets is stronger than between the labor productivity and the average monthly salary. Thus, this region is capital intensive.

Results for Sweden shown in Figure 32.

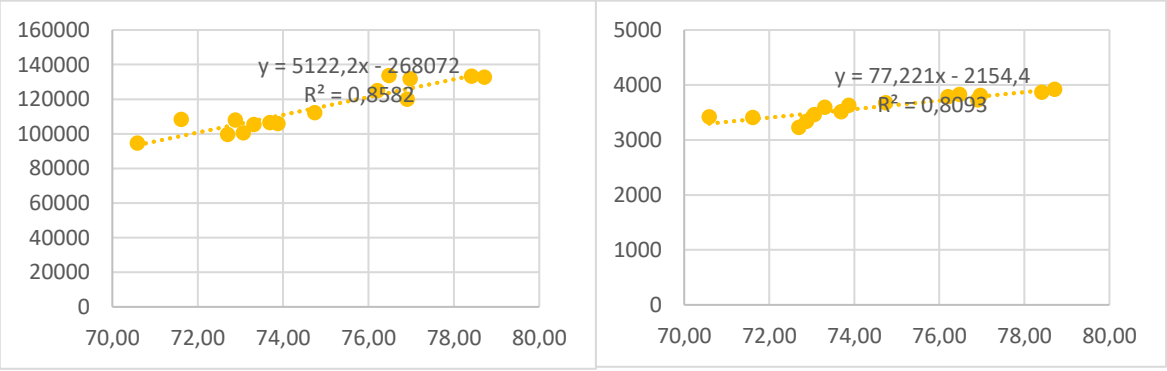

Figure 32. Dependence of labor productivity on investments in fixed assets and average monthly salary in Sweden

The correlation matrix shows that correlation between Y and X1 is 0.92, which, according to the Chaddock scale, means that there is a very strong level of correlation between the labor productivity and the investments in fixed assets in Sweden.

The correlation between Y and X2 is little lower, 0.89, however we come to conclusion that there is a still significant level of correlation between the labor productivity and the average monthly salary in Sweden.

For more accurately determine the relationship between the variables Y and X, it is necessary to evaluate the regression equation obtained, the value of the determination coefficient R-squared, the statistical significance (Student's t-test) and check the overall quality of the model according to the Fisher criterion.

Analyzing the obtained trend lines and R-squared determination coefficients, we can observe that selected factors explain labor productivity by 88.8%, thus we come to conclusion that the factors X1 and X2 are correctly included in the model.

Evaluating the statistical significance of criteria X1 and X2 shows that X1 is statistically significant, because t-statistic value is greater than the t-critical, and X2 is statistically insignificant, since t-statistic value for this factor is 1.78, while the t-critical for the selected model is 2.131. Nevertheless, checking the overall quality of the model according to the Fisher criterion shows that the quality of the model is good, because F-statistic value is 47.54, which is greater than the F-critical, which is 3.68 (see Appendix).

Consequently, based on the conducted correlation and regression analysis, we come to conclusion that in Sweden, there is no significant difference between the labor productivity dependency on the investments in fixed assets and the labor productivity dependency on the average monthly salary. Thus, we cannot make any conclusions on either this region capital intensive or labor intensive.

Thus, based on the above, we come to conclusion that there is only one capital intensive country in the Northern Europe – Norway. Obviously, this is be caused by the fact that the region is crude petroleum and petroleum gas producing, therefore, Norway owns significant fixed assets, that ensure high labor productivity indicators in the country. Moreover, there

are three countries with no significant differentiation between the capital and labor intensity – Finland, Iceland and Sweden, and there is the only one labor intensive region – Denmark.

Moreover, as we can see, in all the Nordic countries (except Iceland) there is a strong correlation between labor productivity and investments in fixed assets, which means that an increase of capital increases the productivity in these countries. In Russian regions such a high dependence is observed only in the leading regions: Yamalo-Nenets AO and the Republic of Tatarstan. All the middle and lagging regions do not have at all or have a low level of capital return on labor productivity.

Consequently, we come to conclusion that the North Europe countries are less differentiated by the capital and labor intensity than the Russian regions, it shows that the economies of these countries developed more proportionally and this ensures the higher labor productivity and other indicators in these countries.

4.3 Production Function of Norway, Finland, Yamalo-Nenets Autonomous Okrug and Republic of Tatarstan

Production Function involves an analysis of the used resources amount and the maximum possible output volume that can be achieved and the relationship between them. This part of the research includes the design of the Cobb-Douglas Production Function for two Nordic countries: Norway and Finland; and two regions of the Russian Federation: Yamalo-Nenets Autonomous Okrug and Republic of Tatarstan.

Methodology

Design of the production function in our research is based on the classical Cobb-Douglas approach, where the gross domestic product of the region equals to the product of capital and labor with special a_0, a_1 and a_2 coefficients:

$$Y = a_0 K^{a_1} L^{a_2} \tag{5}$$

At the first stage, we took the logarithm of both sides in order to conduct a correlation and regression analysis of the dependence of *Y* on *K* and *L* based on this:

$$\ln Y = \ln a_0 + a_1 \ln K + a_2 \ln L \quad (6)$$

Then, using the 'data analysis – regression' function in the MS Excel we found out a_0, a_1 and a_2 coefficients for each region, using which we obtained the production functions.

At the next stage, in order to conduct a practical analysis, we designed isoquants of production functions for each region by GDP 2020 as a constant, based on the following equation:

$$K = \left(\frac{Y}{a_0 L^{a_2}}\right)^{\frac{1}{a_1}} \quad (7)$$

As Capital we gathered the gross fixed capital formation data, as Labor – Average annual number of employed people. Data for analysis were gathered from OECD statistics and Russian Federal State Statistics Service for the last 15 years, 2006-2020. The tables with these indicators presented in the Appendix.

Results

Production function of Norway looks like:

$$Y = 0.085K^{0.340}L^{0.573}$$

The Fischer model quality check shows that this model is designed correctly, since the F-statistical value is 40.5, while the F-critical value is 3.68 (see Appendix).

Isoquant of the production function of Norway shown in Figure 31:

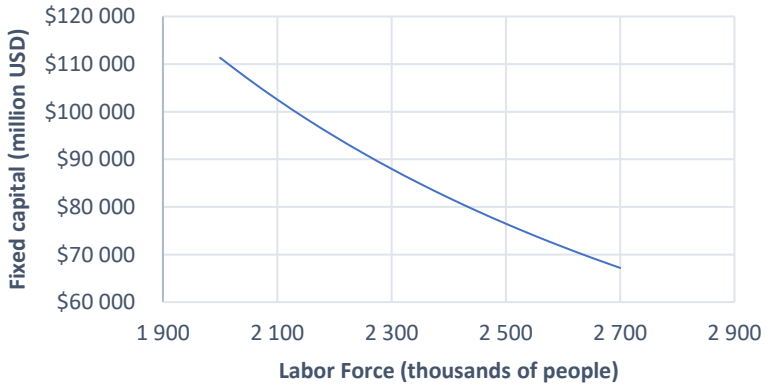

Figure 33. Isoquant of the production function of Norway

As we observed previously, in 2020, the real gross domestic product of Norway amounted to $403.5 billion. Consequently, we can see on the isoquant in what combination is it necessary to spend labor and capital in the country to obtain a GDP volume equal to $403.5 billion.

We have to mention that the isoquant of the production function of Norway is slightly concave and looks almost like a straight line, which means that in Norway, there is a high elasticity of substitution of factors, i.e., one factor can easily be replaced by another.

Production function of Finland shown below:

$$Y = 0.164K^{0.397}L^{0.381}$$

The quality of the model developed by us is very high, since the F-statistical value is 78.8 (see Appendix).

Isoquant of the production function of Finland presented in Figure 32:

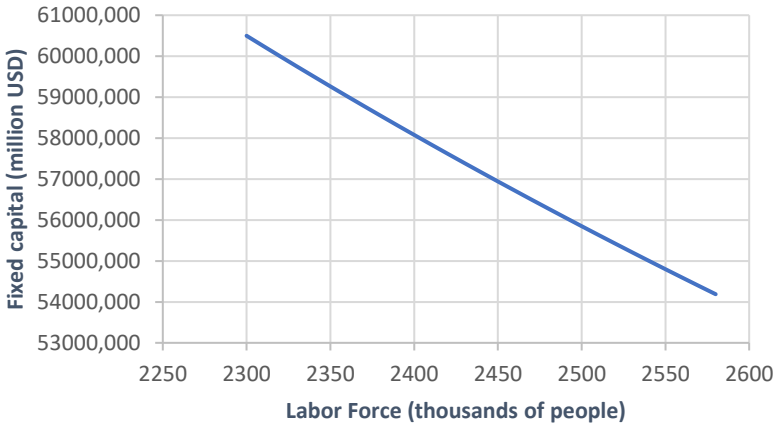

Figure 34. Isoquant of the production function of Finland

In 2020, the real gross domestic product of Finland amounted to $247.6 billion. Thus, we can see on the isoquant in what combination is it necessary to spend labor and capital in the country to obtain a GDP volume equal to $247.6 billion.

We have to mention that the isoquant of the production function of Finland has no concavity and looks like a straight line. Thus, we come to conclusion that in Finland, there is very high

elasticity of substitution of factors, i.e., the probability of replacing one factor with another is significant.

Production function of the Yamalo-Nenets Autonomous Okrug shown below:

$$Y = 0.345^{-8} K^{0.814} L^{2.323}$$

The Fischer model quality check shows that this model is designed correctly, since the F-statistical value is 57.9 (see Appendix).

Isoquant of the production function of the Yamalo-Nenets Autonomous Okrug presented in Figure 33:

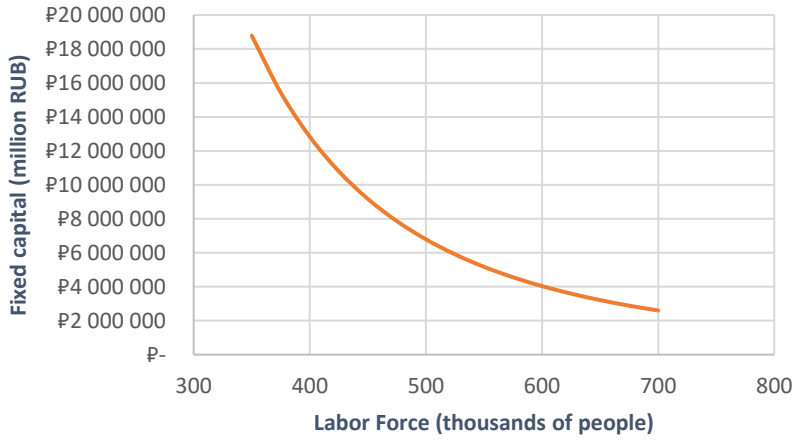

Figure 35. Isoquant of the production function of the Yamalo-Nenets Autonomous Okrug

In 2020, the real gross regional product of the Yamalo-Nenets Autonomous Okrug amounted to 2.382 trillion rubles. Thus, we can see on the isoquant in what combination is it necessary to spend labor and capital in the region to obtain a GDP volume equal to 2.382 trillion rubles.

