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Svetlana Ashmarina
Marek Vochozka *Editors*

Sustainable Growth and Development of Economic Systems

Contradictions in the Era of Digitalization and Globalization

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Part I
Factors and Conditions of Sustainable Development of Modern Socio-economic Systems

Challenges of Corporate Risk Management After the Global Financial Crisis

K. Benetti

Abstract The contribution considers potential challenges of corporate risk management after global financial crisis. The global financial crisis negatively affects the financial health of world economies, which in turn have been affected by the financial health of operating firms. According to Pittman and Ivry (U.S. Taxpayers Risk $9.7 Trillion on Bailout Programs, Huffington Post, 2009), the value of the world's companies has decreased by the crisis by $14.5 trillion or 33%. The most common reason for the bankruptcies of global companies was poor quality of risk management within these companies. One of the positive impacts of this crisis was the creation of the ISO standard ISO 31000:2009 Risk Management—Principles and guidelines (with supporting standard IEC 31010:2009—Risk Management—Risk assessment techniques). Corporate risk management has emerged as one of the most important corporate activities. The influence of ISO 31000 on companies was so fundamental that there was also a significant change in the revised standard ISO 9001: 2015—which in itself involves a new risk management system. Whether these measures improve the future financial health of companies is an important issue for further research.

1 Introduction

The impact of the recent financial crisis can be both positive and negative ones. The negative impact has already been discussed in many scientific and non-scientific works. One of the negative results of the recent financial crisis is the number of bankruptcies, not only personal, but also corporate ones. In recent years, Bokšová et al. (2014), Hospodka et al. (2015) and Maixner et al. (2014) published research results of personal bankruptcies in the Czech Republic. According to a study of Pittman and Ivry (2009), the total value of bankrupt companies amounted to 14.5 trillion USD at the end of 2008. The predominant reason for these bankruptcies,

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according to Barbulescu et al. (2015), was the absence of risk management in interim management, or it was of poor quality. The application of quality risk management to internal company policy can mean early detection of financial problems of these companies. In this view, bankruptcy models (Čámská 2012) and basic characteristics of companies, which are in insolvency, are very important (Čámská 2013). The absence of quality risk management was one of the main reasons for the creation of ISO 31000 for risk management in business practice, which can be considered as a positive result of the recent financial crisis. With regard to reasons for changes in risk management in corporate practice, this contribution will precisely analyse the number of corporate insolvency proposals in the Czech Republic after the crisis period. The research question is whether the issue of ISO 31000 and ISO 31010 had an impact on reducing the number of corporate bankruptcies in the Czech Republic. To answer this question, it is necessary to analyse the development of proposals of corporate insolvencies in the Czech Republic for the period from January 2008 to December 2015.

2 Materials and Methods

The following scientific methods were used in the contribution: method of deduction, methods of graphical and tabular representation of data, comparative analysis, synthesis of partial knowledge, elementary statistical analysis, time series analysis, seasonal decomposition and forecast of values.

For the time series analysis, seasonal decomposition and forecast of values the software STATGRAPHICS Centurion XVI were used. For the analysis, secondary data from Creditreform (2016) were used.

3 Results

3.1 The Analysis of Corporate Insolvency Proposals in the Czech Republic

The main reason for creating ISO 31000—Risk management in corporate practice was the number of bankrupt companies worldwide. According to the published results, the value was 14.5 trillion USD in 2008 (for comparison, see Fig. 1).

The picture above shows that the amount of bankrupt companies worldwide is 145 times greater than the budget of the Marshall Plan to rebuild Europe after World War II. The amount of bankrupt companies worldwide (data until the end of 2008) was even higher than the US GDP. The author cannot determine what the total amount of bankrupt companies was in the Czech Republic due to the impact of the recent financial crisis, but it is possible to analyse trends in the number of

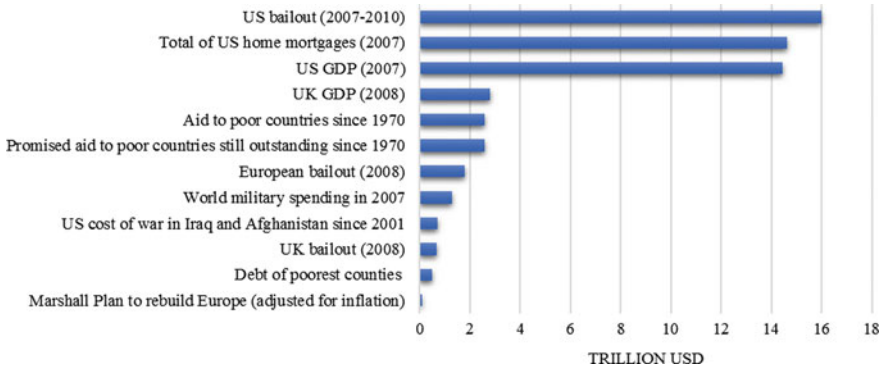

Fig. 1 Losses and bailouts after new global financial crisis. *Source* Author, from Shah (2009), statista.com (2016)

corporate insolvency proposals for the period between 2008 and 2015. First, the author will carry out a fundamental analysis of the number of corporate insolvency proposals—data on an annual basis and then the data on a monthly basis. After that, the analysis of time series with a subsequent prediction for data based on a yearly basis and for data based on a monthly basis will be carried out.

3.2 The Basic Data Analysis

Much attention will be devoted to the analysis of corporate insolvency proposals and bankruptcies in the Czech Republic from 2008 to the present time. Further analysis of trends in the number of corporate bankruptcies in the crisis years was carried out by Kislingerová and Schoenfeld (2014). The data will be analysed since 2008, because this year Insolvency Act (no. 182/2006 Coll., On Bankruptcy and its Solution) that is a significant milestone in the business and in personal bankruptcies (Smrčka 2012, 2013) came into force. For the analysis, the author used secondary data which were taken from company Creditreform, S.r.o. (creditreform.cz 2016). The time series covers the period from 1 January 2008 to 31 December 2015. The results of basic statistical analysis of yearly data are shown in Fig. 2 which includes dynamism of values (Hindels et al. 2000)—first difference ($_1\Delta_t$).

The picture above shows a declining trend in the number of insolvency petition-filed companies for a period of 2012. These results cannot be assumed because the release of ISO 31000 and ISO 31010 had an impact on reducing the number of corporate bankruptcies in the Czech Republic since these standards were released in 2009. If we assume that the implementation of these ISOs to internal company policies (including also a change of strategy) would take about a year (it would also depend on a company size), then the downward trend in the number of insolvency proposals calculated from publication of these norms is two years (Benetti 2016).

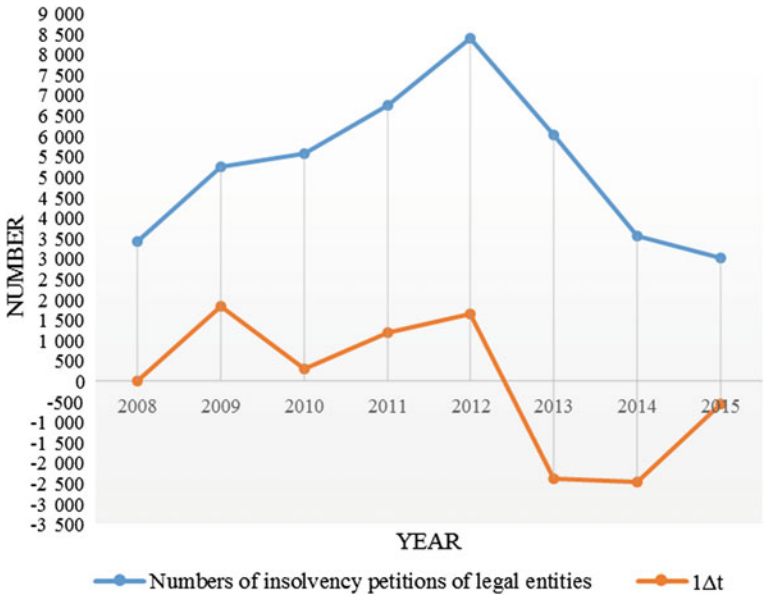

Fig. 2 Development of corporate insolvency proposals (data in years). *Source* Author, from creditreform.cz (2016)

The number of insolvency proposals developed in individual months by time period 2008–2015 is illustrated in Fig. 3.

According to the results of the baseline data analysis, it is clear that the largest decline in the values of the analysed data for the period was recorded in January 2014 when the value of insolvency petitions filed this month was about 403 proposals lower than in December 2013. Conversely, the biggest increase in the number of insolvency petitions was recorded in August 2012—an increase in the number of insolvency petitions filed was 115 higher than the previous month.

For a more detailed analysis including data based on monthly basis, the contribution illustrates a direct effect of ISO 31000 and ISO 31010 on a declining trend in the number of bankruptcies in the Czech Republic. For further development of this indicator, the analysis of time series prediction will be carried out (see Part 3.3, this chapter).

3.3 The Times Series Data Analysis

To select a suitable model for time series analysis, firstly, it is necessary to perform basic statistical analysis (see Part 3.2 , this chapter).

For time series analysis, the author uses software STATGRAPHICS Centurion XVI. Before carrying out time series analysis, it is necessary to do

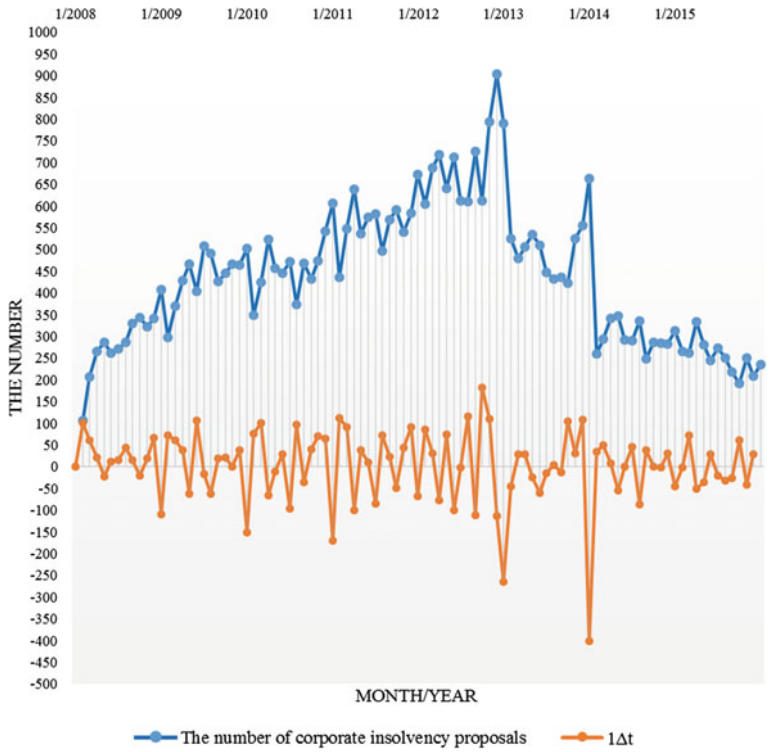

Fig. 3 Development of corporate insolvency proposals (data in months). *Source* Author, from creditreform.cz (2016)

seasonal decomposition (Hindels et al. 2000) of the data. Then, the appropriate model to compensate for time series and prediction will be selected. The results of seasonal decomposition are shown in Table 1.

This table shows the seasonal indices for each season scaled so that an average season equals 100. The indices range from a low of 13, 3557 in season 1 to a high of 190,278 in season 12. This indicates that there is a seasonal swing from 13, 3557% of average to 190,278% of average throughout one complete cycle.

To predict the indicators studied, a model balancing time series and using automatic selection according to the selected data will be selected. The selection will be made for monthly data (for which it was done with seasonal decomposition) and then also for annual data (of course, without seasonal decomposition). It should be recalled that the main results of forecast of the number of corporate insolvency proposals between 2013 and 2017 were published by Kislingerová (2013). Now, we can compare these results with a real situation. Fortunately, the forecast number of corporate insolvency proposals did not materialize.

There, a forecast for the next six seasons (i.e. for the first half of 2016) will be chosen. The results of a suitable model for time series will be evaluated by

Table 1 Seasonal decomposition

Season	1	2	3	4	5	6	7	8	9	10	11	12
Index	13.356	28.245	45.304	61.234	76.569	92.68	106.766	122.4	137.805	154.03	171.326	190.28

Source compiled by the author

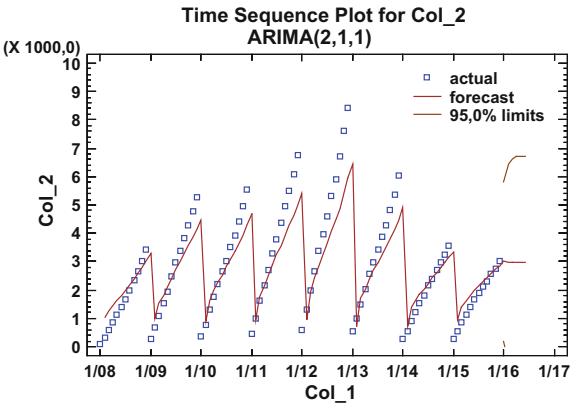

Fig. 4 Time sequence plot (ARIMA). *Source* compiled by the author

individual indices: RMSE (root-mean-squared error); RUNS (test for excessive runs up and down); RUNM (test for excessive runs above and below median); AUTO (Box–Pierce test for excessive autocorrelation); MEAN (test for difference in mean first half to second half); VAR (test for difference in variance first half to second half).

The results of time series analysis and subsequent forecasts for monthly data are as follows. The selected model was the model ARIMA (2, 1, 1). A time sequence plot is shown in Fig. 4; a forecast for next six periods is shown in Table 2.

The results of time series analysis and subsequent forecasts for annual data are as follows. The selected model was the quadratic trend; a time sequence plot is shown in Fig. 5; a forecast for next period is shown in Table 3.

The above analysis shows if the value of companies' insolvency proposals will fall in the coming years. It must be emphasized that the model cannot cover legislative changes and also no other factors may affect the number of corporate insolvencies. So, it is not possible to accept or refuse the hypothesis that the issue of ISO 31000 and ISO 31010 had an impact on reducing the number of corporate bankruptcies in the Czech Republic since 2012.

Table 2 Forecast by model ARIMA (2, 1, 1)

Period	Forecast	Lower 95.0% Limit	Upper 95.0% Limit
1/16	3009.25	206.195	5812.3
2/16	2993.28	−455.528	6442.09
3/16	2981.29	−670.184	6632.77
4/16	2973.97	−740.442	6688.38
5/16	2969.68	−763.496	6702.86
6/16	2967.2	−771.095	6705.49

Source compiled by the author

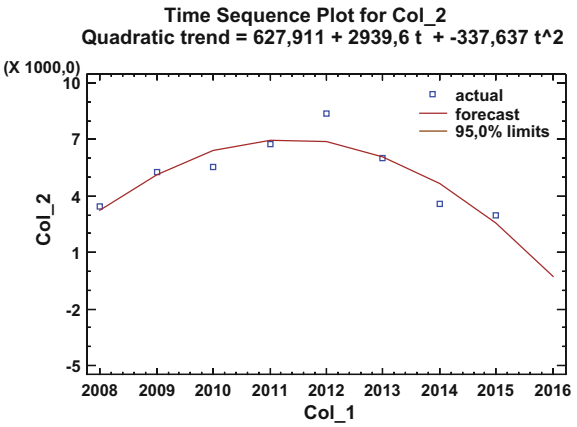

Fig. 5 Time sequence plot (quadratic T.) *Source* compiled by the author

Table 3 Forecast by model quadratic trend

Period	Forecast	Lower 95.0% Limit	Upper 95.0% Limit
2016	−264.268	−4469.3	3940.76

Source compiled by the author

4 Conclusions

It is impossible to confirm or refuse the research question that the implementation of ISO 31000 (with the implementation of ISO 31010) decreased the number of corporate insolvency proposals since 2012. The contribution assumed that the implementation of ISO 31000 in internal management of companies lasted at average one year. The question that ISO 31000 could have an impact on decreasing the number of corporate insolvency proposals should have a two-year delay, but it depends on the interpretation.

According to the results of the above analyses of time series, it is clear that depending on the model there should be a number of insolvency petition companies in the next period of decline. Despite this downward trend, we can recommend the implementation of ISO 31000 and ISO 31010 in companies regardless of their size or area of their business. In response to risk management development for corporate practice this year, risk management has become a part of ISO 9001. For further research in this area, it would be useful to analyse whether the implementation of ISO 9001 will have an impact on businesses increasing their financial health and thereby reducing the total number of insolvency petition companies. Further development of risk management can be seen as an important part of corporate social responsibility.

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“Hexagon” of Property

S. V. Domnina and S. U. Salynina

Abstract The contribution presents the concept of the property in terms of philosophy, law, economics, sociology, politics, and economic psychology. A concept of “hexagon of property” has been developed taking into account all aspects of this complex category. The contribution considers the process when a person acquires a property object and its development taking into account various aspects of the property: philosophical; cognitive, legal, emotional, strong-willed, profitable, political (domineering) and social aspects. The life cycle of the property object is considered from the standpoint of economics, law, sociology, psychology, and politics. The emphasis is on the ownership from the perspective of economic psychology: components of ownership (cognitive, emotional and volitional) and their formation at different stages of the property development, as well as specific subject-object relations related to the notion of “commodity fetishism” are shown. With the help of statistical data, it is justified that property objects are the extension of personality, especially for intellectual property objects.

1 Introduction

Property is one of the most important categories since ancient Roman law and ancient Greek philosophy. It is generally accepted that property has two sides—economic and legal. However, the property category has an interdisciplinary character and is considered in the writings of scientists from different perspectives. Thus, the first theoretical positions of private and public property were formulated by ancient philosophers. Many economists consider the economic essence of

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property rights in their works (Demsetz 2002, 2003, 2008; Driffield et al. 2016; Müller and Schmitz 2016).

Legal property issues are disclosed in the writings of such scientists as Sikor et al. (2017) and Kelli et al. (2016). In sociology, the category of the property was excluded from research for a long time, but it began to be considered in modern sociological studies (Tarando 2012, 2018). Today, special attention is paid to environmental aspects of the property and welfare (Rakotonarivo et al. 2018).

From a policy perspective, scientists consider the power-ownership phenomenon (Lundberg 1971), property and politics issues (Mangialardo and Micelli 2016), the influence of political institutions on economic growth through the ownership channel (Hall and Ahmad 2013). The problem of the property is considered from the point of view of economic psychology (Karnyshev 2002).

Today, much attention is paid to issues of intellectual property (Raghavan et al. 2013; Sukarmijan and Sapong 2014; Ilie 2014; Mingaleva and Mirskikh 2015). However, in the above works property is considered only from one, maximum—two sides, which does not reflect the diversity of property relations in the life cycle of the property object. In addition, there are no studies in the literature that would reveal the concept of the life cycle of the property object from different sides. There are studies that describe the physical, economic, and/or legal cycle.

The authors of the contribution consider the problem of the property and the life cycle of the property object from the position of various parties. The purpose of the contribution is to theoretically substantiate and develop a model of the property and a life cycle of the property object.

Purposes of the contribution:

- Identify the parties of the property and develop its theoretical model;
- Disclose the content of the life cycle of the property object from the position of economics, psychology, law, politics, and sociology.

The subject of the contribution is relations in society arising from the property objects. The results of this contribution are the following:

1. The property category is represented as an interdisciplinary category in the form of “hexagon of property.”
2. The scheme of the life cycle of the property object is developed from the position of economics, law, psychology, politics, and sociology.
3. It is substantiated that property objects become the extension of personality.

2 Materials and Methods

The authors used the following research methods: analysis and synthesis, method of deduction, methods of graphical and tabular representation of data, methods of correlation–regression, and statistical analysis.

The study was carried out in three stages:

(1) Theoretical analysis of "property";
(2) Practical development of the model of "hexagon of property";
(3) Development of the life cycle of the property object.

3 Results

From the point of view of philosophy, property is a historically determined way when people got items of production and non-productive consumption.

From the legal point of view, property is a combination of the owner's rights with respect to property belonging to him, the ways of implementing and limiting these rights (Raisberg et al. 2007).

From the point of view of economics, property characterizes the belonging of objects, material and intellectual objects to certain persons, the legal right to such belongings and economic relations between people through the ownership, division, redistribution of these property objects.

From the point of view of economic psychology, property is the extension of personality in objects and the zone of his/her comfort. This is especially true for intellectual property. After all, these are works of a human mind, individual's unique abilities, a product of his/her self-expression, and self-actualization (Karnyshev 2002). Ownership means 'self-interest', 'beloved mine'. In general, property comes from the Old Slavonic "sobstvo", which means "feature, person" and is close to the term "person." That is, property here is close to the concept of personality, as an individual person, existing "in and for itself."

Property, from the point of view of economic sociology, has been little studied, but it is the basis of social stratification. At the same time, it is proposed to consider this category using a synthetic approach—in the relationship between private and public property, through privatization and socialization (Tarando 2018).

From the political point of view, property is the foundation of power. Participation in politics is difficult for people without property so much that it is virtually impossible.

Thus, the concept of the property fits into the model of "hexagon of ownership" (Fig. 1). It should be noted that all these definitions take place, and moreover, they exist simultaneously, influencing each other.

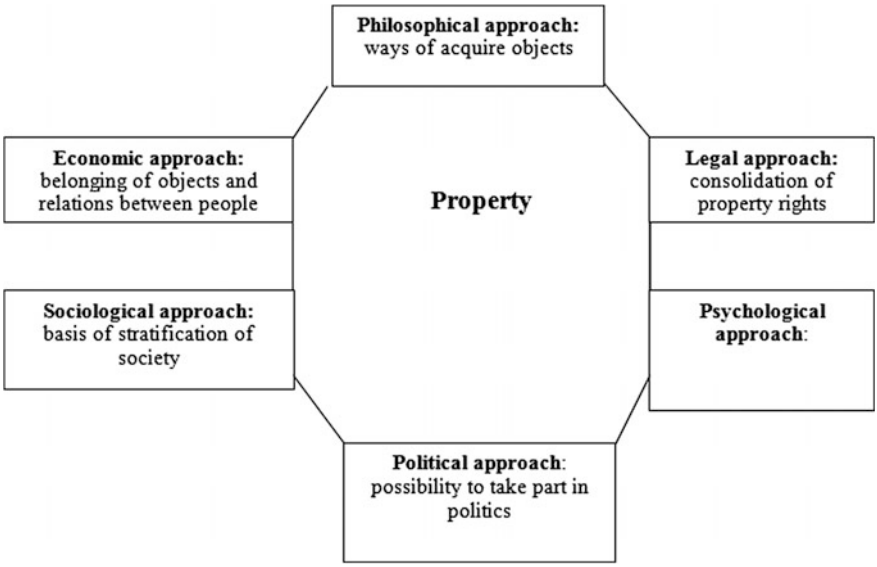


Fig. 1 "Hexagon" of property. *Source* Authors

The process when the person acquires property and its development can be represented in the form of the life cycle of the property object from the perspective of different aspects of ownership (Table 1).

4 Discussion

Consider in more detail the emergence of property and its development, taking into account six aspects of ownership.

4.1 Development of the Object

Initially, there is an "attraction" of people by the object. Indeed, in psychology, such a concept as "human valence of the object" is considered, when an object attracts people to itself, literally forcing to be acquired. Of course, a person chooses this object, but such a "force of attraction" belongs to the object. "Human valence of the object" is measured by the number of people who claim it. So there is competition in the market that regulates people's behavior. At this stage, there are "subject-object" relations in which the object acts as the dominant party. In principle, this idea was reflected in the work "Capital" by K. Marx under the name "commodity fetishism" (Marx 1867).

Table 1 Life cycle of the property object

Stage of the life cycle of the property object (hereinafter—PO)	Development	Implementation	Growth	Maturity	Decline
Economic cycle of PO	Business planning of PO	Strategy development of PO	Management of PO, income generation	Economic examination of PO sales	Economic appraisal of liquidation of PO
Legal cycle of PO	Legal expertise of PO	Registration of rights to PO	Realization of rights to own, use and dispose of PO	Change of ownership, transfer of rights	Liquidation of PO
Physical cycle of PO	Design of PO	Creation of PO	Operation, modernization of PO	Termination of PO	Liquidation of PO (demolition, rebranding, liquidation, transfer to public domain etc.)
Economic and psychological cycle of PO	Attraction of the subject by the object, the human valence of the object	Acquiring the object. Emotional component of the sense of ownership (joy, strong feelings from the ownership of PO). Cognitive component of the sense of ownership	Volitional component of the sense of ownership in protection, preservation, and augmentation of PO	Volitional component of the sense of ownership	Volitional component of the sense of ownership. Emotional component of the sense of property (experience)
Political cycle of PO	Political design of the need for PO	PO as the foundation of power	Realization of power authority and relations. Prestige		Change of power. Change in forms and relations of property
Sociological cycle of PO	Overcoming alienation from the property	Inclusion in public relations	Social significance of PO. Social differentiation of society Potential for upward mobility in higher strata		Clash of class interests

Source compiled by the authors

This is the endowment of goods with supernatural properties. That is, the product is endowed with mystery. C. Palahniuk writes in his novel that the constant acquisition of objects leads eventually to the fact that the person is trapped in his beloved nest, and objects, that he should own, now own him (Palahniuk 2014).

Further, to acquire the object, the person begins to search for the most effective way of acquiring the object in order to overcome alienation from property. For this purpose, we have to carry out:

- Business planning;
- Legal expertise of the object;
- Political design of the need for this object;
- Design of the object and development of the object.

4.2 Implementation

At the implementation stage, the object is acquired by the person, which is possible in various ways: as a result of his own labor, entrepreneurial activity, by means of various transactions (purchase and sale, inheritance, donation), as a result of a happy event (find, treasure, gain, present), and illegally (embezzlement, fraud, etc.).

Then the object is created, the strategy of its development is being developed, the property object is registered, and the society is convinced that the object (cognitive sense of ownership) was acquired legally.

At this stage, the relationship "subject-object" is clearly presented and it illustrates itself in relation to the subject to the object, to the rights to own it. The owner begins to experience emotions from owning the object. These emotions give the acquired object an attractive force, causing a variety of feelings. The emotional feeling when buying the object is always presented, forming an emotional component of the sense of ownership. Next the owner's involvement in public relations comes and the object of ownership gets power.

4.3 Growth

At the stage of growth, the owner receives income from the operation and management of property. When using the object, the owner can extract useful properties from the object, satisfying his needs, and also receiving income, for example, tutoring in your educational institution, a reward for a service, works executed and published, which bring income and recognition, etc.

The right of disposal and transfer of part of rights take place in accordance with the principle of the optimal division of the property rights. The property rights for

the property object should be divided and combined so to increase the total value of the property object. There are various ways of dividing the rights for the same object:

- Physical (separation of the object into separate elements);
- The time of possession and use (rent, life tenure, transfer of rights under license agreements, etc.);
- By types of the property rights (joint lease, mortgage, purchase, and sale with a condition, operational management, easements, etc.).

Such a principle will optimize the income from the property object.

At the stage of growth, subject-object relations arise, and this is the interaction of different actors concerning the certain object. At this stage, the economy acts along with the law, since any transaction has both legal and economic content. In addition, when realizing subject-object relations, the strong-willed term is more clearly illustrated in the sense of ownership, which gives the subject assertiveness, even aggressiveness in the course of acquiring, keeping, and protecting property. The object of ownership is a factor of social differentiation, the reckoning of a person to a certain class. This, in turn, enables power and relations, decision making, influence on policies of the enterprise, the region, the country, and the world as a whole.

The owner can use the object as a potential for upward mobility in the higher strata.

At this stage, there is also a psychological sense of the extension of personality in the object (the psychological aspect of ownership), when "mine" is colored by emotions (joy, even happiness), comfort and has a legal status, proven to society. This is especially true for intellectual property objects.

The fact that intellectual property is the extension of personality is confirmed in statistics. Thus, the table presents data on the number of patents granted, which, undoubtedly, depend on the number of researchers. Table 2 shows the correlation of these data.

The authors present these data in the form of graphs, which show the dependence of the number of patents on the number of researchers over the past 7 years. Moreover, the cyclicity also coincides. So, for the period of 2013–15 there was an increase in these indicators, and then in 2016 there was—a decline (Fig. 2).

At the same time, if the dependence of the number of issued patents on the number of researchers in the Russian Federation over the past three years has been constructed, a direct linear relationship with high reliability of approximation (more than 99%) is visible (Fig. 3).

Thus, the subject and the property object are indivisible, and the object in this sense becomes the extension of personality. Zhanna Mingaleva and Irina Mirskikh came to the same conclusions in their study, who believe that intellectual property is the result of creative intellectual work and a reflection of human personality and individuality (Mingaleva and Mirskikh 2015).

Table 2 Performance of intellectual property indicators in the Russian Federation in the period 2010–2016

Year	Issued patents for inventions, units	Growth rate to previous year (%)	Number of researchers in the Russian Federation, people	Growth rate to previous year (%)
2010	30,322		368,915	
2011	29,999	0.99	374,746	1.02
2012	32,880	1.10	372,620	0.99
2013	31,638	0.96	369,015	0.99
2014	33,950	1.07	373,905	1.01
2015	34,706	1.02	379,411	1.01
2016	33,536	0.97	370,379	0.98

Source compiled by the authors on the basis of sources: Annual reports [Electronic resource]. Official site of the Federal Service for Intellectual Property. URL: https://www.rupto.ru/ru/about/reports (Accessed March 20, 2013); Science, innovation and information society [Electronic resource]. Official site of the Federal State Statistics Service. URL: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/en/statistics/science_and_innovations/science/# (Accessed 03/20/2018)

4.4 Maturity

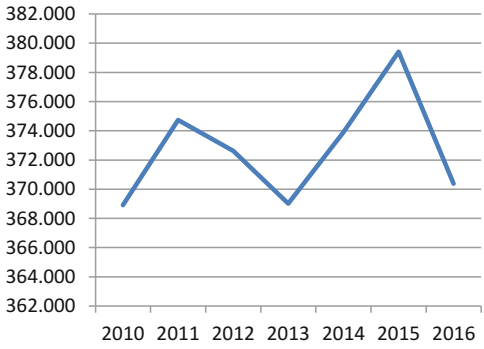
At the stage of maturity, there is a need to change ownership, a sale of the property, a search for new, and more effective options for using the object. It is also possible to stop using the object, which is undoubtedly due to the owner's willful decision and the realization of his power.

4.5 Recession

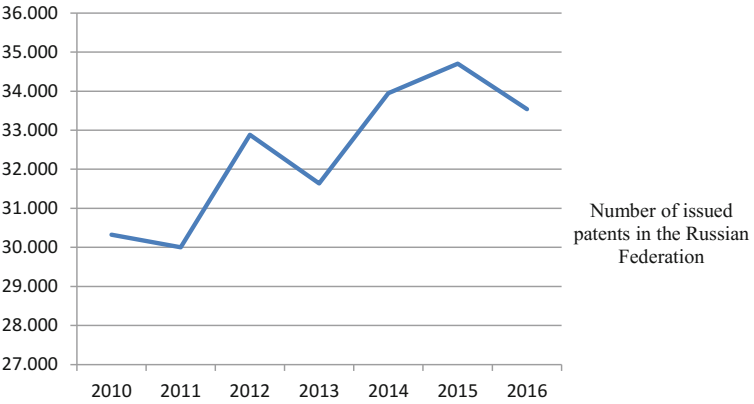
At the stage of recession, clashes of public (class) interests are possible, and property becomes an instrument of anti-crisis policy. There is a change in forms and relations of property. There is also an economic evaluation of the liquidation of the property, the liquidation itself in various forms (demolition, rebranding, transfer to the public domain), its registration. There is a strong-willed and emotional element of the sense of ownership.

Thus, based on the above, it can be concluded that at each development stage of property relations, six approaches of it are presented:

- Acquiring (philosophical);
- Psychological (cognitive, strong-willed and emotional);
- Legal;
- Economic (profitable);



(a) Performance of the number of researchers in the Russian Federation, 2010-2016



(b) Performance of the number of issued patents in the Russian Federation, 2010-2016

Fig. 2 Performance of indicators "the number of researchers" and "the number of issued patents". *Source* compiled by the authors on the basis of the data in Table 2

- Political (overbearing);
- Sociological.

The combination of all these approaches leads to the formation of optimal property relations and a healthy sense of ownership.

Thus, the obtained results fully correspond to the accepted hypothesis about the presence of six faces in the category of "property."

The results of the research are of practical importance for the owner of the object, since the developed scheme of the life cycle shows its possible actions from the perspective of different parties (philosophy, economics, law, sociology, politics, and psychology), which will help to achieve the most effective use of the property.

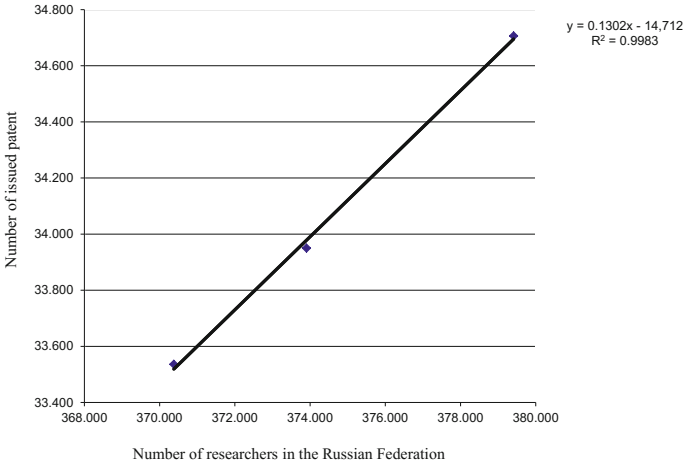


Fig. 3 Dependence of the indicator "the number of issued patents" from "the number of researchers". *Source* constructed by the authors on the basis of the data in Table 2

Future research can be aimed at considering two more approaches of property: the ecological component and the cultural component. In the process of management and operation of the material object, environmental deterioration of property may arise, which can be reduced as a result of the use of intellectual property. The cultural value of the object (if any), on the contrary, does not lose its relevance and even increases over time. In this regard, the model of the life cycle of the property object will require further development and further research.

5 Conclusions

The contribution proved that the category of the property is complex and multifaceted, so that its study through the prism of only legal and economic approaches does not meet modern requirements. In this regard, the existence of six facets of this concept is justified: philosophical, legal, economic, sociological, psychological and political. From these positions, the existence of the life cycle of the property object is proved and various kinds of subject-object relations at different stages of the cycle are described. Particular attention is paid to the psychological component of property: using the example of intellectual property objects and the methods of correlation–regression analysis, the hypothesis about the subject indivisibility and the property object is proved when the object becomes the extension of personality. Further research will be directed to the study of ecological and cultural components of the property.

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Have the Lessons About Crisis Processes in the Russian Economy Been Learned?

M. A. Sherstnev

Abstract The contribution presents the analysis of the crisis phenomena in the Russian economy in 2014–2016 as several interrelated economic processes, the problem of potential recovery mechanisms and theoretical and methodological approaches to develop anti-crisis tools for a country dominated by the primary sector. The study is based on the use of comparative analysis of the main features of systemic financial crises in the countries of Southeast Asia in 1997–1999 and the Russian Federation in 2014–2016 and emphasizes the relevant models of the systemic financial crisis for the Russian Federation.

1 Introduction

The currency crisis in Russia, which broke out in the autumn–winter of 2014–2015, had a diverse impact on the domestic economy. By the results of the first quarter of 2015, the following processes became evident in the country's economy:

- Sharp decline in investment activity;
- Falling sales in the automotive industry (about 2 times) and in the housing market;
- Inflation processes in the market of goods and services;
- Deflationary processes in the asset market;
- Increase in unemployment (as usual in Russian practice, largely in a latent form of part-time work and unpaid leave);
- Serious decline in the sphere of foreign economic relations (up to 1/3 of the foreign trade turnover).