The key point that we should note that the isoquant of the production function of the Yamalo-Nenets AO is much more concave than in Norway, which means there are low elasticity of substitution of factors in the region, i.e., it is difficult to replace one factor by another.

Production function of the Republic of Tatarstan looks like:

$$Y = 0.346^{-5} K^{0.496} L^{1.651}$$

The Fischer model quality check shows that this model is designed correctly, since the F-statistical value is 20.57 (see Appendix).

Isoquant of the production function of the Republic of Tatarstan shown in Figure 34:

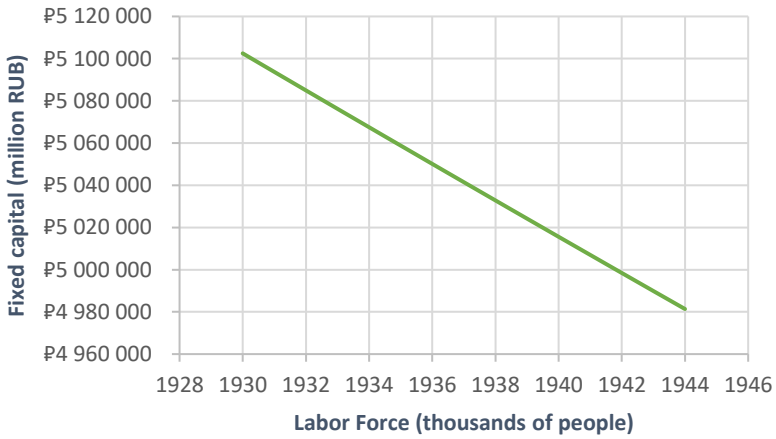

Figure 36. Isoquant of the production function of the Republic of Tatarstan

In 2020, the real gross regional product of the Republic of Tatarstan amounted to 1.96 trillion rubles. Consequently, we can see on the isoquant in what combination is it necessary to spend labor and capital in the republic to obtain a GDP volume equal to 1.96 trillion rubles.

It is interesting that the isoquant of the production function of the Republic of Tatarstan has no concavity and looks like a straight line. Thus, we come to conclusion that in the Republic of Tatarstan, there is very high elasticity of substitution of factors, i.e., the probability of replacing one factor with another is significant.

Thus, based on the above analysis we come to conclusion that in Finland and the Republic of Tatarstan, there are the highest elasticity of substitution of factors, consequently, in these regions one factor can easily be replaced by another. Furthermore, in Norway, this elasticity is lower and the Yamalo-Nenets Autonomous Okrug has the lowest elasticity of substitution of factors, thus, in these regions it is difficult to replace one factor by another.

Production functions designed by us could be used as a theoretical basis in order to determine which factor needs to be increased more, capital or labor, in order to increase the gross domestic product of the regions, etc.

4.4 Improving the labor market management system at the regional level

Based on the analysis presented in the previous paragraphs, we conclude that there are certain problems of labor market in all the Russian Federation subjects.

On the other hand, we come to conclusion that the Nordic countries are the world leaders in the labor productivity. The reasons for such success are:

- High market competition and, as a result, a large number of incentives to increase labor productivity;
- Absence of administrative barriers;
- Continuous implementation of innovative technologies in various industries;
- High level of trust and low transaction costs;
- Highly qualified management of companies, heads of regional and federal authorities, capable, on the one hand, to work with modern technologies, and on the other – to motivate employees;
- Low level of perception of corruption;
- High level of investment.

At the same time, the most important of the above are the high level of social trust, which ensure these "low transaction costs" and the extremely low level of corruption. This fact is confirmed by the Corruption Perception Index for 2021, compiled by the international organization Transparency International: Denmark is in first place, Finland is in third, Sweden is in fourth and Norway is in seventh.

This ensures by the existing principles of the anti-corruption model in the Nordic countries. The essence of this model is to increase the legal culture of citizens from early childhood. Such qualities as intolerance to dishonest, unethical behavior are brought up in children from kindergarten and from school. A society that does not accept any abuses, is not afraid and always publicly reports such, which does not accept those who are able to give or receive bribes – this is the environment in which citizens of the Nordic countries grow up.

In general, in Russia, obviously, one of the most pressing issues is the problem of creating such a modern labor market, which could have the following features: freedom of entrepreneurial activity and high market competition, constant introduction of innovative

technologies in various industries; low transaction costs; high qualification of company management, heads of regional and federal authorities; low the level of perception of corruption, a high level of investment.

Common problems in the development of the labor market of the regions and the Russian Federation are:

1. Low labor productivity. According to the results of our research, in 2020, the average labor productivity in the Nordic countries is 87.7 US dollars per hour, in Russia – 27.3 US dollars per hour. Thus, we come to conclusion, that labor productivity indicators in Russia lag far behind from foreign countries.

2. The general trend of a decrease in the number of employed people. The results of the research showed that in almost all regions, the employed people for 2020 lag behind the indicators of 2006-2012.

3. The lack of adaptation of the labor market to innovation. The labor market in Russia is not mobile enough with regard to the introduction of innovations, various obstacles often arise.

4. The absence or lack of specialists with a high level of qualification, scientific and creative thinking in the field of ‘future professions’ of the ‘Industry 4.0’, i.e., capable of working in new realities with innovative technologies. According to the Atlas of New Professions of the Skolkovo Innovation Center, 186 new professions will appear by 2030 and 57 existing professions will disappear.

5. Low level of capital return on labor productivity. Based on the correlation and regression analysis conducted by us, we compiled the correlation chart, which shown in Figure 35. As we can see, in all the Nordic countries (except Iceland) there is a strong correlation between labor productivity and investments in fixed assets, which means that an increase of capital increases the productivity in these countries.

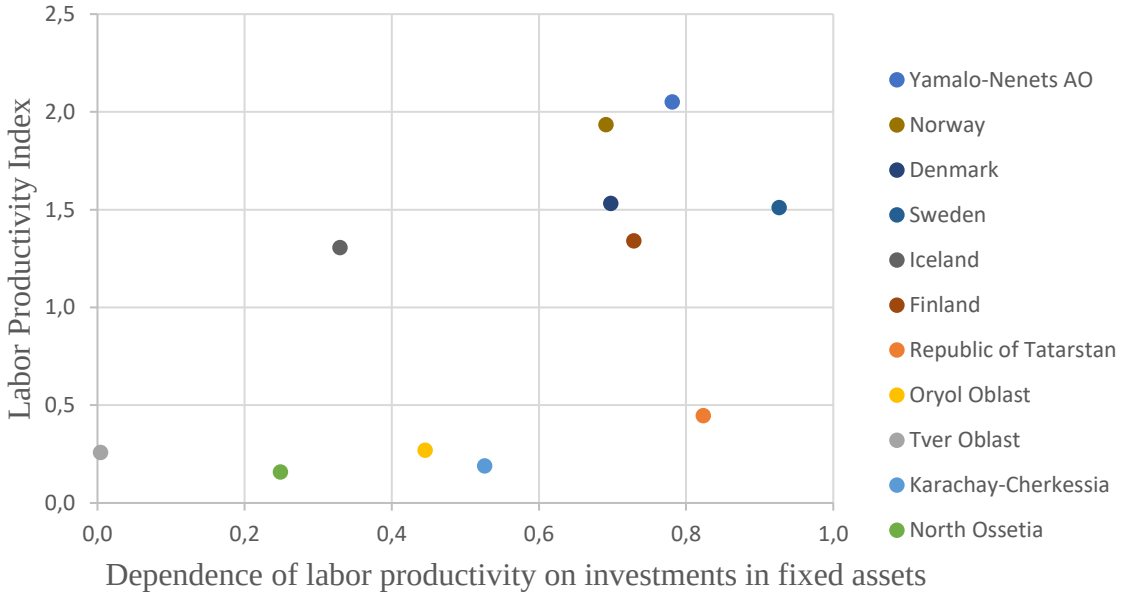

Figure 37. Correlation chart of dependence of Labor Productivity on Capital

In Russian regions such a high dependence is observed only in the leading regions: Yamalo-Nenets AO and the Republic of Tatarstan. All the middle and lagging regions do not have at all or have a low level of capital return on labor productivity.

Thus, we have developed the recommendations for solving the above problems and improving the labor market management system, which are presented in Table 7.

Table 7. Recommendations for the development of the labor market management system in the Russian Federation

Problem	Recommendation
Low labor productivity	1. Diversification of regional economic structures and acceleration of their deindustrialization. It is necessary to significantly expand investments in technological modernization of industry and increase the share of the innovation sector in the economy. 2. Increasing the number of high-tech enterprises with high added value. Now, the regions (including the leaders) mainly export resources, not high value products. 3. Increasing the motivation of the workforce: - Improvement of the remuneration system and elimination of high wage differentiation in budgetary institutions. The regions need to ensure medium-term forecasting of financial and social results and synchronization of the average salary of employees with the growth rate of

	average per capita income in the region (for example, in Tatarstan, per capita incomes are higher than the average in Russia, but average salaries are lower). Now, it is necessary to consider the evaluating of effectiveness of the current system of remuneration of heads of budgetary institutions. Now, the salary of heads of budgetary institutions is often linked to the average salary of employees of these institutions, i.e., the head needs to make every effort to increase the salaries of employees in order to increase his own salary. This is not always justified, since often the increase in wages of employees of such institutions is provided not at the expense of the effective work of the head, but at the expense of additional budget allocations from the federal budget. - Creating an atmosphere of employee involvement in the results of the institutions' activities. In institutions, it is necessary to introduce such a tool as a target job profile, when an employee sees the purpose of his work and knows exactly what he is working for in an institution (not remuneration). 4. Development of financial markets and the offer of cheap loans for real sector enterprises
Reduction in the number of employed people	Development of programs for the involvement in the labor market of persons aged 55-60 years (whose retirement time will be shifted until 2028 in accordance with the pension reform). The share of this population group is increasing (from 24% in 2014 to 25.9% in 2020). Similar programs are being successfully implemented in Israel, Germany, Finland and include the following tools: strengthening financial incentives to continue working (replacing pension payments with unemployment benefits, etc.), reducing costs for employers (anti-discrimination mechanisms for the age of employees in connection with the assessment of labor productivity), etc.
The lack of adaptation of the labor market to innovation Absence/lack of specialists in the field of "future professions" of Industry 4.0	Teaching people new competencies that are in demand for the "professions of the future", specifically: – System thinking; – Intersectoral communication; – Multilingualism and multiculturalism; – Project Management; – Customer orientation; – Lean manufacturing; – Environmental thinking; – Programming/Robotics/Artificial intelligence; – Work in conditions of uncertainty; – Artistic creativity skills. Today, Russia has a large proportion of people employed in professions that will disappear by 2030, therefore, there are risks of reducing the country's competitiveness in the international arena.