The statistical data of subsequent periods showed further development of these negative trends, *which were accompanied by a significant increase in the scale of net outflow of capital from the Russian economy*. The Russian economy faced a

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recession in the period of 2015–2016, and the economic growth resumed in 2017 has not acquired a stable character yet and is characterized by a contradictory and multidirectional dynamics of macroeconomic indicators (primarily in the ratio of GDP dynamics and real incomes) and is behind growth rates in leading developed countries, countries of comparable level and in the world economy as a whole.[1]

In this connection, the question of the origins and nature of the crisis phenomena in the Russian economy of 2014–2016 remains urgent—this is necessary for a correct understanding of the situation, determining the right set of tools for an adequate anti-crisis policy and assessing the results of their practical application, and developing an anti-crisis toolkit for this type of crisis processes for the future.

2 Data, Sources and Methods

The theoretical foundation for discussion is based on the mechanisms which are modeled by the third-generation currency crises models which allow combining the domestic and external crisis processes in the economies with open current and capital accounts in the unified and integrated framework. The empirical basis is formed by the descriptive macroeconomic statistics which is provided by international financial agencies, Bank of Russia and Russian Statistical Agency. The political economy discussion is based on the discourse analysis of official documents of the Bank of Russia, Government of the Russian Federation, and the International Monetary Fund.

3 Results

3.1 Origins of the Crisis

Crisis processes in the domestic economy were not a one-stage phenomenon; they ripened gradually all previous years. It slow downed economic growth, which took place even in the period of high conjuncture in the world commodity markets in the early 2010s. The so-called zero boom was gradually but steadily replaced by stagnation. The Russian economy has not restored the pace of economic dynamics after the global economic crisis, although the conjuncture in the world commodity markets was even more favorable than in the 2000s.

In general terms, at the beginning of 2010, the Russian economy gradually exhausted all growth factors within the framework of the socioeconomic model that

[1]At the time of writing this contribution, the economic program of the Government of the Russian Federation remained unclear regarding the implementation of the task to ensure the rates of economic growth in the country higher than the average world set in the Address of the President V. V. Putin to the Federal Assembly.

Table 1 Comparative analysis of crisis processes in Southeast Asia and the Russian Federation ([3]For detailed author's analysis of crisis processes, see the work of Amirov and Sherstnev 2001)

Southeast Asia, 1997–1999	Russian Federation, 2014–2016
Stable macroeconomic situation on the eve of the crisis (the balance of the main current macroeconomic flows)	Stable macroeconomic situation on the eve of the crisis (balance of the main current macroeconomic flows)
Significant external debt of the private sector with a high proportion of short-term debt (cumulative reserve value)	Significant external debt of the private sector (cumulative stock size)
Significant role of the secondary sector in the economy and in foreign economic relations	Significant role of the primary sector in the economy and in foreign economic relations
Lack of significant financial reserves from the government and the private sector	A significant amount of financial reserves accumulated by various institutional sectors of the economy in the period of high commodity markets

Source Author (on the basis of official statistics)
[3]The Reserve assets/GDP ratio and the term structure of the foreign liabilities

developed in our country in the post-Soviet period. With a stable and even shrinking volume of labor resources (without taking into account external labor migration), the technological and institutional conditions in the economy, as well as the macroeconomic environment, have not created opportunities for labor productivity growth as the basis for increasing the well-being and quality of life of the population (Table 1).

As for the boom of the 2000s (which journalists sometimes called obese years), it is necessary to pay attention to the following circumstances. First, and this was repeatedly noted by economists and analysts, economic growth at the initial stage was compensatory after a deep transformational recession of the 1990s under conditions of a profound devaluation of the national currency (up to 75%) in August–September 1998. Secondly, during this period there was an exceptionally favorable conjuncture in the world commodity and raw materials markets, which led to a significant improvement in the terms of foreign trade for our country. *It should be noted that in the economy of the Russian Federation, periods of higher economic growth rates did not occur during periods of high prices for hydrocarbons and metals, they took place in periods of upward price dynamics in these world commodity markets*.[2]

The growth of both the prices of hydrocarbons and metals, as well as the growth in physical volumes of commodity exports, made it possible to obtain significant revenues (see data on hydrocarbon exports in Tables 2, 3, and 4 of the Appendix). As a whole in 2000–2013, the total amount of these revenues from the export of hydrocarbon raw materials amounted to almost 2.7 trillion US dollars.

[2]More specifically, it is necessary to pay attention to such an important fact that economic growth of the Russian Federation was in the 2000s in the face of rising oil prices, and high stable oil prices in 2012–2013 no longer gave a high rate of economic growth.

These processes of the commodities super boom had a number of important consequences for the Russian economy. First, the positive shock of foreign trade led to an increase in revenues of the budgetary system, enterprises, and households. Secondly, revenue growth in turn led to an increase in aggregate spending and aggregate demand in the economy. At the same time, optimistic expectations about consumer demand to some extent stimulated the growth of investment demand on the part of enterprises (first of all, in the branches of the primary sector). Thirdly, the public administration sector was able to sharply reduce the external public debt and began to accumulate significant external financial assets. Finally, fourthly, the positive trends at that stage in the Russian economy increased the interest of foreign investors in expanding investment and lending in our country, and stimulated the inflow of private capital in various forms (including Russian capital from foreign jurisdictions). For example, the period of 2006–2007 was the time when the balance of the international capital flows of the private sector of the Russian Federation became positive—a unique phenomenon in the economic history of post-Soviet Russia.

The above-described economic processes in turn stimulated the growth of the financial sector, primarily the recovery and growth of the banking sector recovered after the upheavals of the late 1990s. In the conditions of the economic boom and the growth of monetization, the banking system received a significant amount of liquidity, expanded the list of credit instruments, and increased the volume of lending for various borrowers within the country. A new phenomenon for our country in the 2000s was the rapid development of various forms of consumer lending (which, however, largely concentrated on financing personal consumption and non-productive investments of households)—mortgage, car loans, for the purchase of durable goods, through credit cards for current needs, which further contributed to the growth of consumer spending of the population and the magnitude of consumer demand in the economy.

The credit boom also stimulated the growth of prices for assets [shares in enterprises, securities, real estate (primarily in large cities, see, e.g., data on Moscow residential property in Table 5 of the Appendix)]. But at the same time, the expansion of economic activity was accompanied by an increase in levels of debt burden both for enterprises and for households. Dramatic growth showed the external debt of the corporate and banking sectors, despite the fact that both the public administration sector and the private sector increased external assets.

An important feature of the economy of the Russian Federation is the fact that, on the whole, in the post-Soviet period our country had a significant positive balance of the current account of the balance of payments, which is identically equal to the difference between national savings and national investments. *This means that in general, the Russian economy saves much more than invests in domestic development, acting as a net lender and investor in the world economy* (see data in Table 6 of the Appendix). During these years, the real exchange rate of the ruble appreciably strengthened (see the data in Table 7 of the Appendix).

According to various estimates, in the structure of Russia's GDP, the products of the fuel and energy complex occupy 17–20% (i.e., according to the general structure of the economy, ironical comparisons with the oil monarchies of the Arab East are

incorrect, because there this share reaches 50–70%). At the same time, these industries provide about 2/3 of Russian exports (up to 2017) and more than 1/2 of all revenues of the budget system. This is our main offer to the world economy and the basis of both our demand for goods and services of the external world and the basis for the existence of all domestic industries and infrastructure that ensure the movement of these goods and services from the outside world to the Russian consumer, from giant shopping centers in major cities to the greater part of assembly production of world auto giants, concentrated mainly around Moscow and St. Petersburg. These same commodity incomes are the main source of resources for the accumulation of external assets by all the institutional sectors of the Russian economy. Expected future revenues from such exports at the moment (and not, e.g., the current expectations of the export potential from commercialization of the projects of Rosnano Corporation, the new Skolkovo Innovation Centers or even the products of the Russian defense enterprises—the gross export of which even in recent crisis years was inferior to the joint export of fuel and energy complex and metallurgists, and net contribution to the balance of payments on the basis of available open data is impossible to estimate) serve as the main reference point for the outside world when assessing the prospect and development of the Russian economy and their current decisions on investing and lending in the Russian economy.

3.2 Nature and Dynamics of the Crisis

Understanding the lessons of crisis processes requires answers to the following questions:

- What is the nature of crisis processes in the Russian economy and what kind of crisis has our country experienced?
- What analogies can be drawn from the experience of other countries?

According to the author, the totality of crisis processes of 2014–2016 can characterize them as a systemic financial crisis in the Russian economy, which demonstrated a whole set of phenomena and affected both the financial and real sectors of the economy.

The immediate trigger for the crisis was the global drop in oil prices, which significantly changed both *the current picture* of the domestic economy and *expectations* regarding its future development. The negative shock of foreign trade means a drop in incomes of the subjects of the economy, and, consequently, a drop in costs and demand in the economy now and in the future. But the current decisions and long-term investment plans depend on the current expectations of future demand and future profits … The investors, both Russian and foreign, instead of a miracle saw a vanishing mirage, an outflow of private capital began to grow in avalanche—*and the US and the EU sanctions are an additional negative factor, but not the root cause of the change in investor sentiment; we note that potential Asian investors also want to see demand and revenues in the future*—which began to

squeeze various price bubbles in asset markets, including the Russian currency (in fact, the fall in the Russian currency, together with the fall in oil prices in practice, meant impairment of all Russian assets in an almost directly proportional relationship to the global economy).

4 Discussion

Any analogies for a complex socioeconomic reality are conditional and incomplete. But one of the tasks of analysts is to identify and generalize some typical crisis phenomena in the modern world economy that are characterized by the same essential features and functional patterns and allow the development of theoretically grounded recommendations for mitigating and overcoming the consequences of such phenomena.

4.1 International Experience of Financial Crises

The study of financial crises has received considerable scope in the last two decades and has generated extensive scientific, political, and business literature. The given circumstance is connected with an increase in a spectrum and scale of crisis shocks in the modern world economy, starting from the crisis in Mexico in 1994 and finishing with financial cataclysms during the global economic crisis of 2008–2009 and the debt crisis in the euro area in 2011–2012. These processes went in parallel with the global trend to increase the mobility of international capital flows.

Evidently, the current situation in the Russian economy has many similarities to crisis processes in the countries of Southeast Asia in 1997–98, which, with a generally stable macroeconomic situation, faced a stoppage of inflows and then a massive outflow of private capital, which provoked a debt crisis of the private sector burdened with large external debts and the systemic financial crisis that followed it.

The essence of this type of crisis is reduced to the loss of market confidence in a particular economy and its future prospects, which is reflected in certain interrelated economic processes both within the national economy and in its relations with the outside world. In the internal sphere, investment activity is curtailed, the price bubbles are squeezed in the asset markets, the economic recession is falling with recessions of different duration, the problems in public and private finance, and the financial sector instability are growing. In the external sphere, the inflow stops first, and then there is a large-scale outflow of private capital under the free regime of its international movement, which increases the volatility of all other macroeconomic parameters.

The economic price of crisis shocks of this type, as the real experience of Asian countries shows, is quite high (more than 10% of the GDP decline, not counting the costs of recapitalizing the banking sector and various forms of support for enterprises and the population). Through international financial and trade relations,

as well as the interdependence of expectations of international investors, this type of crisis has significant international effects (in the case of the Russian Federation, negative effects primarily fall on the CIS countries and partly on eastern Europe).

4.2 Systemic Financial Crisis and Modern Economic Theory

In the economic theory for modeling this type of crisis, the so-called third-generation currency crisis models have been developed.[3] Based on the experience of countries of Southeast Asia, they attempted to integrate various internal economic and external economic aspects of crisis processes in various institutional sectors of the economy and build a logically linked chain of relationships between observed phenomena. In these models, the interrelations of the currency instability, the banking sector stability, the foreign exchange instability, and the external debt of the private sector are studied.

In the event of the Russian Federation, such a chain can be built as follows:

The boom in the world commodities markets:

The growth of world commodity prices—the growth of incomes of all institutional sectors of the economy with different time lags—the growth of expenditures and aggregate demand of all institutional sectors of the economy with different time lags—the growth of prices for various assets—the expansion of the liquidity of the financial system and the scale of financial intermediation—the expansion of investment activity—the expansion the influx of foreign capital—the strengthening of the real effective exchange rate of the ruble.

Decline in world commodities markets:

The fall in world prices for raw materials—the fall in the incomes of all institutional sectors of the economy with different time lags—the fall in spending and aggregate demand for incomes of all institutional sectors of the economy with different time lags—the fall in the prices of various assets—squeezing the liquidity of the financial system and the scale of financial intermediation—squeezing investment activity—an increase in the outflow of capital—a fall in the real effective exchange rate of the ruble through the currency crisis.

It should be noted that such processes as: the growth (fall) in prices of various types of assets—expansion (squeezing) of the liquidity of the financial system and the scale of financial intermediation—an increase in the inflow (outflow) of capital can form a spiral process with mutual reinforcement of these processes, which is important for understanding the expansion and squeezing of price bubbles in the open market economy.

[3]See Tirole and Tirole (2002), Saxena (2004) and the latest detailed review of Lorenzoni (2015), International Financial Crises in Gopinath, G., Rogoff, K. (Eds.), Handbook of International Economics, Elsevier, 689–740.

Accordingly, this approach more adequately reflects the content side of economic processes in this type of crisis than simply a formal analysis of shocks and the speed of return to potential equilibrium dynamics in DSGE-type models.[4]

5 Conclusions

The following important questions are:

- Will the systemic financial crisis lead to the transformation of the socioeconomic model that has been developed in Russia and what are the possible economic mechanisms for the post-crisis recovery?
- What are the appropriate tools for anti-crisis economic policy in this type of crisis for a country with a commodity-based economy?

With the beginning of the rise in oil prices, the recession in the Russian economy has ended and it shows a small positive trend. However, figures in 1–2% of the annual GDP growth are less than the average growth rates of the world economy in recent years, and developing countries with comparable levels of development and even leading industrialized countries.

5.1 Prospects for Restoring Sustainable Growth

The price of oil is an unpredictable and very volatile parameter; therefore, with the almost mono-cultural structure of exports (in which, up to 2017, almost three-fourths of the value structure of exports of goods was accounted by hydrocarbons and metals), the entire Russian economy inevitably finds itself in a zone of great uncertainty—from formal flows in the budget system to informal flows of various rents. Under such conditions, the swing of fluctuations in the parameters of the economic system may prove incompatible with the stability of the system in the medium and, especially, long-term plan, and this will result in the need for institutional and structural changes. But what are these changes in perspective?

In recent years, at the official level and in a significant part of the expert community, experts mainly talked about import substitution within the current system, as a way of increasing the autonomy of the national economy from external shocks (Why then did they accelerate integration into the world economy, especially the liberalization of investment operations on the eve of the G-8 summit in St. Petersburg in 2006? Did the political prestige turn out to be more important than the

[4]Is it possible to talk theoretically about any equilibrium path in the Russian transition economy in the post-Soviet period, taking into account the real demographic, investment and technological dynamics, the health and education situation around which the temporary shocks occur? Will the use of standard methods of accounting for the growth factor in such an economy be justified?

economic reality? Did they have the illusion that the Russian economy is internal and the nature of foreign economic relations is the same as that of the G-7 countries? And is it necessary to join the WTO as an exporter of primary resources?). But import substitution can give the main results only in the medium and long term and at the same time it requires large current investments, and the Russian, Asian, Latin American, and African investors should see the prospect of future demand and future revenues, on the one hand, and have sources of their financing at reasonable rates, on the other hand (and what could be expected at rates of 20–25% per annum? Carry trade transactions from different geographic areas?).[5] In short, the long-term return on investment in Russia, taking into account the perceived risk, should not be lower than in other parts of the world economy (and this rational choice is made not only by foreign but also by domestic investors under the regime of free international capital flow). But after a quarter of a century of market transformation, what are the prospective spheres of the long-term private investment in Russia, recognized by the world and Russian business, outside the first redistribution sectors, some branches of the food industry and the service sector? And will the country come out of the present crisis with an even more primitive economic structure and even more primitive economic and political institutions? Meanwhile, domestic entrepreneurs will buy up student hostels in London.

5.2 *Crisis and Policy Measures*

The macroeconomic policy of the Government of the Russian Federation was initially focused on stabilizing the national economy in the context of external shocks, but did not contain the potential to overcome crisis processes on the way to the transition to sustainable economic development and growth.[6] To a large extent, in terms of the anti-crisis measures in 2008–2009 (but then there was *a global cyclical economic crisis* in the entire world economy), a program was proposed that was aimed at supporting the banking sector and large companies *within the framework of the existing economic structure through previously accumulated state financial reserves* (which, however, are by no means endless). At the same time, in the budget parameters for 2016–2017 (taking into account the situation in regional

[5]This work did not take into account the issue on the boundaries if import substitution in the globalizing world economy. In the case of the Russian Federation, the issues of ensuring national security in the context of the possibility of financial and technical sanctions outside the UN Security Council and the WTO by certain developed countries and integration groups are important. But at the beginning of the events, the representatives of the largest Russian oil companies started complaining that the proposed policy of import substitution is ineffective and can paralyze the investment process, because they want to work on the most advances equipment that can be purchased only abroad in the foreseeable future. And in the general conceptual framework, the principle of comparative advantage as the basis of international socialization has not been refuted.

[6]Order of the Government of the Russian Federation of January 27, 2015 No 98r.

and municipal finances), macroeconomic policy generally acquired *a pro-crisis character*, because reduction of budget expenditures is an additional source of reduction of aggregate demand in the economy.

The Central Bank, which within the framework of the transition to the inflation targeting policy announced by its leadership, untied the monetary policy from supporting the exchange rate and made the transition to the floating exchange rate of the ruble at the most acute moment of the currency crisis, simultaneously created conditions for high inflation, the volatility of the ruble (30% a quarter in the first half of 2015), and high interest rates.[7] *This is the exact set of conditions that guaranteed the lack of any private investment in projects not related to the rapid turnover of capital and various speculations, as well as the lack of confidence of private consumers in the future…*

In the short term, the volatility of the ruble exchange rate has become a serious problem for the Russian economy, which is already closely linked with the world economy, in such conditions, business entities are not in a position to form sound medium- and long-term investment plans, and even to make short-term economic decisions in foreign economic transactions with a rapid turnover of capital (after all, rates of 50 or 70 rubles per dollar can fundamentally change the economic efficiency of many even current economic operations, although we emphasize once again that such swings of the ruble exchange rate become a Klondike for financial speculators).