Considering the capital and labor return on labor productivity, as a result of the analysis in third chapter we have determined capital- and labor-intensive regions. Consequently, we have developed the specific recommendations for capital-intensive and labor-intensive regions.

Recommendation for capital-intensive regions (Yamalo-Nenets Autonomous Okrug, Republic of Tatarstan) is to increase the investments in fixed assets. Correlation and regression analysis showed that capital investments have the greatest impact on the labor productivity in these regions, therefore it is needed to invest in such more.

Recommendation for labor-intensive regions (Tver Oblast, Oryol Oblast, Karachay-Cherkess Republic, Republic of North Ossetia – Alania) is to increase the average monthly salaries. Correlation and regression analysis showed that labor investments have the greatest impact on the labor productivity in these regions, therefore it is needed to invest in such more.

Furthermore, in order to eliminate the "gap" between the subjects of the Russian Federation identified in the analysis in the second chapter, it is obvious that an effective measure is the reorientation of the economy, i.e., the direction of resources to non-resource industries. Since at the moment a large share of resources is directed to the development of the sphere of mining (oil), which is evident from the indicators of the Yamalo-Nenets Autonomous Okrug, and the rest of the regions (where there are no deposits) are lagging behind, therefore it is necessary to develop the "non-real" sector of the economy (especially in Karachay-Cherkessia and North Ossetia). Thus, it will be possible to increase the productivity of the "forgotten" regions and reduce the gaps between the subjects of the Russian Federation.

Although a new National project "Labor Productivity and employment support" has already been launched in the country, aimed at supporting the basic non-resource sectors of the economy, however, its implementation will not be effective until the Russian labor market meets the modern criteria specified earlier.

Additionally, when solving the above problems in the labor market in Russia, attention should be paid to the current unfavorable demographic situation. To date, the labor market in the Russian Federation requires such improvements that would allow the birth rate to exceed the death rate. A number of such improvements have already been adopted in April

2020 (the appearance of new benefits for the birth of a child, an increase in the size of existing ones, etc.), therefore, in a few years it will be possible to assess the effectiveness of the measures taken.

Thus, the data obtained on the tools for improving the management system for the development of labor potential in the regions of Russia show that: in the middle group of regions and the group of outsider regions, planned work is needed to increase labor productivity and employment of the population;

- increase in the number of workers;
- retraining and advanced training of specialists in the field of "professions of the future" of Industry 4.0;
- improvement of the virtual infrastructure of the regions in the field of employment promotion;
- improving the adaptability of regional labor market management systems to external circumstances.

Effective use of tools to improve the management system for the development of labor potential will contribute to the economic growth of the Russian Federation and increase its competitiveness in the international arena.

5 Conclusions

Currently, labor productivity has a direct impact on the economic well-being of our country. However, to date, the political leadership of Russia directs an insufficient number of resources for the development of the human and labor potential of the country.

In this research, labor market of five Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) and six regions of the Russian Federation (Yamalo-Nenets Autonomous Okrug, Republic of Tatarstan, Tver Region, Oryol Region, Karachay-Cherkess Republic and the Republic of North Ossetia–Alania) were analyzed.

In this research the following aims were completed:

1. Theoretical analysis of strategic labor market management, labor productivity and production function.
2. Evaluation and comparative analysis of labor productivity in Russian regions and Nordic countries.
3. Econometric analysis of the influence of factors on labor productivity in Russian regions in Nordic countries.
4. Designing of production function for Norway, Finland, Yamalo-Nenets Autonomous Okrug and Republic of Tatarstan
5. Development of recommendations for improving the labor market management system at the regional level.

Conducted research in the field of management of the development of the labor market of the regions of the Russian Federation allows us to make the following conclusions:

1. Labor market includes such basic elements as subjects of the labor market, legal norms and socio-economic programs, and the market mechanism itself, showing the relationship between labor supply and demand. Effective labor market management requires the use of instruments of the strategic labor market management, which are strategic analysis, strategic planning, organization of choice and implementation of the strategy and strategic control.

2. Labor productivity is one of the indicators of economic efficiency of production, characterizing the degree of efficiency of labor use in the process of production activity and measured by the ratio of the result of production activity and labor costs.

3. Production function is the relationship between used resources amount (production factors) and the maximum possible output volume that can be achieved provided that all available resources are used in the most rational way. The most common variation of production function is Cobb and Douglas approach, which laid the foundation for economic and mathematical modeling.

4. Today, among the subjects of the Russian Federation, there is a strong preponderance of development towards the leading regions, often mono-economies, the reason for this, in particular, is the excessive raw material orientation of the Russian economy, since at the moment a large share of resources is directed to the development of the sphere of mineral extraction (oil), which is evident from the indicators of the Yamalo–Nenets Autonomous Okrug, and the rest of the regions (where there are no deposits) are lagging behind. In accordance with the conducted labor productivity research, an obvious leader region was identified - the Yamalo–Nenets Autonomous Okrug and outsider regions - the Karachay-Cherkess Republic and the Republic of North Ossetia–Alania. In Northern Europe the obvious leader is Norway.

5. According to all the analyzed indicators, all the Nordic countries are developing within the framework of quite similar trends. Nevertheless, the average labor productivity in the Nordic countries is relatively high – 81.1 dollars per hour, therefore we state that these countries are the world leaders in this indicator.

6. There is a huge difference in the labor productivity between the Nordic countries and the Russian Federation subjects. The average labor productivity of the Nordic countries is two times higher than in the Russian Federation subjects. However, there is the only Russian region, which labor productivity has become very detached from all of the analyzed regions, is the Yamalo-Nenets Autonomous Okrug.

7. There are two capital intensive regions in the Russian Federation: Yamalo-Nenets Autonomous Okrug and the Republic of Tatarstan and four labor intensive regions: Tver Oblast, Oryol Oblast, Karachay-Cherkess Republic and the Republic of North Ossetia.

Consequently. In Northern Europe, there is only one capital intensive country in the Northern Europe – Norway, three countries with no significant differentiation between the capital and labor intensity – Finland, Iceland and Sweden, and there is the only one labor intensive region – Denmark. Consequently, we concluded that the North Europe countries are less differentiated by the capital and labor intensity than the Russian regions, it shows that the economies of these countries developed more proportionally and this ensures the higher labor productivity and other indicators in these countries.

8. Designing of the Cobb and Douglas Production Function showed that in Finland and the Republic of Tatarstan, there are the highest elasticity of substitution of capital and labor factors, consequently, in these regions one factor can easily be replaced by another. Furthermore, in Norway, this elasticity is lower and the Yamalo-Nenets Autonomous Okrug has the lowest elasticity of substitution of factors, thus, in these regions it is difficult to replace one factor by another.

9. In accordance with the provided research, the recommendations for the development of the labor market management system of the regions of the Russian Federation were developed. Moreover, specific recommendations for capital-intensive and labor-intensive regions were developed.

Thus, theoretical contribution of the research is the correlation and regression analysis of dependence of labor productivity on investments and fixed assets and average salaries for chosen regions and designed production function for the Republic of Tatarstan and the Yamalo-Nenets Autonomous Okrug. The first analysis could be used by regional governments in order to determine where to invest more: in fixed assets or average salaries. The production function could be used as a basis for many practical analyses: what increases the gross regional product more effectively: capital or labor, how to change the elasticity of substitution of factors I the region, etc.

The practical contribution of the research is the recommendations for improving the labor market management system at the regional level. These recommendations can be applied in in the labor markets of subjects of the Russian Federation in order to increase labor productivity, assets and GRP of the regions.

Possible limitations of the study are the limited statistical data of the regions, limited information about factors that could have an impact on labor productivity and the gross domestic product of the regions.

In the future, this research could be supplemented by the research of more possible factors that could have an impact on labor productivity and the gross domestic product of the regions; and by designing the production function for all the chosen regions.

References

Aliyev, I.M., Gorelov, N.A., Ilyina, L.O. 2016. Labor economics. Part 1: textbook and workshop for undergraduate and graduate studies [website]. [Accessed 15 March 2022]. Available at: https://cdn1.ozone.ru/multimedia/1015613563.pdf

Cobb, C.W., Douglas, P.H. 1928. A Theory of Production. American Economic Review, [website]. [Accessed 14 April 2022]. Available at: https://www.aeaweb.org/aer/top20/18.1.139-165.pdf

Corruption Perceptions Index. 2021. [website]. [Accessed 10 June 2022]. Available at: https://www.transparency.org/en/cpi/2021/results

Drozdov, O.A., Yakovleva, E.B., Veredyuk, O.V., Bazzhina, V.A., & Mavrina, I.A. 2020. Labor market: textbook and workshop for academic bachelor's degree. [website]. [Accessed 15 March 2022]. Available at: https://elibrary.ru/item.asp?id=42653533

Druzhinin, P., Prokopyev, E. 2018. An Assessment of the Economic Performance of the EU Baltic Region States. Baltic Region. 10. 4-18.

Eckardt, R., Lepak, P. D., Boselie, P. 2018. Integrating strategic human capital and strategic human resource management. The International Journal of Human Resource Management, Vol. 29, No. 1, pp. 34-67.

Felipe, J., McCombie, J. S. L. 2013. The Aggregate Production Function and the Measurement of Technical Change. [website]. [Accessed 14 April 2022]. Available at: https://www.elgaronline.com/view/9781840642551.xml

Gorbunov, V. 2013. Production functions: theory and construction. [website]. [Accessed 14 April 2022]. Available at: https://www.ulsu.ru/media/documents/13.pdf

Gorshenina, E. 2017. Zanyatost i bezrabotitsa. [Employment and Unemployment]. Economic research, No 12, pp. 321-327. [in Rus.]