What solution was offered by the Russian financial authorities? In the Financial Stability Review of the Central Bank of Russia, at the beginning of the crisis, the following was said: "A key role in ensuring financial stability is played not only by anti-crisis measures of state support, but also by the ability of market participants—banks, non-financial organizations and non-financial companies to learn from negative experiences, to improve the practice of risk management, including hedging, to form capital buffers and liquidity. Non-financial organizations can be recommended to more carefully assess currency risks when borrowing, the currency component of the debt should correspond to a certain amount of foreign exchange earnings, including taking into account its possible reduction in the ruble weakening period. Enterprises should use caution in currency derivatives, assess potential losses in the event of stress in advance, and measure them against the expected benefits. It is also advisable for banks to take into full account the interconnection of the currency risk of borrowers and credit risk."[8] That is, according to the regulator, you need to hedge the risks, but you need to do it carefully, remembering the risks of hedging itself! And whose negative experience

[7]Press release of the Bank of Russia of December 17, 2014 "On the measures of the Bank of Russia to maintain the sustainability of the Russian financial sector." In principle, the raising interest rate is a standard tool for stabilizing the exchange rate in the face of its excessive volatility (flight), but in the very short term (Dornbusch 1976). A two-year period of high rates is unlikely to be in this category, and in such a situation there are additional negative effects, which in total can exceed the tax burden from the policy of high interest rates (Stiglitz and Greenwald 2003).

[8]The Bank of Russia. The overview of financial stability. IV quarter 2014 – I quarter 2015, M., 2015.

do the authors of the document mention—*economic agents* acting in accordance with the situation or *macroeconomic management agencies*, who are responsible for macroeconomic stability? Of course, it is better for practitioners to judge such recommendations, but there is a doubt about the ability of the national financial system at this stage of its development to offer the necessary set of hedging instruments in a floating exchange rate in an emerging market economy (a difficult transition of Bretton Woods to the Jamaican currency system or negative results of currency forward contracts in Russia in August 1998).[9] And the global world crisis of 2008–2009 showed that *the use of derivative financial instruments is not a panacea, and it is a source of very serious problems*.

So what are the main lessons of crisis processes? Apparently, the *general conclusion* is that in such an economic situation, the financial authorities should first of all direct efforts to *limit speculative motives in the actions of economic agents*, even within the framework of the current currency regulation legislation. First, if necessary, it is possible to introduce mandatory sales of export foreign exchange earnings to equalize the currency flows in the market. Secondly, the authorities can change the norms of the open currency position of commercial banks and can more prudently approach the licensing of foreign exchange operations from commercial banks. And, finally, thirdly, it is necessary to return once again to a calm discussion of the possibilities of applying measures to control the international capital movement as one of the instruments of macroeconomic management, at least "hot money," taking into account the current level of academic and political discussions on this issue in the world.[10]

As for the stability of the national currency and the equilibrium of inflation and devaluation expectations in the medium and long terms, they can be ensured only by a stable and growing economy (and this is not enough to have price stability for stagnation or even sluggish growth in recovery), but in the short term the plan should at least try to soften the current systemic financial crisis and prevent such catastrophic jumps in the exchange rate of the national currency as in the autumn–winter of 2014–2015.

In the medium-term perspective, the main task of the federal authorities should be to stimulate the structural reorganization of the economy on the basis of investments in its own economy and dynamic innovative economic growth, and here we have to take serious actions, since we have heard about good institutions and the subsequent miraculous "invisible hand" for more the quarter of the century.

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[9]The Russian judicial practice of 1998–1999 qualified such contracts as gambling, and foreign holders were explained that they got in Russian roulette, and if the lose, then they should not complain.

[10]International Monetary Fund, 2012, "The Liberalization and Management of Capital Flows—An Institutional View," (Washington, DC: International Monetary Fund), http://www.imf.org/external/np/pp/eng/2012/111412.pdf; International Monetary Fund, 2016, Capital Flows—Review of Experience with the Institutional View (Washington, DC: International Monetary Fund), https://www.imf.org/external/np/pp/eng/2016/110416a.pdf, Accessed 10 February 2018.

Table 2 Export of crude oil

Indicators/years	2000	2001	2002	2003	2004	2005	2006
Oil run, mln. tons	144.4	164.5	189.5	228	260.3	252.5	248.4
Price, mln. US dollars	25271.9	24990.3	29113.1	39679	59044.8	83438	102282.9
Year-average price, $/barrel	23.94	20.78	21.02	23.81	31.02	45.21	56.32

Indicators/years	2007	2008	2009	2010	2011	2012	2013	Total
Oil run, mln. tons	258.6	243.1	247.5	250.7	244.5	240	236.6	3208.6
Price, mln. US dollars	121502.8	161147	100593.2	135799.3	181812.4	180929.7	173669.6	1419274
Year-average price, $/barrel	64.28	90.68	55.61	74.11	101.74	103.14	100.41	58.005

Source The Bank of Russia

Table 3 Export of oil products

Indicators/years	2000	2001	2002	2003	2004	2005	2006	2007
Oil run, mln. tons	62.6	63.3	75.5	77.7	82.4	97.1	103.5	112.3
Price, mln. US dollars	10918.8	9374.5	11253.2	14060	19269.1	33806.5	44671.7	52227.6
Year-average price, $/barrel	174.53	147.99	149.13	181.01	233.84	348.27	431.63	465.15

Indicators/years	2008	2009	2010	2011	2012	2013	Total
Oil run, mln. tons	118.1	124.5	133.2	132.1	138.2	151.6	1472.1
Price, mln. US dollars	79885.6	48144.9	70471.1	95709.9	103624.2	109334.8	702751.9
Year-average price, $/barrel	676.54	386.76	529.16	724.69	749.94	721.35	422.8564286

Source The Bank of Russia

Table 4 Export of natural gas

Indicators/years	2000	2001	2002	2003	2004	2005	2006	2007
Gas run, billion cubic meters	193.9	180.9	185.5	189.4	200.4	209.2	202.8	191.9
Price, mln. US dollars	16644.1	17770	15897.3	19980.9	21853.2	31670.5	43806.2	44837.4
Year-average price, $/thousand cubic meters	85.84	98.25	85.69	105.51	109.05	151.36	216	233.66

Indicators/years	2008	2009	2010	2011	2012	2013	Total
Gas run, billion cubic meters	195.4	168.4	177.8	189.7	178.7	196.4	2660.4
Price, mln. US dollars	69107.1	41971.4	47739.3	64290.1	62253.3	67232.3	565053.1
Year-average price, $/thousand cubic meters	353.69	249.27	268.48	338.88	348.33	342.29	213.3071429

Source The Bank of Russia

Table 5 Prices for flats of medium quality

Years	2000	2001	2002	2003	2004	2005	2006	2007
Price, m^2	12910.76	16488.8	19980	26868.52	33695.4	38803.9	67533.7	72416.9
Absolute growth[2]	–	3578.05	3491.14	6888.57	6826.92	5108.47	28729.81	4883.17
Growth rate, %	–	27.71	21.17	34.48	25.41	15.16	74.04	7.23

Years	2008	2009	2010	2011	2012	2013
Price, m^2	95700.8	96077.1	101360	98676.9	112500	130753
Absolute growth[2]	23283.91	376.31	5282.89	−2683.13	13822.71	18253.05
Growth rate, %	32.15	0.39	5.50	−2.65	14.01	16.22

Source Russian State Statistics Service, Rosstat

Table 6 Current account balance, savings, and investment of the Russia Federation

Indicators/years	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Current account balance, % GDP	18	11	8	8	10	11	9	5	6	4	4	5	4	2
Gross savings, % GDP	37	33	28	28	30	31	30	31	30	21	26	30	27	24
Gross investment, % GDP	19	22	20	20	20	19	21	25	24	17	22	24	24	23

Source International Monetary Fund

Table 7 Change in real effective exchange rate of the ruble, %

Years	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Change in real effective exchange rate of the ruble, %	4.6	10.1	7.7	4.6	6.2	−3	4.7	2.5	4.5	−2

Source The Bank of Russia

Appendix

See Tables 2, 3, 4, 5, 6, and 7.

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Modeling the Spatial Organization of the Higher Education System in the Regional Economy

E. V. Bolgova and M. V. Kurnikova

Abstract The innovative strategic scenario of Russian regions requires new models for the territorial distribution of resources, key ones to this type of development. The development of these models is especially important for higher education, which is a basic condition for building innovative subsystems, creating poles and growth centers, a factor in reducing development differentiation in regions. The spatial organization was not in the focus of higher education reforms for a long time, despite the innovative agenda, the deep theoretical basis and the successful world experience of its modeling as a management tool. In this regard, the objective of the study is to substantiate the methodology for managing the development of the higher education system on the basis of spatial organization models that have been effective in countries with similar territorial conditions, trends and problems of the university network development. Within the framework of the research, the following tasks should be solved: to study theoretical foundations of modeling the spatial organization of the higher education system and to develop models; to determine the factors for the successful application of a model in Russia that has proved effective in the results of econometric analysis; to generalize foreign experience and suggest schemes for implementing a priority model in the economy of Russian regions. The scientific novelty of the study is to develop a methodology for managing the development of the higher education system with the possible implementation of spatial modeling tools. The methods of the research are theoretical-empirical, systemic and comparative analysis. Special methods of economic and statistical analysis, ranking techniques, general and special purpose software tools (Microsoft Excel, Statistica 8.0) are used for observing and grouping data, building generalizing indicators, in assessing the connection of phenomena, for comparing facts and determining the characteristics of the priority model of the spatial organization of the higher education system, the conditions for its application in the economy of Russian regions. The main conclusions and results can be used for the research in the spatial distribution of economic

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resources in the innovative economy, in the practice of targeted programming for the development of vocational education, taking into account the characteristics of the subjects of the Russian Federation.

1 Introduction

The key to the innovation strategy of the Russian Federation is education, which is inseparable from the goals of the Economy-2030, defined as the economy of the intellect. The urgency of searching for new, effective ways to modernize education is determined by the tasks of expanding the segment occupied by the country in the world market of high-tech products to 10%, bringing the volume of the gross added value of the innovation sector in the country's GDP to 20%, which is expected to be solved solely through the growth of intellectual potential—one of the main competitive advantages of Russia.

The transition of the country's economy to the innovative development is impossible without the implementation of innovative scenarios in Russian regions, which requires significantly improving the rationality of the spatial distribution of resources that provide this type of regional progress.

In resource support of the innovative development, education is considered a pole and growth center, a factor of smoothing the regional differentiation and spatial polarization, an important condition for building a competitive economy that is resistant to crisis phenomena and capable of ensuring high rates of social development. Only the localized education system, spatially integrated into the economy of Russian regions, can solve such problems.

A special role in these processes is assigned to higher education, which, in the strategic perspective, will focus on a significant increase of its contribution to the social and economic development of Russian regions, and on building the competencies necessary for the region to implement the innovative scenario without alternative (Khasaev et al. 2015, 2016; Ashmarina et al. 2017).

Priorities of the innovative development impose organizational and content directions to modernize higher education, which are not just to adapt to changing conditions of the labor market, but to evolve as a system with innovative ideas, breakthrough solutions, and technologies that take into account the characteristics of Russian regions.

The obstacle to such development is management practice, where the functioning of universities located in the region is considered in isolation from the spatial and socio-economic characteristics of the region, selected regional strategies and scenarios for their implementation. In the territorial administration, this gap creates the insufficient contribution of higher education to the development of the regional economy in the innovative scenario. The management of the public service sector leads to the persistence of unsatisfactory performance characteristics of the university network.

The current management practice is based on scientific views of Russian scientists exploring the role of higher education in factors of the socio-economic development and territorial mechanisms for its implementation.

Fundamental provisions of the impact of education on the socio-economic development of the country are formulated in the framework of the knowledge-based economy theory by Makarov (2003), Lvov et al. (2004) and Kolesov (2008) on the basis of the works of Bell, Inozemtsev (1999).

Organizational-economic models that determined the ways to modernize Russian higher education were formed by Volkov et al. (2009) and Mau (2012).

Theoretical and methodological provisions for assessing the contribution of vocational education to macroeconomics were developed by Belyakov and Klyachko (2016).

The authors who formed scientific views on space as the economic phenomenon pointed to the causal relationship of the higher education system and spatial development: Kolosovsky (1969), Artobolevsky et al. (2011) and Granberg (2012).

Structural aspects of the impact of education on spatial socio-economic systems, including production clusters in the region, made it possible to comprehend the results of the studies of Tsihan (2005), Bazhutkina (2005), Kozlova (2013) and the territorial structure of higher education in Russia of Katrovsky (2003).

Highly appreciating the contribution of domestic scientists to the problems, we note that the studies conducted do not sufficiently take into account possibilities of modeling as a tool for managing the spatial development of the higher education system and the positive experience of foreign countries accumulated in the use of these tools.

A number of these countries in similar territorial and socio-economic conditions to Russian ones, as well as related processes in the evolution of the university sector, equally related to large-scale complexities, were able to develop models for the spatial organization of the higher education system and on its basis to form an effective university network in regions.

France, of course, belongs to such countries, higher education is one of the basic priorities of both the state policy and the policy of regions, and the multi-leveled territorial structure and the multistructure of the economy are successfully combined with benchmarks of the innovative development.

2 Materials and Methods

2.1 Theoretical and Methodological Foundations for Modeling the Spatial Organization of the Higher Education System

Theoretical Foundations of Modeling

By the beginning of the third millennium, the spatial aspect of reforming the higher education system has become part of the priority agenda in many European and Asian countries pursuing an active policy of the innovative development of their territories.

In connection with these processes, theoretical foundations of the spatial development of the higher education system, defined by provisions of the "new economic geography," were formed. Perru, Budvil, Lazuen, Potier (1950–2010) and other representatives of the modern French school of spatial economics proposed to combine large and small enterprises, research and education institutions to work together in a particular region, to develop synergies and joint efforts around common tasks.

The views of many scientists, who researched and identified trends in the development of higher education, substantiated their causes by a number of interrelated challenges of the global economy.

The modern challenges such as demographic changes and the growth of the number of students, internal and external migration processes, academic mobility, the expansion of the world market for higher education, the growth of heterogeneity of trainees in terms of socio-cultural characteristics, changes in the labor market increasing the share of employed people having higher education fundamentally change substantive and organizational foundations of higher education (Sinelnikov-Murylev et al. 2017).

Earlier, Bauman (2002) noted that the global context for the development of higher education, the formation of the information economy have made universities rethink their own role, including the territorial one, as the world "which no longer needs their traditional services, sets new rules for prestige and influence, and looks at the values that universities stand for with increasing suspicion."

Goldstein and Drucker (2006) pointed to a shift in the traditional—educational and research—functions of higher education. In the opinion of these authors, the development of technologies leads to the fact that the university begins to fulfill the "entrepreneurial function, the function of commercializing innovation, involving network interactions between higher education organizations, business and the state within individual territories, thereby strengthening the role of higher education in the territorial development."

The territorial interaction is described by the triple helix model proposed by Etzkowitz and Leydesdorff (1997) and Etzkowitz (2002a, b), which assumes the equality of universities, enterprises and authorities in the innovation system. The main content of the model is that in addition to the task of developing innovation by universities through the generation of new knowledge, production tasks of enterprises localized within the boundaries of a certain territory, as well as socio-economic tasks of the development of this territory are being solved in parallel.

The innovation form of higher education, a new model of the university, evolving on the basis of a wide range of approaches, from the "knowledge economy" (Goddard et al. 1999) to the cluster approach to the university as an educational and scientific center, is becoming an answer to challenges of competition in the international market of education services and the factor of the regional development (Etzkowitz 2002a, b; Chatterton and Goddard 2000).

Modeling Methodology

Based on the presented theoretical concepts, as well as on numerous empirical studies conducted and published by foreign scientists in the last twenty years, the Organization for Economic Cooperation and Development (OECD) has proposed four new—possible—models of the higher education system that effectively implement scenarios of the innovative development. The content of these models is determined by options for university interaction with enterprises and forecasts for the development of university education ("Four future scenarios for higher education" http://www.oecd.org/education/skills-beyond-school/42241931.pdf):

- Open international network;
- University—a new responsibility of the state;
- University "Higher education Inc (corporate university)";
- "University on duty of regions and municipalities."

The latter model contains characteristics of the spatial organization of the higher education system, which implies the concentration of universities on national, regional and local goals, tasks and development priorities. Within the framework of the "university on duty of regions and municipalities" model, the functions of universities in education and research strategically coordinate with the needs of the region and municipalities.

3 Results

Conditions and Experience of Using the "University on Duty of Regions and Municipalities" Model in the Economic Space of Russian Regions. Factors for Successful Application of the Model

The increased practical interest in understanding the impact of the higher education system on the regional development in Russia is due to significant changes in conditions both at the global and national levels, which include the weakening of the role of the traditional production sector in economies of many countries and the creation of progressive forms of economic space. Such conditions predetermined the innovative development of regions within countries, the desire to create a knowledge-based economy on their territory, both through the development of knowledge-intensive industries and innovative enterprises, and through an active policy of clustering and retention of qualified personnel with competencies that meet the needs of the innovation economy and rapidly changing clusters' preferences.

To build the "university on duty of regions and municipalities" model of the higher education system in the economic space of the region, two theoretical approaches characterizing the impact of universities on the development of adjacent territories and a number of empirical arguments, substantiated in the works of European scientists, should be singled out.

The first approach regards the university as a provider of basic scientific knowledge for the needs of production, primarily agriculture and manufacturing. Within the framework of this approach, the role of knowledge in the production system is secondary and therefore the exogenous one. The process of the knowledge dissemination and development is considered linearly and is described as a "science push model," in which knowledge is created within the walls of the university or research laboratory of a large firm outside the production system and then transferred to production (Guston 2000).

In the second approach, the role of higher education, fulfilling its research and education function, is: (a) to ensure the development of regions; (b) in the long term —to keep local cultural norms (Smith 1990; Freeman 1995, 2000).

Clusters—innovative spatial systems—united universities and production, created dynamic complexes of interaction between higher education, economics, authorities, business development institutions, labor markets, capital and products, and predetermined the second approach. In the cluster system of interaction, universities perform eight basic functions: creating knowledge, building human capital, transferring existing know-how, creating technological innovations, investing in fixed assets, regional leadership, influencing the regional habitat and producing knowledge infrastructure (Lundwal et al.). The level of importance of higher education within a particular region depends on its ability to meet the needs of production clusters in specialized professional competencies, as well as from a number of factors presented in Table 1, compiled by the authors according to

Table 1 Impact of the higher education system on the socio-economic development of the region

Factor name	Content of the factor
Accounting university specialization of the regional economy	Availability of higher education programs that take into account the needs of territorial production
Development of links between the university and region	History of main interactions between the university and society living in this territory, the university and territorial authorities
Conformity of scientific research to the regional industrial needs	Focus of research activities on meeting production needs of the territory
Institutes of interaction between higher education and the region	Presence of territorial and production associations that include higher education, as well as the existence of institutions that provide interaction between elements of such a system
Regional specialization in the country's economic space	Availability of territorial specialization, as well as the needs of main enterprises in knowledge
Political and economic conditions	Degree of dependence of higher education on major policy decisions and changes in economic conditions

Source
1. Smith et al. (1998)
2. Goldstein et al. (1995)
3. Gunasekara (2004)
4. Kohoutek et al. (2017)
5. Trippl et al. (2004)

Lawton et al. (2001), Goldstein et al. (1995), Gunasekara (2004), Kohoutek et al. (2017) and Trippl et al. (2004).

Econometric Analysis of Model Efficiency

In foreign publications, empirically obtained evidence is provided that the higher education system stimulates the development of less developed regions, such as Wales (Pugh 2016), peripheral regions of southern Italy (Harrison and Turok 2017), rural Israel (Johnston and Huggins 2016; Frenkel and Leck 2017).

In this connection, the econometric analysis of dependence of the economic welfare of regions on universities' activity is of particular interest. Researchers use the multiple regression models, in which the average annual income of workers in the analyzed region is the dependent variable adjusted for the consumer price index. Explaining variables are the amount of expenditure on research activities; the total number of scientific degrees awarded in the region, including the bachelor's and master's degrees; proportion of Ph.D. awarded in the field of science and technology, in the total number of graduates of universities; the number of patents received by universities in the region. The study is based on data on 313 US agglomerations, and the time period covers the interval 1986–2001. The results of the research show that all four variables of the regression equation are significant in explaining changes in the average income level, with the greatest impact on the socio-economic development of the region being spent on R&D. In a relative assessment, they show that every additional 10 million $ increase the average income level of the regional population by 2.3% (Goldstein and Drucker 2006).

Foreign Experience in Applying the Model

The empirical arguments for using the "university on duty of regions and municipalities" model include the positive experience of France, a country in which the significant role of higher education in the regional development is realized by authorities.

At the beginning of the twenty-first century, the task was set to transform higher education institutions into structures that would ensure the development of high-tech industries and the development of new technologies in regions of that country. A number of key reforms and institutional reforms aimed at modernizing the higher education system and creating new institutions providing cooperation between universities, research centers, enterprises and territorial communities were undertaken.

In 2004, the French government decided to create poles of competitiveness (pôles de compétitivité), a tool for a new state and industrial policy. The poles of competitiveness are associations of enterprises, research organizations and education centers located on the same territory. Later, in 2006, a project was launched to create new structures in the field of education and science—the poles of research and higher education (pôles de recherche et d'enseignement supérieur)—designed to foster cooperation between universities, "big schools" and research structures located on the same territory. The poles were adapted to the specifics of regions and local labor markets, and they facilitated the implementation of territorial projects in

the field of education and research, territorial development projects. The policy pursued has optimized the spatial distribution of the higher education system in France, although it has criticized the possible risks of creating an elite education by concentrating the best universities and research centers in several regions, violating the principle of equal access to higher education.

In 2013, the next step was taken to build the "university on duty of regions and municipalities" model, aimed to develop education clusters in the framework of "Initiatives d'Excellence-Idex." The reform at this stage included three priorities: the formation of education clusters within the framework, the reduction and consolidation of the number of universities, the construction of a new model of the university. Already in 2015, 25 territories were selected for the formation of new types of universities in the country, and the main characteristics of universities within the framework of the new model were work at the level of the territory, attraction of private structures and regional management to technologies, solving issues of scientific-technical and regional development, infrastructure for new technopolises. In essence, universities become multidisciplinary centers of research, and they are responsible for the implementation of their results in the practice of the territorial development. Thus, the program "Initiatives d'Excellence-Idex" has achieved its goal of turning the university into an innovation center for scientific, education and regional development (Analytical Interim Report on the Implementation of the Future Investment Program 2016).

The successful introduction of the "university on duty of regions and municipalities" model in France is confirmed by the fact that the top 500 rating of the QS represented about 60% of Parisian universities, and more than 40% of the list were universities operating in the "non-metropolitan" region (the assessment was carried out by the authors according to the Web site https://www.topuniversities.com/qs-world-university-rankings/). This feature of the rating is the result of a conscious modeling of the spatial organization of the higher education system that solves the problem on the uniform placement of universities across France in order to provide the entire population with equal access to quality higher education, and for large, small and medium-sized businesses equal access to the results of scientific research conducted by universities and higher schools.

They prove the high efficiency of the "university on duty of regions and municipalities" model of the spatial organization of the higher education system in France and the results of national ratings. The French national Eduniversal rating is today the only one that assesses the results of higher education in accordance with the market criteria. With the help of their own approach and methodology, based on the criteria of university fame and prestige in the eyes of employers, the size of the average salary of graduates, the students' satisfaction with the results of education, higher education programs are ranked in the bachelor's, master's and doctoral studies. The rating uses a score of programs, conducted on the basis of their own polls and expert opinions, according to which the majority of programs implemented in France are ranked. The popularity of the Eduniversal rating in France is ensured by the transparency of this methodology, high reliability and relevance of the assessment (grades are updated at the beginning of each academic year or cycle,

for programs implemented during 18 months of training or 2 times a year), and an obvious practical benefit.

The classification of the three best master's degree programs, performed in the context of the university or the higher school location in which it is implemented, proves that the principle of uniformity remains a priority in the spatial organization of the higher education system in France.

Out of 189 master's degree programs, MSC and MBA, which are included in TOP-3 in Paris, 88 or 47% are implemented. In the group of three best programs in each area of training, 101 programs or 53% are implemented by universities and higher schools outside the capital. Obviously, the presented classification is a result of high quality of higher education not only in large cities and recognized university centers such as Grenoble, Bordeaux and Lyon, but also in cities whose importance as territories with a developed higher education system in the global aspect has not been universally recognized yet (the assessment was carried out by the authors according to the data from the site http://www.meilleurs-masters.com).

The uniformity of placement on the territory of the country is also demonstrated by the distribution of the number of students by large territorial units—macroregions of France, presented in Table 2.

In departments located outside Paris and the capital of the Ile-de-France district, 62% of undergraduate students, 60% of master's degree programs and 55% of doctorates are trained. The number of students is distributed evenly and is in the range from 7 to 11% in each of macroregions with a high uniformity of the distribution by the region. It is obvious that France managed to avoid excessive concentration of the higher education system in the capital or central regions, to ensure a high uniformity of the distribution and territorial balance.

Author's Schemes for Implementing the "University on Duty of Regions and Municipalities" Model in the Economic Space of Russian Regions

The conclusion, which confirms the successful proposed model of the spatial organization of the higher education system, leads to the conclusion that the dissemination of the accumulated experience can become an example for Russia and those countries that seek to implement an innovation scenario in the regional development and consider the higher education system as a factor of such development.

The network scheme to implement the model proposed by the authors is determined by the content of education programs and research works for individual universities in the regional university network and is formed by two interrelated parameters defined by the UNESCO International Standard Classification of Education (ISCED): the area of education and the level of education (Fig. 1, Appendix 1).

The field of education forms a professional profile of the graduate, and education programs of higher education institutions are oriented toward the specific type of their employment/occupational employment in the cluster of enterprises, determined by its industry specialization. The stage of education establishes graduate's

Table 2 Distribution of the number of students by region in France in 2016

Regions of France	Number of students-bachelor's degree, people	Ratio (%)	Number of students—master's degree, people	Ratio (%)	Number of students-Ph.D., people	Ratio (%)
France—total	*1,025,434*	*100.0*	*890,359*	*100.0*	*67,679*	*100.0*
1. Ile-de-France	*269,788*	*26.3*	*254,581*	*28.6*	*25,162*	*37.2*
2. Regions around Paris	*120,112*	*11.7*	*97,136*	*10.9*	*5209*	*7.7*
Champagne-Ardennes	16,532	1.6	15,500	1.7	630	0.9
Picardy	18,855	1.8	15,598	1.8	687	1.0
Upper Normandy	22,497	2.2	23,411	2.6	1153	1.7
Center-Loire Valley	27,809	2.7	15,496	1.7	1069	1.6
Lower Normandy	16,658	1.6	13,082	1.5	670	1.0
Burgundy	17,761	1.8	14,049	1.6	1000	1.5
3. North-Nord-Pas-de-Calais	*65,839*	*6.4*	*58,869*	*6.7*	*2351*	*3.5*
4. East	*75,741*	*7.4*	*66,575*	*7.5*	*4986*	*7.4*
Lorraine	33,086	3.2	28,249	3.2	1609	2.4
Alsace	29,466	2.9	27,046	3.0	2568	3.8
Franche-Comte	13,189	1.3	11,280	1.3	791	1.2
5. West	*120,072*	*11.7*	*99,309*	*11.1*	*5935*	*8.7*
Pen-de-la-Loire	49,275	4.8	41,874	4.7	2226	3.3
Brittany	49,919	4.9	40,779	4.6	2670	3.9
Poitou-Charentes	20,878	2.0	16,656	1.8	1039	1.5
6. South-West	*109,623*	*10.7*	*97,602*	*11.0*	*7218*	*10.7*
Aquitaine	47,740	4.6	45,051	5.0	2875	4.3
Midi-Pyrenees	53,024	5.2	46,061	5.2	3824	5.6

(continued)

Table 2 (continued)

Regions of France	Number of students-bachelor's degree, people	Ratio (%)	Number of students—master's degree, people	Ratio (%)	Number of students-Ph.D., people	Ratio (%)
Limousin	8859	0.9	6490	0.8	519	0.8
7. Center-East	*125,774*	*12.3*	*114,002*	*12.8*	*8707*	*12.9*
Rhône-Alpes	106,354	10.4	100,330	11.3	7802	11.5
Auvergne	19,420	1.9	13,672	1.5	905	1.4
8. Mediterranean	*116,389*	*11.3*	*93,372*	*10.4*	*7536*	*11.1*
Languedoc-Roussillon	45,306	4.4	35,464	3.9	2735	4.0
Provence-Alpes-Côte d'Azur	68,348	6.6	56,785	6.4	4666	6.9
Corsica	2735	0.3	1123	0.1	135	0.2
9. Overseas Territories	*22,096*	*2.2*	*8913*	*1.0*	*575*	*0.8*
Guadeloupe	4491	0.4	2256	0.3	278	0.4
Martinique	3582	0.3	2026	0.2	0	–
Guyana	1914	0.2	819	0.1	0	–
Reunion	10,888	1.2	3812	0.4	297	0.4
Mayotte	1221	0.1	0	–	0	–

Source http://ec.europa.eu/eurostat, Accessed 1 April 2018

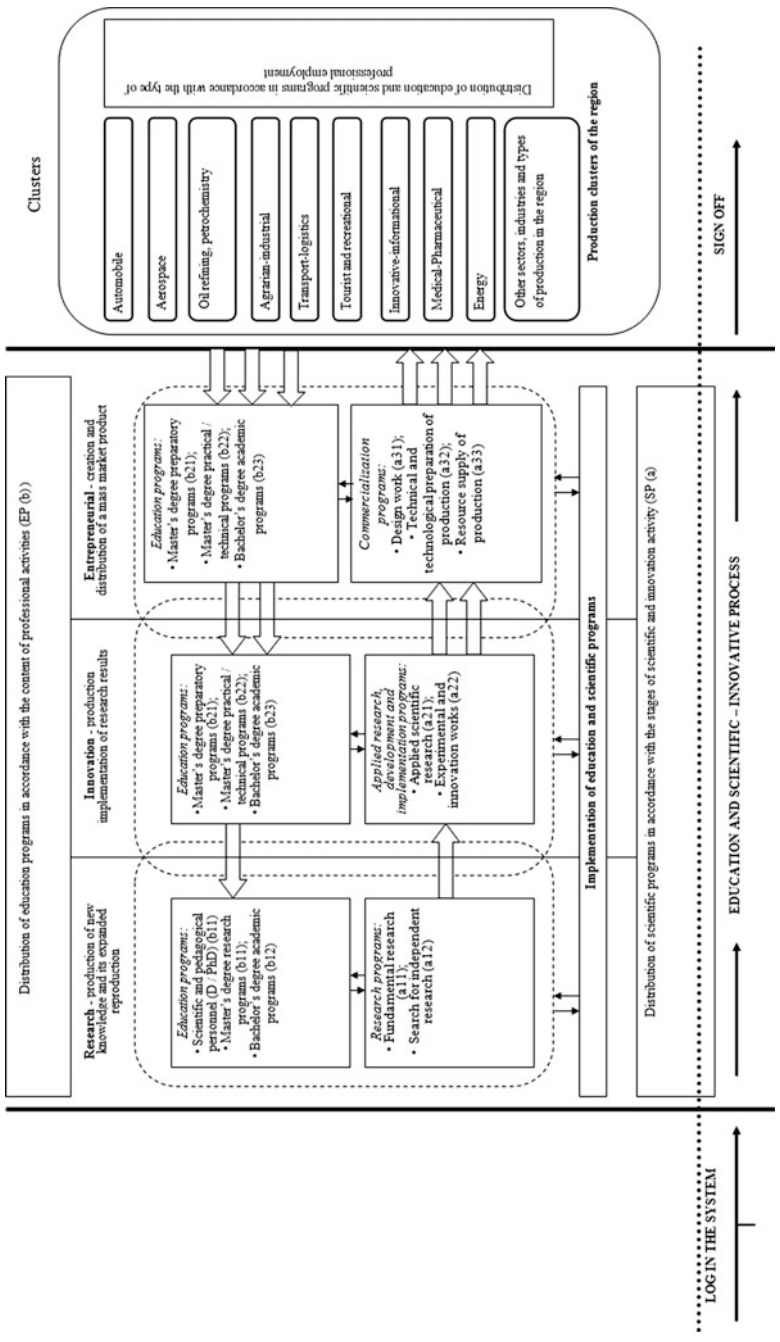

Fig. 1 Regional university network in the "university on duty of regions and municipalities" model. *Source* Authors

qualifications, and the content of education programs is formed on the place in the professional hierarchy, which the graduates will apply to.

The position in the professional hierarchy determines the sequence of innovation stages: participation in initial stages (entrepreneurial activity) means the availability of the first stage of higher education and the bachelor' degree; to participate in the next stage (innovation activity), it is necessary to master the programs of the second stage and the master's degree program; research and development require training in advanced (academic) research programs that correspond to master's degree programs, and programs of original research corresponding to the doctor's degree (Doctorate/Ph.D.) (research activity).

Areas and levels of education form the content of the individual university's activity in the form of a complex of education and research programs, and the spatial configuration of the regional university network develops links with production clusters of the region. Frame and focal intracluster links as a result of their evolution led to the possibility of implementing two schemes of interaction between higher education institutions and cluster enterprises: "equal coalition" (Fig. 2, Appendix 2) and "center-periphery" (Fig. 3, Appendix 3).

The "equal coalition" scheme is used as a variant of interaction between a particular cluster and a number of universities in the region, and the "center-periphery" scheme as a variant of cooperation with a profile university, if it is formed in the region and is able to be the "core" of the cluster.

The proposed interaction schemes are based on "orders" performed by the regional university network for clusters localized in the region. In essence, the "order" is a multivariate complex of programs in the field of training personnel and developing innovative products. Individual programs of the complex are implemented by specialized universities in the course of research and education activities. In interaction with clusters, the "cell" of the higher education system is not a separate institution, but a sector of this system that can solve the task of the innovative development of the individual cluster or groups of clusters with the help of the individualized program complex. These sectors are groups of universities that realize complexes of research (R), innovation (IN), entrepreneurial (E) programs, in the field of research (SP) and education activity (EP), oriented to the needs of a specific customer cluster.

The level of the research program (fundamental or applied research, development, commercialization—(a)) and education program (bachelor, master, doctorate —(b)) is also selected in accordance with the requirements of the cluster.

The need to perform a multitude of research and education programs for a separate cluster predetermines the development of matrix links between higher education institutions with each other and with clusters of the region ($Cluster_i$), which gives a network view to the spatial organization of both schemes.