Hart, R. A. 2022. Labour productivity during the Great Depression and the Great Recession in UK engineering and metal manufacture. Oxford Economic Papers, 74(2), 431-452.

Herzog-Stein, A., Lindner, F., Sturn, S. 2018. The German employment miracle in the Great Recession: The significance and institutional foundations of temporary working-time reductions. Oxford Economic Papers, 70(1), 206-224.

Kadermyatova, R.A. 2015. Labor market: educational and practical manual. [website]. [Accessed 15 March 2022]. Available at: https://biblioclub.ru/index.php?page=book&id=363488

Kang, H. 2022. An analysis of the relationship between energy trilemma and economic growth. Sustainability (Switzerland), 14(7), pp. 1-23.

Karlöf, B., Lövingsson, F. 2005. The A-Z of management concepts and models. [website]. [Accessed 15 March 2022]. Available at: http://www.books24x7.com/marc.asp?bookid=11378

Kashepov, A.V., Sulakshin, S.S., Malchinov, A.S. 2018. Labor market: problems and solutions. [website]. [Accessed 15 March 2022]. Available at: http://labourmarket.ru/books/rynok_truda_kashepov.pdf

Kazimov, K. G. 2017. Regulation of the labor market and employment of the population. [website]. [Accessed 17 April 2022]. Available at: https://biblioclub.ru/index.php?page=book&id=456085

Krutova, O. 2019. Immigrants' Contribution and Share: Multilevel Analysis of Migrant Labor Contribution to Productivity, Welfare and Income in Finland. Economics and Sociology, 12(4), 21-42.

Lema, T. Z., Masresha, S. E., & Neway, M. M. 2022. Analysis of the Technical Efficiency of Barley Production in North Shewa Zone of Amhara Regional State, Ethiopia. Cogent Economics and Finance, 10(1), pp. 1-10.

Leviäkangas, P., Kauppila, O. 2020. Digitalization of Industries: A Comparative Analysis from Australia and Finland. Int. J. Technology, Policy and Management, Vol. 20, No. 1, pp.70–89.

Markhaichuk, M. M., Panshin, I. V., Chernov, V. G. 2022. Impact of Budget Investment on Labor Productivity in Resource Models of Intellectual Capital (on the Example of Russian Regions). Montenegrin Journal of Economics, 18(2), 191-202.

Mikheeva, N. N. 2016. Comparative Analysis of Labor Productivity in Russian Regions. Regional Research of Russia. 6, 105–114.

Nagaeva, O.S., Popodko, G.I. 2019. Comparative Analysis of Labor Productivity in the Resource and Non-resource Regions of Russia. Russian Journal of Labor Economics, Vol. 6, No. 4, pp. 1229-1315.

Official statistics of Organization for Economic Co-operation and Development. [online database]. [Accessed 27 May 2022]. Available at: https://stats.oecd.org

Official website of the Federal State Statistics Service. [online database]. [Accessed 20 April 2022]. Available at: http://www.gks.ru

Phale, K., Fanglin, L., Mensah, I. A., Omari-Sasu, A. Y., & Musah, M. 2021. Knowledge-based Economy Capacity Building for Developing Countries: A panel Analysis in Southern African Development Community. Sustainability (Switzerland), 13(5), 1-29.

Randolph, T. H., Ralph, D. E. 2017. Construction Site Management and Labor Productivity Improvement. [website]. [Accessed 20 March 2022]. Available at: https://doi.org/10.1061/9780784414651

Regions of Russia. Socio-economic indicators. 2021. [online database]. [Accessed 10 June 2022]. Available at: https://rosstat.gov.ru/storage/mediabank/Region_Pokaz_2021.pdf

Schmidt, J. A., Willness, C. R., Jones, D. A., & Bourdage, J. S. 2018. Human resource management practices and voluntary turnover: A study of internal workforce and external labor market contingencies. International Journal of Human Resource Management, 29(3), 571-594.

Simerson, B. K. 2011. Strategic Planning: A Practical Guide to Strategy Formulation and Execution. [website]. [Accessed 18 March 2022]. Available at: http://publisher.abc-clio.com/9780313384813

Sink, D.S. 1985. Productivity Management: Planning, Evaluation, Control, and Improvement. Wiley. [website]. [Accessed 20 March 2022]. Available at: https://books.google.ru/books?id=VQtPAAAAMAAJ

Statistics Denmark. [online database]. [Accessed 26 May 2022]. Available at: https://www.dst.dk/en

Statistics Finland. [online database]. [Accessed 26 May 2022]. Available at: https://www.stat.fi/en

Statistics Iceland. [online database]. [Accessed 26 May 2022]. Available at: https://www.statice.is

Statistics Norway. [online database]. [Accessed 26 May 2022]. Available at: https://www.ssb.no/en

Statistics Sweden. [online database]. [Accessed 26 May 2022]. Available at: https://scb.se/en

Stundziene, A., Baliute, A. 2022. Personnel Costs and Labour Productivity: The Case of European Manufacturing Industry. Economies, 10(2), pp. 1-17

Varvařovská, V., Staňková, M. 2021. Does the Involvement of "Green Energy" increase the Productivity of Companies in the Production of the Electricity Sector? European Journal of Business Science and Technology, 7(2), 152-164.

World Bank Open Data [online database]. [Accessed 26 May 2022]. Available at: https://data.worldbank.org

Zanoni, A.B. 2011. Strategic Analysis: Processes and Tools. [website]. [Accessed 18 March 2022]. Available at: https://books.google.fi/books?id=w3qpAgAAQBAJ&printsec=copyright&redir_esc=y#v=onepage&q&f=false

Appendices

APPENDIX 1**.** Average annual number of employed people (thousands of people)

Region	Denmark	Finland	Iceland	Norway	Sweden	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	2746,7	2327,0	169,8	2354,0	4120,1	375,2	1932,9	705,3	360,2	172,7	298,4
2007	2810,8	2379,0	177,5	2446,4	4216,4	376,5	1953,0	704,3	358,8	174,0	296,9
2008	2844,1	2432,0	179,3	2525,0	4245,7	387,2	1952,6	703,5	356,1	174,8	298,4
2009	2752,2	2370,0	164,6	2497,0	4157,1	388,4	1939,0	685,5	346,6	178,7	300,5
2010	2691,2	2356,0	162,5	2517,0	4183,6	387,7	1949,3	676,8	342,5	179,1	301,7
2011	2683,9	2374,0	164,3	2562,0	4280,6	389,8	1959,4	661,1	346,1	179,4	300,4
2012	2671,5	2379,0	167,4	2589,0	4312,2	392,6	1961,5	653,8	347,0	178,6	300,9
2013	2673,5	2376,0	171,3	2619,0	4353,9	396,1	1957,1	645,8	344,7	177,5	300,7
2014	2699,9	2379,0	175,5	2650,0	4414,8	395,4	1951,1	640,3	340,6	175,7	298,3
2015	2734,3	2353,0	180,5	2597,1	4480,1	393,8	1950,3	630,1	335,9	173,3	294,7
2016	2775,8	2398,0	188,7	2613,7	4577,4	403,0	1951,2	608,5	330,2	171,7	287,2
2017	2820,1	2442,0	196,7	2647,3	4686,3	420,5	1945,1	610,0	321,1	169,2	289,7
2018	2866,8	2512,0	202,6	2683,4	4808,4	417,7	1944,3	605,0	314,5	174,7	297,9
2019	2903,2	2539,0	202,4	2710,4	4829,2	423,0	1941,3	593,5	298,7	168,4	273,1
2020	2876,1	2467,0	192,8	2681,5	4760,8	417,2	1938,8	576,0	293,8	161,8	248,7

APPENDIX 2**.** Nominal GRP of Russian regions (billion RUB)

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	546,3658	605,9115	127,3638	64,8016	23,2601	43,3412
2007	594,6786	757,4014	156,0346	77,1012	27,4697	52,8048
2008	719,3970	926,0567	192,2830	96,6699	35,7142	57,7074
2009	649,6400	885,0640	197,6870	90,6236	38,5841	64,0814
2010	782,2149	1001,6228	219,0049	106,1967	43,6515	75,3274
2011	966,1104	1305,9470	255,0730	131,1982	49,2521	85,8767
2012	1191,2719	1437,0010	268,0639	146,1032	58,7121	97,4488
2013	1375,8788	1551,4721	298,6692	164,7970	66,1066	118,6375
2014	1633,3822	1661,4138	316,6132	178,8225	65,3266	125,9605
2015	1791,8256	1867,2587	329,6160	208,2379	67,4827	126,0512
2016	1963,8705	1937,6371	359,3451	213,9240	73,1513	125,4983
2017	2378,3455	2132,0616	380,3509	216,2967	77,1055	128,6324
2018	2954,7730	2469,2121	425,9147	231,2585	79,8746	135,8568
2019	3058,5852	2644,3026	441,5584	249,5549	85,1774	146,2862
2020	2680,3454	2479,6987	443,7826	266,2269	89,9623	156,9653

Nominal GDP of Nordic countries (billion USD)

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	282,885	217,089	17,465	345,581	423,093
2007	319,423	256,378	21,653	400,937	491,253
2008	353,361	285,716	18,075	462,250	517,706
2009	321,241	253,498	13,154	386,190	436,537
2010	321,995	249,424	13,751	428,757	495,813
2011	344,003	275,604	15,222	498,283	574,094
2012	327,149	258,290	14,752	509,506	552,484
2013	343,584	271,362	16,125	522,762	586,842
2014	352,994	274,863	17,868	498,410	581,964
2015	302,673	234,534	17,517	385,802	505,104
2016	313,116	240,771	20,793	368,827	515,655
2017	332,121	255,648	24,728	398,394	541,019
2018	356,841	275,715	26,267	437,000	555,455
2019	347,561	268,508	24,858	404,941	533,880
2020	356,085	269,595	21,718	362,198	541,220

APPENDIX 3**.** Real GRP of Russian regions (constant 2015 billion RUB)