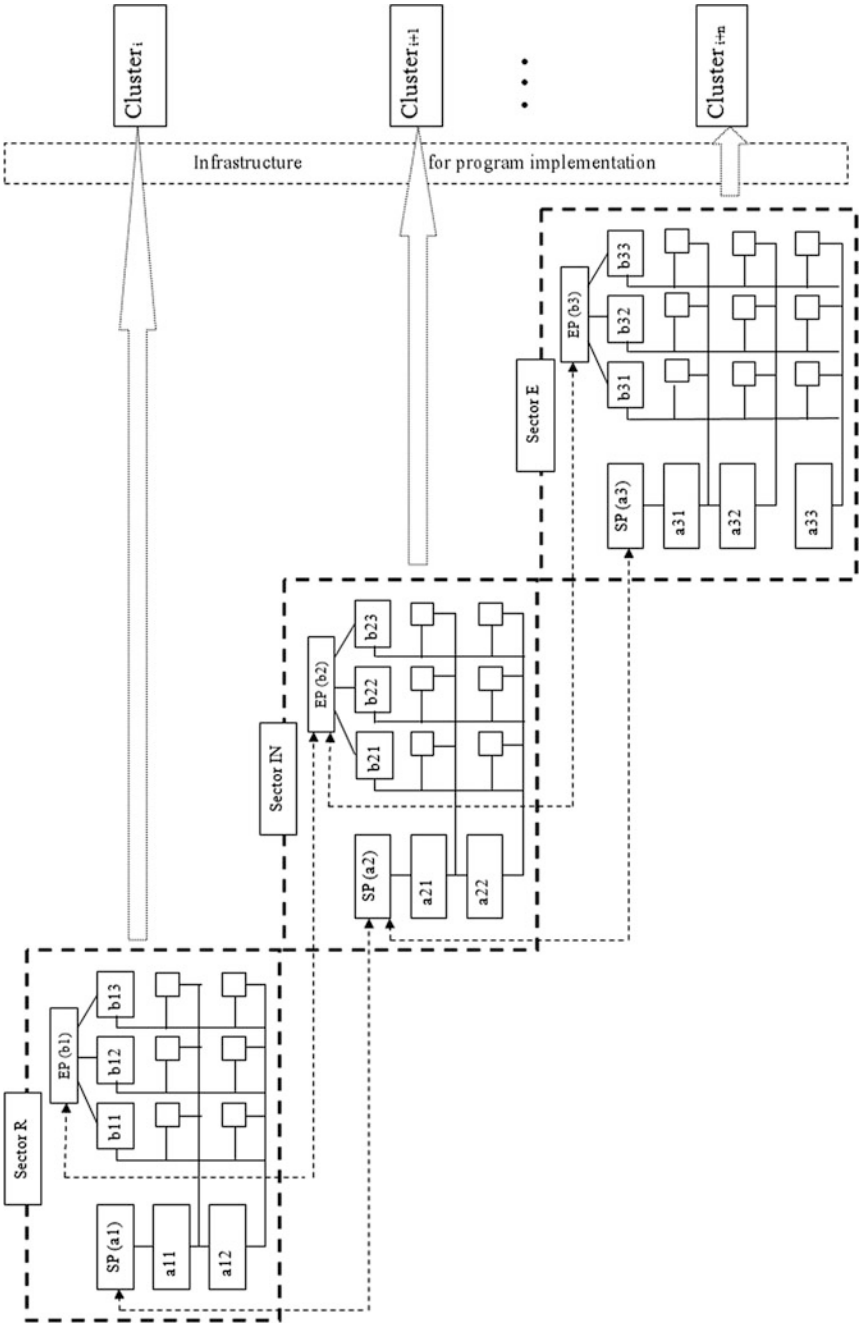

Fig. 2 Interaction of the higher education system and clusters of the region in the "equal coalition" scheme. *Source* Authors

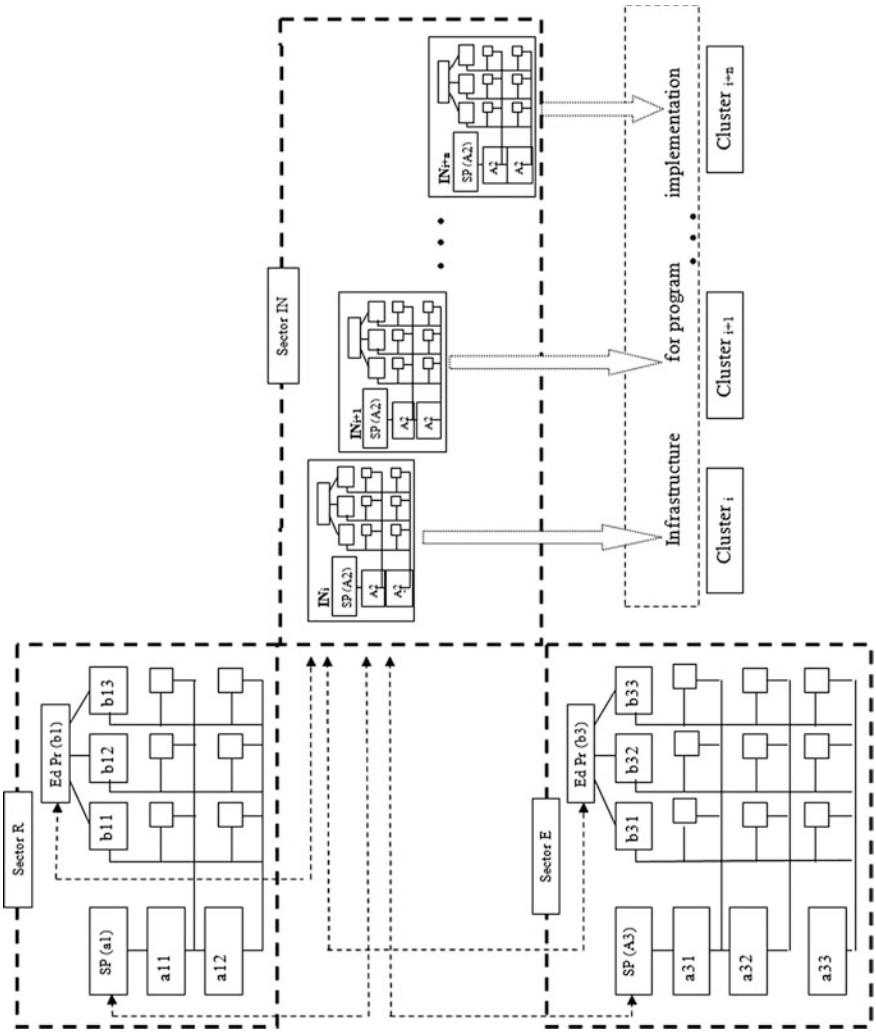

Fig. 3 Interaction of the higher education system and clusters of the region in the "center-periphery" scheme. *Source* Authors

4 Discussion

Thus, the models of the spatial organization of the higher education system and the author's network schemes for their implementation in Russian regions are constructed on the basis of theoretical provisions of the "new economic geography," in accordance with the methodology of modeling the OECD higher education system and the practical implementation of the "university on duty of regions and municipalities" model in the economy of France. The efficiency of this model, confirmed empirically in a number of scientific papers, as well as the results of the authors' own analysis makes it possible to bring the university network in the region closer to the ideal "learning" system that is widely used for organizations working in the field of innovation. The advantages of the proposed network schemes for implementing the "university on duty of regions and municipalities" model; in the economic space of Russian regions include: (a) adaptability—ability of the higher education system to adapt to changes in demand for research program results and graduate competences through the selection of programs, corresponding to the needs of a separate cluster; (b) targeting—ability of higher education institutions to solve innovation tasks specific for a particular cluster; (c) profitability, which is created as a result of conducting research at the same time for several sectoral clusters; (d) motivation—use of market mechanisms in the formation of orders for research and education programs, which increases the interest of universities in the final results of their activities.

5 Conclusions

In accordance with the urgency of the innovative development in Russian regions and the role of higher education in ensuring this development, the authors studied the theoretical foundations and foreign experience in developing spatial models of the university network. Based on the provisions of the "new economic geography," the OECD modeling methodology and the analysis of foreign experience, a hypothesis was advanced about the high efficiency of modeling spatial organization as a tool for managing the development of the higher education system. The methodology of management, the proposed spatial model: "university on duty of regions and municipalities" and the developed schemes for its implementation, substantiated by the authors, firstly take into full account the processes of clustering that are actively taking place in the economy of Russian regions; secondly, they make it possible to bring the university network closer to the ideal innovative "learning" subsystem; in the third, this subsystem is oriented to contribute to the social and economic development of regions, as one of the main criteria for the development of the university network.

Appendix 1

See Fig 1.

Appendix 2

See Fig. 2.

Appendix 3

See Fig. 3.

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Modern Issues of Development of the Customs and Logistics Infrastructure of the International North-South Transport Corridor

R. V. Fedorenko

Abstract The relevance of issues about development of the customs and logistics framework of international transport corridors is caused by constantly increasing value of global supply chains. The international differentiation of labor creates conditions for increase in volumes of the export–import cargo transportation that, in its turn, leads fight for attraction of international transportation flows. The purpose of the contribution consists in determination of development prospects of the International North-South Transport Corridor and designation of the most important improvement tendencies of its customs and logistic infrastructure. The key regularities of development of the commodity turnover between the members countries of the North-South corridor are revealed in the work, the factors exerting the greatest impact on the volumes of cargo transportation are defined, and the development prospects of the foreign trade cooperation are designated. In the course of the research, the main issues impeding full use of the transit potential of the transport corridor are emphasized, the improvement tendencies of its transport, customs and logistics infrastructure are determined. The relevance of the studied issue is caused by keen interest of the member countries of the International North-South Transport Corridor to its further development and increase in volumes of mutual trade. Development of the transport corridor is especially important for Russia. It allows enhancing our own export potential and increasing budget revenues due to attraction of the considerable transit freight traffic, passing between the countries of Europe and Southeast Asia.

1 Introduction

The International North-South Transport Corridor is a strategically important route, uniting the Baltics, Russia, Iran and India and acting as an alternative to the Southern sea route. Russian leadership in issues of development of this corridor is

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caused by its geographical location; however, the considerable potential of the route is still not realized. One of the most important reasons of this situation is rather low level of customs service in the Russian ports and also lack of development of the logistics infrastructure maintaining processing of big freight traffic.

A rather large number of modern publications are devoted to the issues of development of international transport corridors (Šakalys and Batarliene 2017; Drewello and Scholl 2015). Improvement of ITC requires modernization of the transport infrastructure of ITC (Otsuka et al. 2017) and also improvement of customs escort of the freights, passing through the corridor (Liao 2017).

In general, it is possible to draw a conclusion that certain tendencies of the offered project are studied in sufficient detail in modern science, however the complex research of the customs and logistics service system of international transport corridors was not conducted yet.

The relevance of the research on customs and logistics potential of the International North-South Transport Corridor is caused by a number of modern political and economic factors:

1. Removal of sanctions from Iran in 2016 provided opportunities for development of joint projects; it resulted in activation of foreign-policy relations between Moscow and Tehran. During the summit of Russia, Iran and Azerbaijan, which was in autumn in 2017 in Tehran, the important political decisions were made. They create a possibility for activation of work on development of a corridor.
2. Active advance of an initiative of "Silk Road Economic Belt" by China provides additional opportunities for integration of the North-South ITC in the system of trans-Eurasian cargo transportation and increase in value of Russia at this market. At the same time, retard with solution of issues of administrative and technological development of the corridor can lead to the actual excluding of Russia from the transit trade in this region. It also results in moving of freight traffic to the Southern and central directions of the trans-Eurasian economic corridors, going around the territory of the Russian Federation.
3. Entry into force of the EEU Customs Code on January 2018 created the legal basis for forming of the effective system of customs service of trade flows; that is, especially important for the North-South ITC.
4. Development of the customs and logistics infrastructure within INSTC will promote achievement of ambitious goals of Russia of occupation and retention of leader positions in the world grain market, providing dynamic accumulation of volumes of grain export, laying foundation for formation of a new political and economic belt of force of "Russia–Iran–India".

In general, the relevance of this research is determined by objective need of creation of customs and logistics basis for successful reorientation of the Russian foreign economic policy in conditions of the system opposition to the West and search of an alternative development model, based on creation of new vectors of interaction at the level of the Eurasian partnership.

The scientific merit of the stated issue is caused by need of a complex approach to formation of the framework of the international transport corridor uniting a terminal and warehousing infrastructure, the system of customs administration and a complex of services, provided by logistics providers and customs intermediaries.

2 Materials and Methods

The methodological research basis consists of the general scientific methodological approaches such as system and structural, cause-effect, situation, comparative, economic and statistical, factorial analysis, a multilevel complex approach, graphic methods.

3 Results

3.1 Development History of the North-South ITC

In modern conditions, development of the transport and logistics system is considered as the most important growth point of economy of the Russian Federation. Integration into the global transport space through the structures of international transport corridors (ITC), implementation of the transit potential of the country, development of regional and foreign economic logistics relations are defined as priority events in the existing Transport strategy of the Russian Federation. One of the perspective tendencies of effective integration of Russia into the international trade system is the North-South ITC, passing across the territory of the country.

The North-South ITC is a multimodal transport route of transfer of cargo and passengers, starting from Saint Petersburg to the Indian port of Mumbai. Its total length is 7200 km.

Formation of the corridor and development of the necessary infrastructure were initiated by the Ministry of Transport of the Russian Federation in order to provide a possibility for strategic partnership of the Russian Federation with the countries of the Caspian region. The ITC is designed to ensure growth of freight turnover between Russia, Gulf States and the Southern Asia and also to attract transit Eurasian goods traffic for load of domestic transport communications.

The idea of creation and development of the North-South ITC appeared in 1993. However, at the international level it got approval only in 2000, when the corresponding agreement was signed between Russia, India and Iran; in 2005 Azerbaijan also joined it. In 2013, construction of the Turkmenistan-Kazakhstan railway link of the corridor was completed; in 2014, similar works were finished in the Southern link of the corridor on border with Iran.

From 2004 to 2011, about 6 million tons of freights were transported by the North-South ITC through the Russian ports of the Caspian Basin. After 2012 because of implementation of economic sanctions by the western countries against Iran, the volumes of cargo transportation along this route decreased considerably. After introduction of measures of restrictive character the cargo turnover of the ports of Astrakhan and Olya began to decrease steadily, it fell up to 3 million tons per year; that is, half from the average values of the last period.

The North-South ITC acted only as the Caspian project for a long time. One of the main cargo forming regions of the Western India, the Mumbai port and also ports of the Northwestern Europe practically did not take part in work of the corridor.

The cargo forming region of the Western India, the Mumbai port and the Jawaharlal Nehru port, ports of the Northwestern Europe do not work in the corridor. In this regard, conclusion of new contracts and agreements on transportation of freights by ITC with India and China took on great importance.

After lifting of sanctions of the USA against Iran, the activity of participants of the North-South ITC has again sharply increased. Since 2016 meetings on discussion of development of the corridor have been regularly held at the highest level. In August 2016, the declaration on need of joint measures on ensuring development of transport and communication infrastructure of the North-South ITC was adopted at the meeting of the top officials of Russia, Iran and Azerbaijan.

In the present time within interaction of Russia, Azerbaijan and Iran, work on formation of the multimodal route India–Iran–Azerbaijan–Russia is carried out. It will be the regular basis for organization of transportation of goods in containers. The route presupposes sea transportation of freights between the ports of India and Iran, use of the railway and motor transport in the territory of Iran and the subsequent delivery by Azerbaijani and Russian Railways to the ultimate user.

The important development tendency of the corridor is adjustment of the direct overland transport on the Western coast of the Caspian Sea through the branch railway Qazvin—Astara. Russia, Iran and Azerbaijan signed the agreement on creation of the consortium for building of this branch railway, which capacity at the first stage is 10 million tons per year and 15 million tons after the end of modernization. On March 5, 2018, there was the trial start of the railway, which was designed to connect Iran with the railway system of the Eurasian Economic Union.

The railway between two border cities of Iran and Azerbaijan, including the necessary infrastructure for change of wheel pairs between 1520 and 1435 mm gauges, is the last link essential for commissioning of the railway line acting as a land element of the North-South ITC.

By March 2018, the railway track under construction is ready for 90%. The total length of the railway section is about 2000 km. At the same time, it runs through the rugged relief and includes several dozens of tunnels and bridges. Completion of construction will allow creating the system of reloading-free land traffic with the carrying capacity of 6 thousand tons annually, with the prospect of increase up to 20 tons per year within the next 5 years.

3.2 Characteristics of Freight Turnover Between Countries, United by the North-South ITC

According to the Transport Development Strategy for the Russian Federation until 2030, one of the development tendencies of the North-South ITC is advance of the transit potential of the country and attraction of considerable volumes of the Eurasian cargo transportation. At the same time, mostly freights between Russia, Iran, Azerbaijan and India are transported within ITC. Despite opportunities of attraction of transit cargoes, use of ITC for transportation of the Russian export and imported freights remains the priority one. It requires regular monitoring of the volumes of cargo turnover between Russia, Iran, Azerbaijan and India (Table 1). Dynamics of goods turnover between Russia, Iran, Azerbaijan and India is presented in Fig. 1.

In the period from 2010 to 2017, the commodity turnover between Russia and India fluctuated from 7 710 to 10 604 million tons per year, the minimum indicators were in 2016, and maximum—in 2012. Decline in goods turnover volumes in 2015–2016 was caused by development of the economic crisis in Russia, weakening of the national currency and effect of the western sanctions. In 2017, the commodity turnover grew by 22%, at the same time the volume of container traffic increased by two and a half times. The North-South ITC can play a big role in development of bilateral trade; participation in it was officially coordinated with India in late 2017.

In 2017, the volume of cargo transportation by means of the North-South ITC grew by 20% and reached an indicator of 5 million tons, at the same time the volume of container transportations grew by two and a half times (it increased to 7 thousand containers). In December 2017, the agreement was reached on start of container cargo transportation from India by means of the North-South ITC. In the course of strategic negotiations in Mumbai, the agreement was reached on implementation of the first pilot intermodal transportations at the beginning of 2018 according to the TIR procedure between India and Iran along the International North-South Transport Corridor. As a result, reduction of driving time is expected by 40%, and costs for conducting trade—by 30%.

At the same time, the Indian party expressed intentions to use the "North- South" ITC also for sending freights to the European countries; that provides growth in transit income for Russia and strengthening of its regional geopolitical influence.

Imposition of sanctions against Iran in 2012 influenced greatly on the goods turnover between Russian and Iran, it led to decrease in export by 45%. After imposition of sanctions trade with Iran was important only at the regional level: in 2013–2014 the share of Iran in the international trade turnover of the Astrakhan region was about 17%.

Negative development tendencies of the Russian-Iranian trading relations in 2012–2015 were caused not only by the western sanctions, but also by a number of other factors. Since 2013 there is a tendency of reorientation of a part of the Iranian freights from ports of the Astrakhan region to the Kazakhstan ports, in particular,

Table 1 Characteristics of foreign trade between Russia, India, Iran, Azerbaijan, 2010–2017

	2010, million dollars	2011, million dollars	2012, million dollars	2013, million dollars	2014, million dollars	2015, million dollars	2016, million dollars	2017, million dollars	Absolute deviation, 2017 from 2010, million dollars	Growth rate, 2017–2010, %	Absolute deviation, 2017 from 2015, million dollars	Growth rate, 2017–2015, %
Russia–India												
Export	6392	6080	7563	6983	6341	5571	5313	6456	64	101	885	115
Import	2143	2786	3041	3091	3172	2258	2397	2902	759	135	644	128
Goods turnover	8535	8866	10.604	10.074	9513	7829	7710	9358	823	109	1529	119
Russia–Iran												
Export	3380	3406	1900	1169	1327	1017	1882	1317	−2063	38	300	129
Import	272	351	428	433	355	263	303	392	120	144	129	149
Goods turnover	3652	3757	2328	1602	1682	1280	2185	1709	−1943	46	429	133
Russia–Azerbaijan												
Export	1562	2505	2846	2943	3373	2287	1508	1935	373	123	−352	84
Import	386	572	564	636	635	518	446	692	306	179	174	133
Goods turnover	1948	3077	3410	3579	4008	2805	1954	2627	679	134	−178	93

Source Author, drawn up according to the report materials of the site Foreign Trade of Russia http://russian-trade.com/

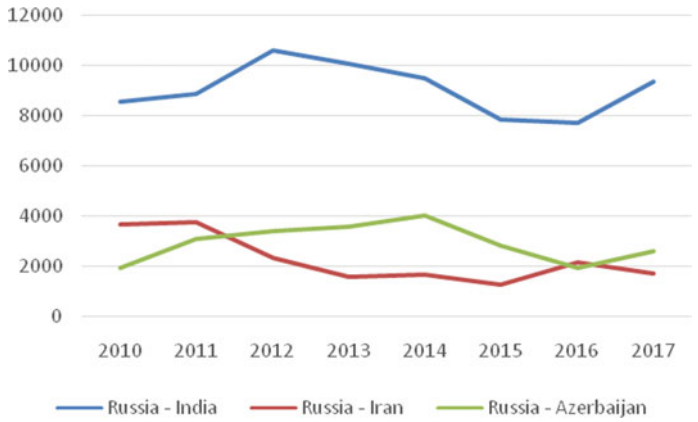

Fig. 1 Dynamics of goods turnover of Russia with India, Iran and Azerbaijan. *Source* Author, drawn up according to the report materials of the site Foreign Trade of Russia http://russian-trade.com

actively modernized Aktau port, which carrying capacity will reach 18 million tons per year by 2020.

Such factors as distinction of approaches to estimation of cost of imported goods by Russian and Kazakhstan customs authorities, existence of issues, connected with shallowing of the Volga-Caspian shipping canal, periodically arising problems of fumigation in the Astrakhan port of the wood exported to Iran also serve as reasons for reorientation of a part of freights to the Aktau port.

After lifting of sanctions in 2016, there was a significant increase in goods turnover between Russia and Iran, and agricultural freights occupied significant share in the structure of commodity turnover. In 2016, Iran introduced the licensing system of supply of imported wheat. It led to decrease in indicators of goods turnover between the countries in 2017, however the potential for development of export–import deliveries still remains rather big.

The commodity turnover between Russia and Azerbaijan remains almost unchangeable for the period of 2012–2017; at the same time in 2017, there was its increase by 34.5% in comparison with data of 2016.

In general, following the results of 2017 the commodity turnover between Russia, India, Iran and Azerbaijan exceeded 11 million tons per year that is 2.2 times more than the volumes of freight traffic passing through the North-South ITC. It allows drawing a conclusion on existence of serious potential of ITC, which successful realization requires completion of construction of the branch railway line between Iran and Azerbaijan and launch of reloading-free land container transportation.

3.3 Advantages of the North-South ITC

The main competitor of the North-South ITC is the Southern sea route, passing through the Suez Canal. The advantage of the North-South corridor is reduction of carrying distance more than twice. It allows reducing the cost of container transportation of freights in comparison with use of the sea route.

As experience of cargo transportation shows, the delivery time from the Mumbai port to Astrakhan is 15–17 under favorable conditions, and the general time of freight traffic to Moscow will be 21–23 days in comparison with 40 days of delivery by the Southern sea route.

The main advantage of the North-South ITC is the high speed of transit of freights. Gulf States, the South Asian, East European and Western European countries can act as the main consignors within the corridor. Delivery of freight from the Persian Gulf to Helsinki by sea through the Suez Canal and the Mediterranean Sea takes on average from 45 to 60 days, while railway transportation within the North-South ITC along Iran–Azerbaijan-Russia–Belarus route will take from 20 to 25 days that is more than two times faster.

In the long view, the International North-South Transport Corridor can become a serious competitor to traditionally used itinerary along the Southern sea route through the Suez Canal. Freight from the Southern Asia to Europe is delivered in 35 days through the Suez Canal, and by means of the North-South corridor is delivered in 20–25 days.

Development of the North-South ITC is favorable for all countries, where this route passes. As for Russia, development of ITC can create conditions for significant increase in the export potential of the grain complex up to its doubling by 2025. The consequence for Iran will be development of foreign trade and ensuring the basis for the social and economic growth of the country. Azerbaijan can attract additional investments into the national economy, carry out modernization of the transport infrastructure and provide the high level of stability in the region. India can reduce delivery time of their flows of export to the Northern European countries and increase the foreign trade turnover with the countries—project members. In the long term, the North-South project will also promote increase in growth of the commodity turnover between the participating countries.

The main advantage of the North-South ITC is reduction of carrying distance more than twice and also depreciation of container transportation. Nowadays, one of weak points of ITC is lack of unification of technological processes and customs procedures. The solution to this issue will allow reducing time expenditures and the transport cost of goods.

3.4 Development of the Customs and Logistics Framework of the North-South ITC

Currently, the load of the Southern ports of Russia is about 20% that is testimony to the considerable development potential. The North-South ITC passes via a number of Russian regions; it includes both the branch railway line and the internal river route. Creation of the effective customs and logistics infrastructure at ITC entrance and exit and, in the long term, at internal route sections will promote increase in transit freight traffic and inclusion of a number of the Russian regions in active international commodity turnover, especially those regions, which are in the borders of the Volga basin.

One of the key issues interfering full use of carrying capacity of the North-South ITC is weak organization of customs service of trade flows that is emphasized both in works of economists and in studies of international organizations. In particular, in the rating of **Logistics Performance Index** (2016), made by the World Bank, according to the indicator of "International deliveries" India is in the 39th place, Iran in the 89th, Russia in the 116th place. The situation with the "Customs service" indicator is not better. Therefore, India is in the 38th place, Iran in the 111th, Russia in the 141st place from 160 countries.

In the course of drawing up the Doing business rating, specialists of the World Bank carry out calculation of costs for standard export–import deliveries. The results of calculations are presented according to the data of 2017 (Tables 2, 3, 4 and 5) in the rating of 2018.

A new Customs Code of the Eurasian Economic Union came into force on January 1, 2018. Its standards were not considered by experts of the World Bank in the course of drawing up the rating. The new code considerably simplifies preparation of documents for a respectable participant of international economic activities, creates conditions for automatic release of declarations, fixes an obligation of customs authorities to justify discovery of additional documents, prescribes to customs workers to request existing documents from various supervisory

Table 2 Structure of costs for export–import transactions in Russia, 2017

Cost elements	Time expenditures (h)		Financial expenditures, dollar/container	
	Export	Import	Export	Import
Completion of documents	26	43	80	160
Border and customs control	72	14	665	400
Total	98	57	745	560

Source Author, drawn up according to the report materials of the World Bank (2018)

Table 3 Structure of costs for export–import transactions in Iran, 2017

Cost elements	Time expenditures (h)		Financial expenditures, dollar/container	
	Export	Import	Export	Import
Completion of documents	120	192	125	197
Border and customs control	101	141	565	650
Total	221	333	690	847

Source Author, drawn up according to the report materials of the World Bank (2018)

Table 4 Structure of costs for export–import transactions in India, 2017

Cost elements	Time expenditures (h)		Financial expenditures, dollar/container	
	Export	Import	Export	Import
Completion of documents	58	65	94	129
Border and customs control	85	267	348	536
Total	143	332	442	665

Source Author, drawn up according to the report materials of the World Bank (2018)

Table 5 Structure of costs for export–import transactions in Azerbaijan, 2017

Cost elements	Time expenditures (h)		Financial expenditures, dollar/container	
	Export	Import	Export	Import
Completion of documents	33	38	300	200
Border and customs control	29	30	214	300
Total	62	68	514	500

Source Author, drawn up according to the report materials of the World Bank (2018)

authorities, including tax administration, transfers emphasis on carrying out post-control when importing. In total, it considerably accelerates the processes of customs registration and control.

Representatives of Iran at the highest level actively participate in a discussion of issues concerning unification of customs procedures between member countries of the North-South ITC, the issue about creation of the free trade zone between Iran and EEU is considered at the present time. One of the steps, which allows improving international trade indicators, is the decision (made by Iran authorities) on reduction of tariffs by 50% for freights, passing through the North-South ITC.

Indicators of costs for export–import transactions in India reflect considerable excess of temporary and financial expenses under import over expenses under export. It should be considered when determining transit potential of the

North-South ITC. Attraction of freights, sent from India to the countries of Eastern and Western Europe, is represented as the most perspective in this situation. As for the direction from the South to the North, it has considerably smaller potential for the reason of too big expenses of importers in India.

The level of costs for export–import transactions in Azerbaijan allows using the transit potential of the North-South ITC rather effectively.

In general, it should be noted that attraction of transit freights and use of the international transit procedure with the TIR procedure allows reducing expenditures of participants of foreign trade activities for a period of 5 days; it increases force of attraction of the corridor to consigners at the Eurasian direction. Ensuring large volumes of cargo transportation by ITC between member countries of the corridor requires solution of issues concerning unification of customs registration and control. In the absence of this work, registration of export delivery from Russia to Iran can take up to 17 days; that is almost equal to the transportation time. As a result, the effect from reduction of the delivery time is less noticeable.

4 Discussion

The issues of managing foreign economic activity have been studied in sufficient detail in the scientific works, but much less attention has been paid to the problems of organizing customs and logistics services for foreign trade flows. In the modern scientific literature, a number of theoretical and practical questions of the organization of customs services for foreign economic activity are considered. The results of such studies can be found in the scientific papers of Grainger A. (2008, 2011, 2014), Wilson J. (2009).

The issues of logistics support for foreign trade are devoted to the works of Bowersox D. (2013), Cassone G. (2014), Christopher M. (2010), Ferguson M. (2012), Lambert D. (2017), Linders M. (2017), Leinbach T. (2007), Rodrigue J.-P. (2012) and others.

The study of the problems of the functioning of international transport corridors was carried out by such scientists as Günther F.C. (2017), Hilmola O. (2008), Henttu M. (2015), Lumiste R. (2011), Prause G. (2011), Šakalys, R. (2017).

Perspectives of development of container shipments on the ITC “North-South” were studied by Iranian scientists Haghighi M., Hassangholi Pour, T., Khodadad Hossani H., Yousefi H. (2013).

The necessity of development of international transport corridors and active participation of the state in creation of conditions for their improvement were repeatedly approved by researchers (Kampan 2017; Tulokhonov 2017). In addition, considerable attention is traditionally paid to the issues of modernization of the existing transport and logistics infrastructure (Haghighi et al. 2013; Seo et al. 2017).

Management issues of international economic activity are investigated in detail in scientific works of various authors, and the customs services, rendered by participants of foreign economic activities and customs authorities (Gupanova 2011) and the services, provided by specialized intermediaries (Fedorenko 2014) are studied separately.

5 Conclusions

The necessity of development of international transport corridors and active participation of the state in creation of conditions for their improvement was repeatedly approved by researchers (Kampan 2017; Tulokhonov 2017). In addition, considerable attention is traditionally paid to the issues of modernization of the existing transport and logistics infrastructure (Haghighi et al. 2013; Seo et al. 2017).

Management issues of international economic activity are investigated in detail in scientific works of various authors, and the customs services, rendered by participants of foreign economic activities and customs authorities (Gupanova 2011) and the services, provided by specialized intermediaries (Fedorenko 2014) are studied separately.

At the same time, there is still no complex understanding of organization processes of movement of international goods flow, uniting issues of customs support, development of terminal cargo handling, embedding of the existing logistics infrastructure in the international transport corridor and making this route attractive both for foreign companies, which use it as a transit route, and for domestic enterprises, aimed at export of production.

The customs and logistics framework of the international corridor must be designed to correspond to the scale of logistics processes of goods distribution within the considerable transfer stream and to provide decrease in expenditures connected with crossing of customs borders, declaring of goods and customs payment. Criterion for evaluation of efficiency of the transport corridor should be reconciliation of immensity of global supply chains with the level of expenditures of internal supply chains, which include a part of the North-South ITC passing within the borders of Russia. It will allow increasing competitive advantages in conditions of ensuring trade and economic integration.

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Prospects for the Functioning of the New Customs Code of the Eurasian Economic Union

E. S. Smolina and R. N. Seryomina

Abstract The contribution considers the key aspects of the improvement of the new Customs Code, as well as possible prospects of its application for the cooperation of the countries participating in the Eurasian Economic Union. The authors consider the new Customs Code of the Eurasian Economic Union and new opportunities for the development of cooperation between business representatives of five countries (Russia, Armenia, Belarus, Kazakhstan, and Kyrgyzstan) that it opens. The authors analyze different aspects of this Custom Code to show its advantages and possible problems, its role on facilitating the development of trade in the EEU, creation of easier conditions for enterprises to conduct foreign economic activities, including interacting with partners in the union.

1 Introduction

We live in a very dynamically developing world, which entails all kinds of changes and innovations. The economic sphere of our society, including aspects of international cooperation of countries, is no exception.

Usually, the problems and prospects of interaction between the particular states in different customs unions are studied in the legal context. Scientists of the EEU member states discuss the changes came into force on January 1, 2018. The changes were due to new Customs Code of the Eurasian Economic Union.

It should be noted the works of such authors as Starodubtsev (2016a, b), Romanova (2017), Hovsepyan (2017), Armekov (2016), Özer (2018), Aihonsu (2017), Loda (2017), and others. The main attention of researchers is focused on the problems of harmonization of customs union members' legislation and on the studying of economic effect of participation in customs union for any state.

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For today, there are very little researches devoted to economic and political sustainability of customs unions themselves, tasks, and prospects of its development.

So, the purpose of our research is to define strengths and weaknesses of new Customs Code of the Eurasian Economic Union and the prospects of its functioning based on the interests of EEU member states (The Customs Code of the EEU 2018).

2 Materials and Methods

The research is based on the study of world experience of customs unions, analysis of the EEU Customs Code provisions, previous and updated, and on the studying of economic effect of participation in customs union for EEU member states.

3 Results

The history of cooperation between five states (Russia, Armenia, Belarus, Kazakhstan, and Kyrgyzstan) in EEU lets us make some conclusions about advantages and disadvantages of customs union for the countries (Table 1).

An improvement of EEU customs legislation meets the world trends and requirements of the time. We can see it comparing the previous and updated EEU Customs Code (Table 2) and European Union (EU) Customs Code (Table 3).

So, EEU Customs Code is aimed at providing more opportunities for business and became closer to European customs legislation.

4 Discussion

The authors of the new code heavily reworked the structure of the document. The old Customs Code was divided into two parts: general and special. At the same time, the document contained 8 sections, 50 chapters, and 372 articles. One of the significant shortcomings of the document was that many issues were regulated at the national level, and a number of aspects were regulated by 20 international agreements, which sometimes contradicted themselves. As a result, the Customs Code itself did not fully fulfill its functions, and in the union states, there were many differences in the implementation of mechanisms for the implementation of customs procedures.

In the new Customs Code, much more issues were raised to the level of the Eurasian Economic Commission. The document has become much broader. It is not divided into parts; there are 61 chapters, 9 sections, including transitional

Table 1 Advantages and disadvantages of EEU for member states

Country	Advantages	Disadvantages
Kyrgyzstan	+ Export became faster due to facilitation of trade between EEU member states + Unification of quality and document requirements in EEU + Access to the common labor market + Expansion of investment and credit opportunities	− Export became more expensive − The increasing competition in the local markets − Reallocate investment resources to the export industries − Outflow of the able-bodied population
Armenia	+ The decline in imported energy prices + Access to the common labor and good markets + Investment flows into the national economy + The opportunities for strategic development of national energy system	− Rising prices in domestic markets − Reallocate investment resources to the export industries − Outflow of the able-bodied population − Dependence of the national economy on allied support
Belarus	+ The decline in imported good prices + Export and import became faster due to facilitation of trade between EEU member states + The decline in imported energy prices + Expanding access to financial resources + Growth of trade with allies and of exports capacity	− Dependence of the Russian cheap energy resources − The increasing competition in the local markets − The opportunities for privatization of state property by allies
Kazakhstan	+ The strengthening of educational and scientific integration + Expansion and diversification of markets + Transport logistics with access to world markets + Expanding opportunities to use national transit potential	− As Kazakhstan is the member of some international unions, it generates some divergent requirements to goods and documents − There are negative changes in the commodity balance
Russia	+ Expansion of markets for non-primary industries + Export and import became faster due to facilitation of trade between EEU member states + Improvement of transit and transport infrastructure of foreign trade operations + Access to the cheap labor markets	− Raw material orientation of the investments to the allies countries − The need to maintain low energy prices for the allies − An influx of labor migrants generates rising costs of health and pension insurance − The similarity of the export structure with associated countries

Source Authors

provisions, which specify how to act if, at the time of entry into force of the EEU TC, additional ECE decisions are not yet in force.