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	1467,7713	1333,2960	286,9906	167,4101	57,6576	101,5209
2007	1519,1433	1475,9587	309,0888	177,4547	59,7910	107,7137
2008	1602,6962	1589,6075	331,9614	188,6344	64,4546	108,1446
2009	1439,2212	1535,5609	303,7447	161,8483	65,0992	110,8482
2010	1584,5825	1601,5900	314,0720	167,3511	66,3361	117,7208
2011	1627,3662	1692,8806	331,9741	189,6088	69,7856	121,1347
2012	1663,1683	1785,9891	331,9741	197,0036	73,0655	123,0728
2013	1728,0318	1828,8528	335,2939	200,5496	72,4079	127,5035
2014	1826,5297	1867,2587	331,6056	203,3573	70,9597	129,4160
2015	1791,8256	1867,2587	329,6160	208,2379	67,4827	126,0512
2016	1892,1678	1885,9313	334,5602	203,8649	70,3845	120,5049
2017	2041,6491	1923,6499	338,5750	201,0108	71,0179	118,6974
2018	2347,8965	1965,9702	350,4251	203,2219	69,5976	117,0356
2019	2486,4223	2021,0174	344,8183	208,9121	70,4327	116,0993
2020	2381,9926	1958,3658	333,0945	208,9121	67,8267	118,1891

Real GDP of Nordic countries (constant 2015 billion USD)

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	291,913	232,106	15,411	345,774	434,637
2007	294,567	244,406	16,714	356,127	449,585
2008	293,059	246,322	17,084	357,823	447,559
2009	278,680	226,433	15,774	351,644	428,136
2010	283,894	233,647	15,328	354,112	453,619
2011	287,689	239,599	15,610	357,587	468,114
2012	288,341	236,251	15,777	367,253	465,360
2013	291,032	234,121	16,495	371,051	470,887
2014	295,745	233,266	16,773	378,359	483,402
2015	302,673	234,534	17,517	385,802	505,104
2016	312,498	241,128	18,621	389,936	515,562
2017	321,316	248,826	19,403	398,995	528,802
2018	327,708	251,667	20,352	403,459	539,113
2019	334,638	254,740	20,847	406,468	549,821
2020	327,738	247,607	19,491	403,553	533,612

APPENDIX 4**.** Annual hours worked per employed

Country	Denmark	Finland	Iceland	Norway	Sweden	Russia
2006	1456	1608	1627	1426	1451	1998
2007	1433	1605	1605	1438	1463	1999
2008	1430	1601	1625	1443	1472	1997
2009	1417	1580	1536	1422	1459	1974
2010	1422	1585	1528	1430	1484	1976
2011	1437	1578	1538	1435	1484	1979
2012	1423	1568	1523	1431	1472	1982
2013	1426	1560	1524	1421	1464	1980
2014	1414	1558	1513	1424	1465	1985
2015	1407	1555	1511	1427	1466	1978
2016	1412	1555	1520	1430	1478	1974
2017	1404	1549	1507	1419	1466	1979
2018	1381	1546	1496	1419	1466	1970
2019	1371	1539	1480	1419	1452	1965
2020	1342	1531	1447	1411	1424	1874

APPENDIX 5. Nominal Labor Productivity in Russian regions (RUB/h)

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	728,83	156,89	90,38	90,04	67,41	72,70
2007	790,14	194,00	110,83	107,50	78,98	88,97
2008	930,37	237,49	136,87	135,94	102,31	96,84
2009	847,32	231,23	146,09	132,45	109,38	108,03
2010	1021,04	260,04	163,76	156,91	123,34	126,35
2011	1252,39	336,79	194,96	191,55	138,73	144,45
2012	1530,94	369,63	206,87	212,44	165,86	163,40
2013	1754,33	400,37	233,58	241,46	188,10	199,26
2014	2081,09	428,98	249,11	264,49	187,31	212,73
2015	2300,35	484,04	264,47	313,42	196,86	216,24
2016	2468,66	503,06	299,16	328,20	215,83	221,36
2017	2858,01	553,88	315,07	340,38	230,27	224,37
2018	3590,82	644,66	357,36	373,26	232,09	231,50
2019	3679,74	691,44	377,66	424,10	256,75	271,90
2020	3428,28	649,23	391,09	459,97	282,24	320,38

Nominal Labor Productivity in Nordic countries (USD/h)

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	70,74	58,02	63,22	102,95	70,77
2007	79,30	67,14	76,00	113,97	79,64
2008	86,88	73,38	62,03	126,87	82,84
2009	82,37	67,70	52,03	108,76	71,97
2010	84,14	66,79	55,38	119,12	79,86
2011	89,20	73,57	60,28	135,53	90,37
2012	86,06	69,24	57,86	137,52	87,04
2013	90,15	73,21	61,76	140,46	92,07
2014	92,48	74,16	67,27	132,11	89,98
2015	78,67	64,10	64,21	104,13	76,91
2016	79,89	64,57	72,49	98,69	76,22
2017	83,87	67,58	83,42	106,04	78,75
2018	90,14	71,00	86,64	114,73	78,80
2019	87,29	68,72	82,97	105,32	76,14
2020	92,23	71,38	77,84	95,74	79,83

APPENDIX 6**.** Real Labor Productivity in Russian regions (constant 2015 RUB/h)

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	1957,94	345,24	203,66	232,62	167,10	170,28
2007	2018,46	378,06	219,54	247,41	171,90	181,49
2008	2072,71	407,66	236,29	265,26	184,64	181,48
2009	1877,16	401,18	224,47	236,56	184,55	186,87
2010	2068,39	415,80	234,85	247,28	187,44	197,47
2011	2109,59	436,57	253,74	276,83	196,56	203,76
2012	2137,38	459,40	256,19	286,44	206,41	206,37
2013	2203,34	471,95	262,22	293,84	206,03	214,15
2014	2327,18	482,13	260,90	300,78	203,46	218,56
2015	2300,35	484,04	264,47	313,42	196,86	216,24
2016	2378,52	489,64	278,53	312,77	207,66	212,56
2017	2453,41	499,73	280,47	316,32	212,09	207,04
2018	2853,31	513,27	294,02	328,01	202,23	199,43
2019	2991,38	529,80	295,67	355,93	212,85	216,34
2020	3046,68	539,00	308,59	379,44	223,69	253,59

Real Labor Productivity in Nordic countries (constant 2015 USD/h)

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	72,99	62,03	55,78	103,00	72,70
2007	73,13	64,01	58,67	101,23	72,88
2008	72,06	63,26	58,63	98,21	71,61
2009	71,46	60,47	62,39	99,03	70,59
2010	74,18	62,57	61,73	98,38	73,06
2011	74,59	63,96	61,82	97,26	73,69
2012	75,85	63,33	61,88	99,13	73,31
2013	76,36	63,16	63,18	99,70	73,88
2014	77,48	62,93	63,15	100,29	74,74
2015	78,67	64,10	64,21	104,13	76,91
2016	79,73	64,66	64,92	104,34	76,21
2017	81,14	65,78	65,45	106,20	76,97
2018	82,78	64,80	67,13	105,92	76,48
2019	84,04	65,19	69,59	105,72	78,41
2020	84,89	65,56	69,86	106,67	78,71

APPENDIX 7**.** Labor Productivity in Russian regions (USD/h, PPP)

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	49,91	10,74	6,19	6,17	4,62	3,40
2007	51,92	12,75	7,28	7,06	5,19	3,93
2008	56,30	14,37	8,28	8,23	6,19	4,09
2009	45,15	12,32	7,78	7,06	5,83	4,77
2010	52,22	13,30	8,38	8,03	6,31	5,40
2011	67,96	18,28	10,58	10,39	7,53	6,00
2012	79,19	19,12	10,70	10,99	8,58	6,60
2013	105,02	23,97	13,98	14,45	11,26	7,89
2014	108,03	22,27	12,93	13,73	9,72	8,40
2015	123,81	26,05	14,23	16,87	10,60	8,77
2016	106,76	21,76	12,94	14,19	9,33	8,95
2017	112,12	21,73	12,36	13,35	9,03	8,93
2018	145,84	26,18	14,51	15,16	9,43	8,94
2019	157,95	29,68	16,21	18,20	11,02	10,18
2020	143,99	27,27	16,43	19,32	11,85	11,57

Labor Productivity in Nordic countries (USD/h, PPP)

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	49,00	45,79	43,65	73,87	53,41
2007	51,05	49,50	45,34	73,55	56,53
2008	53,81	51,66	47,63	79,36	57,96
2009	55,07	51,12	52,73	73,46	57,55
2010	60,17	52,84	50,95	77,61	59,44
2011	61,77	55,13	51,69	82,79	61,84
2012	63,62	55,21	52,84	86,72	63,49
2013	66,53	57,03	55,07	89,58	65,00
2014	68,52	57,96	56,70	88,06	65,92
2015	70,02	59,34	59,66	81,02	68,27
2016	73,30	62,64	62,55	79,41	69,15
2017	77,84	66,03	64,45	86,67	71,04
2018	81,40	67,36	66,56	93,57	72,87
2019	82,88	67,51	70,16	88,80	75,37
2020	87,75	70,12	70,42	85,55	79,06

APPENDIX 8**.** Average monthly nominal salary in Russian regions (RUB)

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	32336	8850	8040	6774	5871	5918
2007	37364	11469	10177	8611	7558	7626
2008	44169	14904	13065	11152	9384	9151
2009	46481	15207	14161	11854	10477	10832
2010	52619	17350	16155	13174	11346	11818
2011	59095	20009	17747	14529	12447	13376
2012	63696	23234	20246	16888	15511	15897
2013	69192	26035	22450	19273	17858	18664
2014	74489	28294	23866	20885	19746	20311
2015	77272	29147	24804	21772	20511	21267
2016	83238	30224	26193	23127	21546	22806
2017	89938	32324	27612	24811	22638	24715
2018	97204	35172	31049	27476	25430	26958
2019	101012	37418	33524	29683	26955	28751
2020	111216	39761	36077	31862	29865	30479

Labor Productivity to Salary Index in Russian regions

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	3,75	2,95	1,87	2,21	1,91	2,05
2007	3,52	2,82	1,81	2,08	1,74	1,94
2008	3,51	2,65	1,74	2,03	1,81	1,76
2009	3,00	2,50	1,70	1,84	1,72	1,64
2010	3,20	2,47	1,67	1,96	1,79	1,76
2011	3,50	2,78	1,81	2,17	1,84	1,78
2012	3,97	2,63	1,69	2,08	1,77	1,70
2013	4,18	2,54	1,72	2,07	1,74	1,76
2014	4,62	2,51	1,73	2,09	1,57	1,73
2015	4,91	2,74	1,76	2,37	1,58	1,68
2016	4,88	2,74	1,88	2,33	1,65	1,60
2017	5,24	2,83	1,88	2,26	1,68	1,50
2018	6,06	3,01	1,89	2,23	1,50	1,41
2019	5,97	3,03	1,84	2,34	1,56	1,55
2020	4,81	2,55	1,69	2,25	1,48	1,64

APPENDIX 9. Average monthly constant salary Nordic countries (USD)

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	4312,10	3603,88	5368,65	3854,56	3225,10
2007	4359,10	3652,61	5529,21	4027,90	3337,84
2008	4418,10	3683,69	4902,43	4117,03	3405,07
2009	4525,22	3715,53	4148,06	4159,89	3418,08
2010	4577,36	3767,59	4269,53	4215,47	3461,16
2011	4553,65	3769,45	4454,37	4362,23	3513,40
2012	4547,51	3773,35	4428,07	4481,39	3589,99
2013	4577,08	3736,37	4497,13	4571,05	3629,35
2014	4664,66	3736,45	4561,33	4593,38	3672,17
2015	4746,65	3766,18	4864,71	4616,99	3726,59
2016	4753,62	3799,03	5245,75	4518,68	3785,25
2017	4779,59	3778,23	5754,22	4509,76	3806,71
2018	4816,18	3814,24	6038,81	4557,55	3826,38
2019	4830,61	3854,05	5865,93	4646,08	3868,16
2020	4869,14	3852,46	5624,00	4648,32	3918,37

Labor Productivity to Salary Index in Nordic countries

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	2,05	2,31	1,41	3,18	2,73
2007	2,00	2,34	1,42	3,01	2,66
2008	1,94	2,29	1,62	2,87	2,58
2009	1,86	2,14	1,93	2,82	2,51
2010	1,92	2,19	1,84	2,78	2,61
2011	1,96	2,23	1,78	2,67	2,59
2012	1,98	2,19	1,77	2,64	2,51
2013	1,98	2,20	1,78	2,58	2,48
2014	1,96	2,19	1,75	2,59	2,48
2015	1,94	2,21	1,66	2,68	2,52
2016	1,97	2,21	1,57	2,75	2,48
2017	1,99	2,25	1,43	2,79	2,47
2018	1,98	2,19	1,39	2,75	2,44
2019	1,99	2,17	1,46	2,69	2,45
2020	1,95	2,17	1,50	2,70	2,38

APPENDIX 10**.** Real investments in fixed assets in Russian regions (constant 2015 million RUB)

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	384142	360597	50149	28688	13804	14504
2007	552780	413605	66598	46361	14204	27369
2008	647858	437181	74589	42234	14871	27424
2009	577890	422754	97936	31718	13206	20787
2010	576734	480248	110178	32321	11093	22492
2011	649402	527793	116348	45411	15685	25483
2012	757853	581100	94358	49997	19732	26477
2013	752548	617128	88697	50597	22850	33785
2014	891769	617128	90470	53076	23170	34495
2015	779406	617128	73462	47981	19648	25457
2016	951655	617128	86832	41168	19589	24082
2017	905024	612808	93258	40056	20059	24371
2018	952085	591360	88408	42339	18755	24615
2019	836883	570071	70019	45938	17911	24984
2020	965763	519335	57906	41988	13863	20587

Real investments in fixed capital in Nordic countries (constant 2015 million USD)

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	64094	51144	5764	79120	99605
2007	64536	56411	5130	88814	107852
2008	62925	56768	4183	89817	108273
2009	54765	49939	2198	83516	94559
2010	51618	51090	2013	78153	100458
2011	51819	53075	2233	83976	106437
2012	53753	52924	2348	90310	105290
2013	55222	50485	2400	96031	105855
2014	56940	49560	2788	95789	112236
2015	60083	49792	3387	91953	119980
2016	64833	54265	3996	95579	124828
2017	67433	56848	4418	98097	131751
2018	70243	58892	4555	100279	133603
2019	70318	58019	4458	109819	133153
2020	73928	57544	4069	103623	132725

APPENDIX 11. Real average monthly salary in Russian regions (constant 2015 RUB)

Region	Yamalo-Nenets AO	Republic of Tatarstan	Tver Oblast	Oryol Oblast	Karachay-Cherkessia	North Ossetia
2006	64022	18446	18414	15529	14283	13397
2007	69080	22154	21470	18262	16669	15768
2008	72534	25499	24025	20691	17619	16462
2009	67239	23663	23401	19615	17460	17400
2010	70668	25343	24992	20399	17408	17748
2011	75403	27041	25392	20665	17373	18405
2012	79173	30043	27525	22917	20813	20816
2013	81627	31515	28488	24430	22353	22960
2014	82117	31924	27776	24381	23046	23396
2015	77272	29147	24804	21772	20511	21267
2016	77890	28652	24506	21467	20039	21310
2017	81707	29798	25095	22219	20340	22354
2018	85792	31645	27554	24040	22374	23851
2019	87680	32341	28628	24810	22687	24543
2020	94694	33344	29745	25728	24275	25279

Real average monthly salary in Nordic countries (constant 2015 million USD)

Country	Denmark	Finland	Iceland	Norway	Sweden
2006	64094	51144	5764	79120	99605
2007	64536	56411	5130	88814	107852
2008	62925	56768	4183	89817	108273
2009	54765	49939	2198	83516	94559
2010	51618	51090	2013	78153	100458
2011	51819	53075	2233	83976	106437
2012	53753	52924	2348	90310	105290
2013	55222	50485	2400	96031	105855
2014	56940	49560	2788	95789	112236
2015	60083	49792	3387	91953	119980
2016	64833	54265	3996	95579	124828
2017	67433	56848	4418	98097	131751
2018	70243	58892	4555	100279	133603
2019	70318	58019	4458	109819	133153
2020	73928	57544	4069	103623	132725

APPENDIX 12. Correlation and regression analysis of the Yamalo-Nenets AO

Yamalo-Nenets AO			
	LP (Y)	**K (X1)**	**L (X2)**
2006	1957,94	384142	64022,0
2007	2018,46	552780	69079,7
2008	2072,71	647858	72533,7
2009	1877,16	577890	67238,7
2010	2068,39	576734	70667,9
2011	2109,59	649402	75402,6
2012	2137,38	757853	79172,8
2013	2203,34	752548	81627,1
2014	2327,18	891769	82116,9
2015	2300,35	779406	77272,0
2016	2378,52	951655	77890,2
2017	2453,41	905024	81706,8
2018	2853,31	952085	85792,1
2019	2991,38	836883	87679,6
2020	3046,68	965763	94693,9

	Y	**X1**	**X2**
Y	1		
X1	0,9559	1	
X2	0,9076	0,9186	1

Регрессионная статистика								
Множественный R	0,958838793							
R-квадрат	0,919371831							
Нормированный R-квадрат	0,905933803							
Стандартная ошибка	113,5419239							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	1763998,203	881999,1014	68,41567958	2,74739E-07			
Остаток	12	154701,2217	12891,76848					
Итого	14	1918699,424						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	1108,11005	589,9723784	1,878240559	0,084854626	-177,3293372	2393,549437	-177,3293372	2393,549437
Переменная X 1	7,19653E-05	1,90707E-05	3,773602688	0,002654319	3,04138E-05	0,000113517	3,04138E-05	0,000113517
Переменная X 2	0,00843241	0,009276136	0,909043406	0,38122238	-0,011778553	0,028643373	-0,011778553	0,028643373

APPENDIX 13. Correlation and regression analysis of the Republic of Tatarstan

Republic of Tatarstan			
	LP (Y)	**K (X1)**	**L (X2)**
2006	345,24	360597	18446,1
2007	378,06	413605	22153,7
2008	407,66	437181	25498,9
2009	401,18	422754	23663,0
2010	415,80	480248	25343,1
2011	436,57	527793	27041,1
2012	459,40	581100	30042,6
2013	471,95	617128	31514,7
2014	482,13	617128	31924,4
2015	484,04	617128	29147,0
2016	489,64	617128	28651,5
2017	499,73	612808	29797,6
2018	513,27	591360	31645,0
2019	529,80	570071	32341,2
2020	539,00	519335	33343,8

	Y	**X1**	**X2**
Y	1		
X1	0,8961	1	
X2	0,8661	0,74758	1

Регрессионная статистика								
Множественный R	0,943522809							
R-квадрат	0,890235291							
Нормированный R-квадрат	0,871941173							
Стандартная ошибка	62,62103797							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	381648,7529	190824,3764	48,66237801	1,74895E-06			
Остаток	12	47056,73275	3921,394396					
Итого	14	428705,4856						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	-262,208812	138,0765591	-1,899010329	0,081864335	-563,0517904	38,63416651	-563,0517904	38,63416651
Переменная X 1	4,11759E-05	1,05209E-05	3,913710986	0,00205839	1,82527E-05	6,4099E-05	1,82527E-05	6,4099E-05
Переменная X 2	0,018199084	0,005892057	3,08874888	0,009384123	0,005361395	0,031036773	0,005361395	0,031036773

APPENDIX 14. Correlation and regression analysis of the Tver Oblast

Tver Oblast			
	LP (Y)	**K (X1)**	**L (X2)**
2006	203,66	50149	18413,80
2007	219,54	66598	21470,49
2008	236,29	74589	24025,48
2009	224,47	97936	23400,82
2010	234,85	110178	24992,07
2011	253,74	116348	25391,95
2012	256,19	94358	27524,87
2013	262,22	88697	28488,24
2014	260,90	90470	27776,04
2015	264,47	73462	24804,00
2016	278,53	86832	24506,35
2017	280,47	93258	25094,50
2018	294,02	88408	27553,77
2019	295,67	70019	28628,36
2020	308,59	57906	29744,87

	Y	**X1**	**X2**
Y	1		
X1	0,84426	1	
X2	0,82231	0,70069	1

Регрессионная статистика								
Множественный R	0,904086526							
R-квадрат	0,817372446							
Нормированный R-квадрат	0,786934521							
Стандартная ошибка	13,98664429							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	10506,59515	5253,297574	26,85375003	3,7102E-05			
Остаток	12	2347,514623	195,6262186					
Итого	14	12854,10977						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	115,7506945	39,3555882	2,941150159	0,012345564	30,002234	201,499155	30,002234	201,499155
Переменная X 1	2,24418E-05	7,36819E-06	3,045768835	0,010164323	6,3879E-06	3,84957E-05	6,3879E-06	3,84957E-05
Переменная X 2	0,004594182	0,001752424	2,621615372	0,022318307	0,000775978	0,008412386	0,000775978	0,008412386

APPENDIX 15. Correlation and regression analysis of the Oryol Oblast

Oryol Oblast			
	LP (Y)	**K (X1)**	**L (X2)**
2006	232,62	28688	15528,85
2007	247,41	46361	18261,92
2008	265,26	42234	20690,76
2009	236,56	31718	19614,84
2010	247,28	32321	20399,43
2011	276,83	45411	20664,63
2012	286,44	49997	22917,07
2013	293,84	50597	24429,60
2014	300,78	53076	24380,74
2015	313,42	47981	21772,00
2016	312,77	41168	21467,19
2017	316,32	40056	22218,54
2018	328,01	42339	24040,46
2019	355,93	45938	24809,76
2020	379,44	41988	25727,72

	Y	**X1**	**X2**
Y	1		
X1	0,44515	1	
X2	0,84294	0,62456	1

Регрессионная статистика								
Множественный R	0,849348869							
R-квадрат	0,721393501							
Нормированный R-квадрат	0,674959084							
Стандартная ошибка	24,63773612							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	18860,96144	9430,480718	15,53575031	0,000467679			
Остаток	12	7284,216493	607,0180411					
Итого	14	26145,17793						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	9,73750325	53,29156697	0,182721279	0,858067379	-106,3748466	125,8498531	-106,3748466	125,8498531
Переменная X 1	-0,000804978	0,001177979	-0,683355057	0,507362592	-0,003371572	0,001761617	-0,003371572	0,001761617
Переменная X 2	0,014565876	0,003068275	4,747252174	0,00047434	0,007880679	0,021251074	0,007880679	0,021251074

APPENDIX 16. Correlation and regression analysis of the Karachay-Cherkess Republic

Karachay-Cherkessia			
	LP (Y)	K (X1)	L (X2)
2006	167,10	13804	14283,41
2007	171,90	14204	16668,74
2008	184,64	14871	17618,86
2009	184,55	13206	17460,29
2010	187,44	11093	17407,91
2011	196,56	15685	17373,09
2012	206,41	19732	20812,96
2013	206,03	22850	22353,12
2014	203,46	23170	23046,07
2015	196,86	19648	20511,00
2016	207,66	19589	20039,25
2017	212,09	20059	20339,84
2018	202,23	18755	22373,82
2019	212,85	17911	22687,05
2020	223,69	13863	24275,15

	Y	X1	X2
Y	1		
X1	0,52616	1	
X2	0,89341	0,62187	1

Регрессионная статистика								
Множественный R	0,894201472							
R-квадрат	0,799596273							
Нормированный R-квадрат	0,766195652							
Стандартная ошибка	7,604763632							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	2768,966192	1384,483096	23,93956295	6,47791E-05			
Остаток	12	693,9891588	57,8324299					
Итого	14	3462,955351						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	101,1350844	14,16815852	7,13819543	1,18339E-05	70,26531887	132,00485	70,26531887	132,00485
Переменная X 1	-0,000205187	0,000705667	-0,290770583	0,77619104	-0,001742704	0,001332329	-0,001742704	0,001332329
Переменная X 2	0,005044468	0,000901631	5,594825296	0,000117099	0,003079983	0,007008953	0,003079983	0,007008953

APPENDIX 17. Correlation and regression analysis of the Republic of North Ossetia

North Ossetia			
	LP (Y)	K (X1)	L (X2)
2006	170,28	14504	13396,74
2007	181,49	27369	15767,96
2008	181,48	27424	16461,75
2009	186,87	20787	17400,07
2010	197,47	22492	17748,08
2011	203,76	25483	18404,76
2012	206,37	26477	20815,78
2013	214,15	33785	22959,80
2014	218,56	34495	23396,04
2015	216,24	25457	21267,00
2016	212,56	24082	21309,53
2017	207,04	24371	22353,70
2018	199,43	24615	23851,40
2019	216,34	24984	24543,09
2020	253,59	20587	25279,38

	Y	X1	X2
Y	1		
X1	0,24856	1	
X2	0,86223	0,4000	1

Регрессионная статистика								
Множественный R	0,868619693							
R-квадрат	0,754500171							
Нормированный R-квадрат	0,713583533							
Стандартная ошибка	10,7709019							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	4278,519702	2139,259851	18,43993559	0,000218931			
Остаток	12	1392,147933	116,0123277					
Итого	14	5670,667635						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	112,566533	18,83732882	5,975716308	6,45302E-05	71,52351933	153,6095467	71,52351933	153,6095467
Переменная X 1	-0,000471067	0,00064089	-0,735020824	0,47644661	-0,001867446	0,000925311	-0,001867446	0,000925311
Переменная X 2	0,005098033	0,000876111	5,818936483	8,2265E-05	0,003189152	0,007006915	0,003189152	0,007006915

APPENDIX 18. Correlation and regression analysis of Denmark

Denmark			
	LP (Y)	**K (X1)**	**L (X2)**
2006	72,99	64094	4312,10
2007	73,13	64536	4359,10
2008	72,06	62925	4418,10
2009	71,46	54765	4525,22
2010	74,18	51618	4577,36
2011	74,59	51819	4553,65
2012	75,85	53753	4547,51
2013	76,36	55222	4577,08
2014	77,48	56940	4664,66
2015	78,67	60083	4746,65
2016	79,73	64833	4753,62
2017	81,14	67433	4779,59
2018	82,78	70243	4816,18
2019	84,04	70318	4830,61
2020	84,89	73928	4869,14

	Y	**X1**	**X2**
Y	1		
X1	0,6978	1	
X2	0,9193	0,4685	1

Регрессионная статистика								
Множественный R	0,967703766							
R-квадрат	0,93645058							
Нормированный R-квадрат	0,925859009							
Стандартная ошибка	1,202984247							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	255,9024212	127,9512106	88,41470838	6,58673E-08			
Остаток	12	17,36605318	1,447171098					
Итого	14	273,2684744						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	-23,77841809	8,577278822	-2,772256631	0,016891107	-42,46670323	-5,09013295	-42,46670323	-5,09013295
Переменная X 1	3,2908E-05	7,92037E-06	4,154860095	0,001334969	1,5651E-05	5,0165E-05	1,5651E-05	5,0165E-05
Переменная X 2	0,019084124	0,002071368	9,213295949	8,61555E-07	0,014571002	0,023597247	0,014571002	0,023597247

APPENDIX 19. Correlation and regression analysis of Finland

Finland			
	LP (Y)	**K (X1)**	**L (X2)**
2006	62,03	51144	3604
2007	64,01	56411	3653
2008	63,26	56768	3684
2009	60,47	49939	3716
2010	62,57	51090	3768
2011	63,96	53075	3769
2012	63,33	52924	3773
2013	63,16	50485	3736
2014	62,93	49560	3736
2015	64,10	49792	3766
2016	64,66	54265	3799
2017	65,78	56848	3778
2018	64,80	58892	3814
2019	65,19	58019	3854
2020	65,56	57544	3852

	Y	**X1**	**X2**
Y	1		
X1	0,7288	1	
X2	0,6390	0,3950	1

Регрессионная статистика								
Множественный R	0,822906629							
R-квадрат	0,67717532							
Нормированный R-квадрат	0,623371206							
Стандартная ошибка	0,870581896							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	19,07809033	9,539045166	12,58593957	0,00113188			
Остаток	12	9,094954047	0,757912837					
Итого	14	28,17304438						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	18,84447499	12,72623788	1,48075772	0,164443525	-8,883615376	46,57256537	-8,883615376	46,57256537
Переменная X 1	0,000237973	7,52713E-05	3,161534332	0,008197463	7,39707E-05	0,000401975	7,39707E-05	0,000401975
Переменная X 2	0,008546146	0,003667963	2,329943218	0,038074341	0,000554341	0,016537951	0,000554341	0,016537951

APPENDIX 20. Correlation and regression analysis of Iceland

Iceland			
	LP (Y)	**K (X1)**	**L (X2)**
2006	55,78	5764	5369
2007	58,67	5130	5529
2008	58,63	4183	4902
2009	62,39	2198	4148
2010	61,73	2013	4270
2011	61,82	2233	4454
2012	61,88	2348	4428
2013	63,18	2400	4497
2014	63,15	2788	4561
2015	64,21	3387	4865
2016	64,92	3996	5246
2017	65,45	4418	5754
2018	67,13	4555	6039
2019	69,59	4458	5866
2020	69,86	4069	5624

	Y	**X1**	**X2**
Y	1		
X1	0,3298	1	
X2	0,4162	0,8570	1

Регрессионная статистика								
Множественный R	0,909097828							
R-квадрат	0,826458862							
Нормированный R-квадрат	0,797535339							
Стандартная ошибка	1,752757343							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	175,5673022	87,78365111	28,57393481	2,73158E-05			
Остаток	12	36,86589965	3,072158304					
Итого	14	212,4332019						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	26,93805021	5,120580773	5,260741194	0,000200831	15,78126313	38,09483729	15,78126313	38,09483729
Переменная X 1	-0,005096645	0,000758323	-6,720940682	2,13094E-05	-0,006748889	-0,0034444	-0,006748889	-0,0034444
Переменная X 2	0,010843209	0,001437467	7,543275334	6,8274E-06	0,007711237	0,01397518	0,007711237	0,01397518

APPENDIX 21. Correlation and regression analysis of Norway

Norway			
	LP (Y)	**K (X1)**	**L (X2)**
2006	103,00	79120	3855
2007	101,23	88814	4028
2008	98,21	89817	4117
2009	99,03	83516	4160
2010	98,38	78153	4215
2011	97,26	83976	4362
2012	99,13	90310	4481
2013	99,70	96031	4571
2014	100,29	95789	4593
2015	104,13	91953	4617
2016	104,34	95579	4519
2017	106,20	98097	4510
2018	105,92	100279	4558
2019	105,72	109819	4646
2020	106,67	103623	4648

	Y	**X1**	**X2**
Y	1		
X1	0,6910	1	
X2	0,4476	0,7803	1

Регрессионная статистика								
Множественный R	0,706340242							
R-квадрат	0,498916538							
Нормированный R-квадрат	0,415402628							
Стандартная ошибка	2,547493962							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	77,53992979	38,76996489	5,974053136	0,015829253			
Остаток	12	77,87670583	6,489725486					
Итого	14	155,4166356						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	85,29109998	12,28685105	6,941656545	1,55681E-05	58,52035128	112,0618487	58,52035128	112,0618487
Переменная X 1	4,0503E-05	1,51463E-05	2,674117222	0,020256022	7,50203E-06	7,3504E-05	7,50203E-06	7,3504E-05
Переменная X 2	-0,00307345	0,00428914	-0,716565578	0,48735455	-0,012418683	0,006271783	-0,012418683	0,006271783

APPENDIX 22. Correlation and regression analysis of Sweden

Sweden			
	LP (Y)	**K (X1)**	**L (X2)**
2006	72,70	99605	3225
2007	72,88	107852	3338
2008	71,61	108273	3405
2009	70,59	94559	3418
2010	73,06	100458	3461
2011	73,69	106437	3513
2012	73,31	105290	3590
2013	73,88	105855	3629
2014	74,74	112236	3672
2015	76,91	119980	3727
2016	76,21	124828	3785
2017	76,97	131751	3807
2018	76,48	133603	3826
2019	78,41	133153	3868
2020	78,71	132725	3918

	Y	**X1**	**X2**
Y	1		
X1	0,9264	1	
X2	0,8996	0,8841	1

Регрессионная статистика								
Множественный R	0,942309077							
R-квадрат	0,887946396							
Нормированный R-квадрат	0,869270795							
Стандартная ошибка	0,892619138							
Наблюдения	15							
Дисперсионный анализ								
	df	*SS*	*MS*	*F*	*Значимость F*			
Регрессия	2	75,76603384	37,88301692	47,54580121	1,9795E-06			
Остаток	12	9,5612271	0,796768925					
Итого	14	85,32726094						
	Коэффициенты	*Стандартная ошибка*	*t-статистика*	*P-Значение*	*Нижние 95%*	*Верхние 95%*	*Нижние 95,0%*	*Верхние 95,0%*
Y-пересечение	46,72420207	5,315160217	8,790741985	1,41447E-06	35,1434628	58,30494134	35,1434628	58,30494134
Переменная X 1	0,000108523	3,74058E-05	2,901243356	0,013295575	2,70231E-05	0,000190024	2,70231E-05	0,000190024
Переменная X 2	0,004300222	0,002409553	1,784655191	0,099598684	-0,000949744	0,009550187	-0,000949744	0,009550187

APPENDIX 23. Production function of Norway data

	GDP (Y)	**K**	**L**	***Y'***	***K'***	***L'***
2006	345,7736	79120	2354	*5,8458*	*11,2787*	*7,7639*
2007	356,1271	88814	2446	*5,8753*	*11,3943*	*7,8024*
2008	357,8235	89817	2525	*5,8800*	*11,4055*	*7,8340*
2009	351,6438	83516	2497	*5,8626*	*11,3328*	*7,8228*
2010	354,1117	78153	2517	*5,8696*	*11,2664*	*7,8308*
2011	357,5871	83976	2562	*5,8794*	*11,3383*	*7,8485*
2012	367,2531	90310	2589	*5,9061*	*11,4110*	*7,8590*
2013	371,0507	96031	2619	*5,9163*	*11,4724*	*7,8705*
2014	378,3587	95789	2650	*5,9358*	*11,4699*	*7,8823*
2015	385,8016	91953	2597	*5,9553*	*11,4290*	*7,8621*
2016	389,9356	95579	2614	*5,9660*	*11,4677*	*7,8685*
2017	398,9950	98097	2647	*5,9889*	*11,4937*	*7,8813*
2018	403,4590	100279	2683	*6,0001*	*11,5157*	*7,8949*
2019	406,4680	109819	2710	*6,0075*	*11,6066*	*7,9049*
2020	403,5529	103623	2682	*6,0003*	*11,5485*	*7,8941*

Регрессионная статистика	
Множественный R	0,933260288
R-квадрат	0,870974765
Нормированный R-квадрат	0,849470559
Стандартная ошибка	0,022033057
Наблюдения	15

Дисперсионный анализ

	df	*MS*	*F*
Регрессия	2	0,01966218	40,50253096
Остаток	12	0,000485456	
Итого	14		

	Коэффициенты	*t-статистика*	*P-Значение*
Y-пересечение	-2,45931474	-1,804041998	0,09636675
Переменная X 1	0,340180337	2,900650986	0,013310211
Переменная X 2	0,572580081	1,939832338	0,076266287

APPENDIX 24. Production function of Finland data

	GDP (Y)	**K**	**L**	***Y'***	***K'***	***L'***
2006	232,11	51144	2327,0	*5,4472*	*10,8424*	*7,7523*
2007	244,41	56411	2379,0	*5,4988*	*10,9404*	*7,7744*
2008	246,32	56768	2432,0	*5,5066*	*10,9467*	*7,7965*
2009	226,43	49939	2370,0	*5,4224*	*10,8186*	*7,7706*
2010	233,65	51090	2356,0	*5,4538*	*10,8413*	*7,7647*
2011	239,60	53075	2374,0	*5,4790*	*10,8795*	*7,7723*
2012	236,25	52924	2379,0	*5,4649*	*10,8766*	*7,7744*
2013	234,12	50485	2376,0	*5,4558*	*10,8294*	*7,7732*
2014	233,27	49560	2379,0	*5,4522*	*10,8109*	*7,7744*
2015	234,53	49792	2353,0	*5,4576*	*10,8156*	*7,7634*
2016	241,13	54265	2398,0	*5,4853*	*10,9016*	*7,7824*
2017	248,83	56848	2442,0	*5,5168*	*10,9481*	*7,8006*
2018	251,67	58892	2512,0	*5,5281*	*10,9835*	*7,8288*
2019	254,74	58019	2539,0	*5,5402*	*10,9685*	*7,8395*
2020	247,61	57544	2467,0	*5,5118*	*10,9603*	*7,8108*

Регрессионная статистика	
Множественный R	0,964008664
R-квадрат	0,929312705
Нормированный R-квадрат	0,917531489
Стандартная ошибка	0,009869387
Наблюдения	15

Дисперсионный анализ

	df	*MS*	*F*
Регрессия	2	0,007683377	78,88088304
Остаток	12	9,74048E-05	
Итого	14		

	Коэффициенты	*t-статистика*	*P-Значение*
Y-пересечение	-1,80716661	-1,968694577	0,072522996
Переменная X 1	0,39707668	5,201025274	0,000221526
Переменная X 2	0,3807235	1,993352976	0,069459974

APPENDIX 25. Production function of the Yamalo-Nenets AO data

	GRP (Y)	**K**	**L**	***Y'***	***K'***	***L'***
2006	1020,02	4611181	375	*6,9276*	*15,3440*	*5,9275*
2007	1015,77	4749598	377	*6,9234*	*15,3736*	*5,9309*
2008	1121,43	5852597	387	*7,0224*	*15,5824*	*5,9589*
2009	926,34	5807539	388	*6,8312*	*15,5747*	*5,9620*
2010	1039,14	6342318	388	*6,9462*	*15,6628*	*5,9602*
2011	1251,64	7480401	390	*7,1322*	*15,8278*	*5,9656*
2012	1493,91	8566051	393	*7,3092*	*15,9633*	*5,9728*
2013	1623,53	7926860	396	*7,3924*	*15,8858*	*5,9817*
2014	1806,27	8677920	395	*7,4990*	*15,9763*	*5,9799*
2015	1791,83	8387662	394	*7,4910*	*15,9423*	*5,9758*
2016	1871,77	9788024	403	*7,5346*	*16,0967*	*5,9989*
2017	2239,11	10659107	421	*7,7138*	*16,1819*	*6,0414*
2018	2716,85	11636165	418	*7,9072*	*16,2696*	*6,0348*
2019	2769,92	12647980	423	*7,9266*	*16,3530*	*6,0474*
2020	2334,31	12884758	417	*7,7555*	*16,3716*	*6,0336*

Регрессионная статистика	
Множественный R	0,951904314
R-квадрат	0,906121824
Нормированный R-квадрат	0,890475461
Стандартная ошибка	0,124034023
Наблюдения	15

Дисперсионный анализ

	df	*MS*	*F*
Регрессия	2	0,890953122	57,91261777
Остаток	12	0,015384439	
Итого	14		

	Коэффициенты	*t-статистика*	*P-Значение*
Y-пересечение	-19,4859699	-1,683157137	0,118157871
Переменная X 1	0,814148069	2,595090403	0,023437029
Переменная X 2	2,322611094	0,858259277	0,407565595

APPENDIX 26. Production function of the Republic of Tatarstan data

	GRP (Y)	**K**	**L**	***Y'***	***K'***	***L'***
2006	1333,30	2534461	1932,9	*7,1954*	*14,7455*	*7,5668*
2007	1475,96	2956576	1953,0	*7,2971*	*14,8995*	*7,5771*
2008	1589,61	3011557	1952,6	*7,3712*	*14,9180*	*7,5769*
2009	1535,56	3336234	1939,0	*7,3367*	*15,0204*	*7,5699*
2010	1601,59	3679778	1949,3	*7,3788*	*15,1184*	*7,5752*
2011	1692,88	4823697	1959,4	*7,4342*	*15,3891*	*7,5804*
2012	1785,99	4025783	1961,5	*7,4877*	*15,2082*	*7,5815*
2013	1828,85	4072616	1957,1	*7,5114*	*15,2198*	*7,5792*
2014	1867,26	3785581	1951,1	*7,5322*	*15,1467*	*7,5761*
2015	1867,26	3921931	1950,3	*7,5322*	*15,1821*	*7,5757*
2016	1885,93	4103317	1951,2	*7,5422*	*15,2273*	*7,5762*
2017	1923,65	4401203	1945,1	*7,5620*	*15,2974*	*7,5731*
2018	1965,97	4592654	1944,3	*7,5837*	*15,3400*	*7,5727*
2019	2021,02	5401873	1941,3	*7,6114*	*15,5023*	*7,5711*
2020	1958,37	5289598	1938,8	*7,5799*	*15,4813*	*7,5698*

Регрессионная статистика	
Множественный R	0,879885184
R-квадрат	0,774197936
Нормированный R-квадрат	0,736564259
Стандартная ошибка	0,062905777
Наблюдения	15

Дисперсионный анализ

	df	*MS*	*F*
Регрессия	2	0,081406	20,57194493
Остаток	12	0,003957137	
Итого	14	0,210297642	

	Коэффициенты	*t-статистика*	*P-Значение*
Y-пересечение	-12,5750824	-0,411246042	0,688141551
Переменная X 1	0,496480279	6,320247067	3,83024E-05
Переменная X 2	1,650526832	0,407463362	0,690842739