The document was developed more than 3 years, and official representatives of five countries took part in the work: Russia, Belarus, Kyrgyzstan, Kazakhstan, and

Table 2 Comparative analysis of the previous and updated EEU Customs Code

Positive changes	Negative changes
Submission of customs declaration and documents mainly by electronic format	The list of information about goods in the customs declaration was expended
Usually it is necessary to submit the customs declaration only	The time of verification of customs declarations was extended for some types of customs operations
Registration of customs declarations and the transfer of information to the database of the customs authority was automated	Liability for violation of customs clearance rules was increased
The time of verification of customs declarations was reduced for the most of customs operations	Procedure of customs declaration for multicomponent goods supplied in disassembled form was complicated
Administration of customs applicant's funds was simplified	
The basis for the revision of the customs value was changed conceptually	

Source Authors

Table 3 Comparative analysis of the new EEU Customs Code and EU Customs Code

EU Customs Code	EEU Customs Code (updated)
Submission of customs declaration and documents mainly by electronic format	Submission of customs declaration and documents mainly in electronic format, but it also possible to submit customs declaration by traditional paper format in some cases
Ensuring the exchange of information between regulatory authority by electronic format	Ensuring the exchange of information by electronic format is set for customs authorities of EEU member states
The concept of "centralized registration"—the opportunity to declare the goods and pay customs fees at the location of the declarant	"The concept of resident"—there is no opportunity to declare the goods and pay customs fees at the location of the declarant—only at the location of crossing the customs border
All control actions are going at a time at one location	

Source Authors

Armenia. Experts of the business community were the first to draw up the document. Despite the fact that entrepreneurs always strive for the maximum reduction of taxes, duties, and bureaucratic procedures, the state remains tasked with filling the budget and ensuring security. Therefore, the new Customs Code sought to ensure an ideal balance between the interests of these parties and take into account the wishes of entrepreneurs who don't firsthand know about the problematic nuances of customs procedures.

Thus, on January 1, 2018, the Agreement on the Customs Code of the Eurasian Economic Union (EEU) came into force. All five countries of the Eurasian Economic Union have ratified the treaty and sent notifications to the Eurasian Economic Commission on the implementation of the domestic procedures necessary for its entry into force.

According to many experts, the new Customs Code of the Eurasian Economic Union of the EEU opens new opportunities for the development of cooperation between business representatives of five countries (Russia, Armenia, Belarus, Kazakhstan, and Kyrgyzstan).

Earlier in the Eurasian Economic Commission it was noted that the Customs Code of the EEU will become one of the key documents of the regulatory framework of the Union, which will increase the level of unification and coherence between the countries of the Eurasian "five" in the sphere of customs regulation (Decision of the Commission of the Customs Union 2018). At the core of the EEU code is the transition to electronic technology, the improvement of the conditions for doing foreign economic activity, in particular, the promotion of exports.

The new Customs Code will facilitate the development of trade in the EEU; it will be easier for enterprises to conduct foreign economic activities, including interacting with partners in the union.

According to many experts, unification of a large market, the customs area is aimed at removing barriers and providing new business opportunities. Many have an unequivocal opinion that such an innovation should expect an exceptionally positive effect (the agreement "On the determination of the customs value of goods transported across the customs border of the Customs Union" of January 25, 2008).

At the same time, many note the fact that the time through which the results from these positive changes will become visible depends on the actions of each enterprise, the businessman, and also on how ready they are to take advantage of the benefits offered by the new Customs Code of the EEU.

Such advantages include the "movement" of customs authorities and procedures toward the introduction of information technology and digitalization, which corresponds to global trends. Here, we mean the "digitization" of the whole system of regulation of foreign economic activity. This reduces the time of procedures, as well as minimizes the impact of the human factor in their implementation. While positively characterizing the norms of the code envisaged in this field, it should be specially emphasized that the participants of the EEU have yet to resolve issues related to the use of the digital signature.

Experts also pay close attention to the principle of a "one stop shop" for participants in foreign economic activity stipulated by the Customs Code. According to many analysts, this simplifies the interaction of entrepreneurs with customs authorities. In addition, experts add that "any new regulatory document is fraught with certain difficulties." In this regard, it is necessary to help business to make greater use of information technologies in its activities, to clarify the nuances of the new code in cooperation with state bodies and experts of the participating countries and the Eurasian Economic Commission.

Not all entrepreneurs are ready now to take advantage of the benefits provided by the code, to integrate "into a new model" of business. As noted by experts and analysts, the transition to the IT sphere is a definite challenge for a business that has become accustomed to working on an established model. This requires new skills, but also gives new opportunities. On the one hand, the Customs Code simplifies work in many ways, opens new opportunities, but, on the other hand, is a challenge in terms of the ability to use these tools.

So, the main parts of the new Customs Code are:

(1) Now, there will be no need to provide the customs inspector with the documents that were used to complete the declaration. But they must be available in case there is a risk management system.
(2) By default, paperwork is replaced by electronic declarations. The "paper" form of documents will be preserved only for customs transit procedures, goods sent by international postal items or intended for personal use, as well as for vehicles of international transportation.
(3) Due to the automation of registration processes, the time for passing customs will be shortened: The new time for auto-registration of declarations will not exceed 1 h from the time of filing, whereas with the participation of customs inspectors, the registration takes at least 2 h. Time of release of goods will decrease to 4 h, whereas for today, this rate is 6 times more. It is also planned to introduce an automatic release of those products that will pass without remarks monitoring of the risk management system. All decisions will be made not by officials, but by an information and analytical system, which will reduce the probability of errors related to the "human factor."
(4) Entrepreneurs can no longer provide monitoring bodies with information that can be "extracted" from the system. This will save them from having to submit the same documents to representatives of the customs, transport, veterinary, and phytosanitary services, and the controlling authorities can simultaneously conduct the audit.
(5) Before the decision on additional control is taken, the declarant gets the opportunity to change the declaration data (this concerns correction of formal errors, but not changes in the goods themselves). This can be done until a request has been issued from the risk management system to provide supporting documents, and the customs officer did not inform the declarant about the place and time of the inspection.

Throughout all the above stages of economic integration, international and domestic regulations of the member states of the EAEC have been developed and improved.

Among the national legal acts of the Russian Federation defining the basis for customs, tariff, and non-tariff regulation are: Federal Law No. 311-FZ "On Customs Regulation in the Russian Federation," Civil, Criminal and Tax Codes, Federal Law No. 173 "On Currency Regulation and Currency Control," Federal Law

No. 184 "On Technical Regulation," Federal Law No. 114 "On Service in the Customs Bodies of the Russian Federation," Federal Law No. 164 "On the Basics of State Regulation Externally."

To date, the draft of the Customs Code of the EAEC is being agreed upon, and according to expert estimates, there will be no significant changes. The main comments are:

(1) It is written in a heavier language than the previous TC code. More legally accurate, but more difficult to perceive the person who first encountered customs activities.
(2) Many consecutive references, but this is necessary in order to avoid ambiguous perception.
(3) The code became unnecessarily detailed, because the experts wanted everything that had accumulated in six years, to reflect all the sore points in it. As a result, the level of detail has grown, but its depth turned out to be different. The document is useful, and it does not preserve the current situation, but provides an opportunity for years to improve customs administration.
(4) The new code sets the priority of electronic technologies not so much as electronic declaring, since it as such is generally implemented, namely the priority of electronic technologies over paper processes. It would seem that even now the customs authorities report that they have 99% and the indefinite indicators of electronic declaration, but today's electronic declaration is based on the transfer of paper technology to electronic rails. It has its flaws.

The new code says that all technologies should be on an electronic platform. The transition will not happen immediately, but the pressure of the universal electronic technologies will force the customs authorities in their normative acts to alter the customs technologies. It is one thing when we first write paper technology and then mechanically translate it into an electronic form. It is another matter when we must first prescribe the procedure for electronic document management. The first message, laid down in the code, will prevail over all customs services, over all ministries, and they will have to reformat their technologies.

The second is that the new Customs Code really legislates the refusal to provide documents at the time of submission of the electronic declaration. Such now is not present. The possibility of voluntary steps by the customs authorities aimed at reducing the list of documents that confirm the information in the customs declaration in the current TC TC exists. In particular, the FCS of Russia removed a large number of documents from the list of mandatory documents. The new code says that when submitting an electronic declaration, no documents will be needed at all.

The third, which is fundamentally important, is the so-called automatic release. Directly, such a term could not be fixed in the new code, but by the description of the process, the procedure itself is fixed. There is also a rule that customs operations can be carried out by the information systems of customs bodies without the participation of officials.

Together, these three sendings, mutually complementing each other, are able to save the foreign trade participant and customs from excessive communication, exchange of notes, or electronic messages. But all this can remain at the level of good wishes, if the customs services do not reformat the risk management system.

5 Conclusions

Coming to completion, it will not be superfluous to once again detail the main directions and aspects of improving the Customs Code. The main objectives of the development of the Customs Code of the EEU were the creation of a single customs legislation of the most direct effect, meeting the level of integration achieved in the sphere of customs regulation and the level of development and introduction of information technologies in the law enforcement practice of the EEU countries (The Customs Code of the EEU).

The Customs Code of the EEU lays the legal foundation for the digitization of the system for regulating the foreign economic activity of the Union. Among the main innovations are the transition to electronic declaration, the remote interaction of foreign trade participants with customs authorities via the Internet, the transfer of decision-making functions throughout the supply chain—from registering the declaration to releasing goods for free circulation—from the customs inspector to the information system of customs authorities and others.

The Eurasian Economic Commission, a permanent supranational regulatory body of the Eurasian Economic Union, began its work on February 2, 2012. The ECE includes representatives from Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia. Decisions of the Commission are binding for implementation in the countries of the Union.

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World Economy, Economic Science, and Economic Policy: What Comes After the Crisis

M. A. Sherstnev

Abstract The contribution analyzes the current discussions on the state of economics with special focus on interrelationships between key ideas of economic theories and real actions of economic policy in the course of the global economic crisis. The global economic crisis showed the limited ability of mainstream in economics, primarily in new macroeconomics and financial economics, the practice of economic policies, and therefore, the attention of researchers and economic policy-makers was drawn again to some alternative views in economics, related to the uncertain nature of economic development and the complexity of expectation formation and decision-making of economic agents with relevant implications for public policy. Section 1 compares the policy responses to Great Depression and Great Recession and documents the divergence of actual policies and neoclassical vision in both cases. Section 2 traces the retreat and renaissance of the neoclassical vision in the XX century but tries to argue that principal weaknesses are not overcome in the course of development of DSGE models. Section 3 offers the brief outline theoretical concepts beyond mainstream which might be fruitful for further research and macroeconomic policy formulation. Finally, Sect. 4 concludes the research.

1 Introduction

The world economic crisis has led to increase in degree of discussions in world economic science on various questions of interrelation of economic policy and the ideas of economic theory. At the same time, economic theory—first of all macroeconomics and financial economics—was an object of fierce criticism from public opinion and creators of economic policy, first of all in respect of adequacy of its ideas of economic reality and practical recommendations for economic policy following from these representations. Economic theory in general remains a rather

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wide field of theoretical and empirical fights. So, the works of G. Mankiw and M. Woodford demonstrate the competition of various research programs in macroeconomics for rather fundamental issues (see Woodford 2009; Menkiw 2009). However, the global economic crisis has led to a high-quality change of situation when in focus of more heated debates, and there were fundamental theoretical and methodological bases of various sections of the modern economic analysis again. Among the powers who asked sensitive issues to economists, there was even Her Majesty the Queen Elizabeth II who visited London School of Economics and Political Science at the end of 2008 and took an interest in the fact why none of economists had predicted sharpness and depth of the broken-out economic crisis.

These discussions were from the very beginning splashed out on pages of the wide international press. In particular, in summer of 2009 the world famous London magazine "The Economist" published two special articles with the critical analysis of main units of new classical macroeconomics and financial economics (The Economist 2009). Also the cover of the magazine on which the chocolate-milk textbook of the economic theory spreading after melting had been designed to make an impression… The critical materials about the current state of macroeconomics prepared by the large official of OECD appeared on pages of the magazine "Finances and Development" published by IMF (White 2009, 2010). A number of economists with alarm suggest that theoretical departments of the economic profile at universities which have become isolated in exercises of the abstract theory of the logical choice will inevitably lose a considerable part of students in advantage business: schools and faculties (departments) of applied disciplines (Bradford 2011).

In this regard, the analysis of the polemic developed in the world on problems of interrelation of economic theory and practice of economic policy in which the largest modern economists, including Nobel Prize laureates and possible consequences of these discussions for development of the world economic thought, is of undoubted interest. This analysis is the main objective of the study.

2 Materials and Methods

The discursive analysis is used in this work. First, the general moments in political actions for fight against economic crises in the course of Great Depression and Great Recession come to light. Secondly, comparison of practice of the specified actions with dominating submissions of economic theory is made. Thirdly, the potential ability of mainstream in economics that provides a substantial research of emergence and increase of non-equilibrium phenomena (disproportions) in economy which are shown during deep recessions and depressions at the cyclic movement of economy is analyzed. Fourthly, preliminary discussion—what ideas in economic theory may contain the potential for further development at research and substantial explanation of the specified phenomena—is offered.

3 Results

Practice of overcoming Great Depression and Great Recession has shown that the governments are not ready to rely on spontaneous market mechanisms of overcoming economic recessions which are offered by mainstream in economic theory, first of all within the neoclassical research program and various options of new neoclassical synthesis. This divergence of practice of economic policy and the main kernel of the neoclassical research program testify to the fact of limited potential of the specified program in the substantial research of processes of emergence and increase of non-equilibrium phenomena (disproportions) in the market economy. In this regard, it is necessary to address research programs which allow a substantial research of non-equilibrium dynamic processes at the cyclic movement of the market economy of industrial type.

4 Discussion

4.1 Logic of Crisis and Practice of Crisis Response Measures

On a number of indicators, the developed global economic crisis which has already received the name of Great Recession in the world literature is compared to the world economic crisis of 1929–1933 which received the name of Great Depression. Both phenomena have many common features: considerable decline in production, high unemployment rate, deflationary phenomena in the sphere of pricing, and fast compression of volumes of international trade.

In either case, special crisis response measures of state economic policy were required, though there are differences in time of the beginning of realization of crisis response measures. "The new course" of F. Roosevelt begun to be implemented when the economy of the USA already was in depression and practicians of policy and business lost hope for an automatic exit of economy from this state. All previous G. Hoover's presidency took place under the slogans of commitment to free business as to a basis of health and force of the nation, the idea of balance of public finances and in general commitment to the main operating conditions of "an invisible hand" of the free market. But Great Depression showed a huge force of quite tangible "leg of the market" in drama shocks of all world economy in the 1930th years. For all Western world, this event remained one of the greatest social disasters of the twentieth century (and for the USA, probably, even much bigger than World War II) and has rather strongly settled in social memory for many decades.

On the contrary, the approach of a sharp phase in the economic crisis in the fall of 2008 quickly stopped any talk on relying on will of market elements, and on allowing investment banks die quietly, etc. The governments took measures to

support cumulative demand by means of tools of fiscal policy, provided various financial aid to the largest companies, took additional measures for social support of the population, the central banks satisfied promptly increased demand of economic agents for money in the conditions of panic flight to liquidity by means of tools of monetary policy through support of liquidity of the banking sector. Special attention was paid to problems of stability of all financial sectors and support of systemically important financial institutions. In modern political rhetoric people often speak about non-conventional measures of economic policy. But maybe this new policy is a well-forgotten old one?

Their international coordination within G20 in the conditions of the new interconnected global economy became new basic features of these actions (and this turn in the USA happened at Republican Administration of J. Bush Jr.). At the same time, it should be noted that all the observed stylized fact that in practice, any government in group G20 did not decide to rely on salutary forces of market elements and did not provide exclusively price mechanisms to overcome economic downturn and to restore economic growth (Drobyshevsky et al. 2010).

Practical actions of creators of economic policy have obviously dispersed from mainstream in economic science which repeats for the second time in the situation of the deep economic crisis. This circumstance has raised a question about volume how academic economic science within dominating representations is capable to perform the practical function and has most pushed to renewal very deep discussions, much less quiet in a form, on key methodological and theoretical questions of modern economic science.

4.2 Economic Reality and Prevailing Ideas of Economic Theory

The economic crisis does not represent a new phenomenon; crisis processes shake the capitalist market economy throughout all its own history since the beginning of the nineteenth century. And, as the patient expects that the medical science will give him explanations of the reasons of his illness and effective recipes how to fight against various diseases, the same way the society, subject to social and economic disorders, expects that economic science will give the accurate explanation of the nature of crisis processes and practical offers how to counteract them or, at least, how to mitigate their consequences.

Certainly, such processes constantly drew attention of economists. Radical critics of capitalist society, including early socialists, K. Marx and modern radical economists, see in crisis processes forms of unsolvable internal contradictions in the capitalist economic system which in principle cannot be finally allowed within this system. The dominating currents in world economic science pay prime attention to all set of concrete economic mechanisms forming a business cycle in the capitalist market economy and consider an economic crisis (economic recession) as one of

natural phases of cyclic processes. However, the understanding of the nature of this phase and, respectively, recommendations about public actions following from such understanding (speaking more particularly, use tools of macroeconomic policy and chose the correct combination of such tools) significantly differ between various currents of the economic thought.

The birth of modern ideas of macroeconomic processes goes back to the well-known book by J. M. Keynes "The general theory of employment, percent and money" in which, aftershocks of Great Depression, the new circle of ideas about macroeconomic processes in the market economy and possible ways of public impact on these processes for general welfare has been formulated in a system look. In focus of the research, there were regularities of formation of cumulative demand in the market economy with special attention to the investment component which in the conditions of decentralized economic processes of the market system are connected with expectations of businessmen concerning future opportunities of income from goods and services made by investments, the decision on implementation and financing that are made are in the present. During the postwar period, the Keynesian macroeconomics became a part of mainstream in economics and really formed the intellectual basis for macroeconomic regulation in developed countries of the West and for the policy development in Third World countries.

However, the attempt of incorporation of ideas of Keynes in mainstream of economics was incomplete and contradictory. The "Keynesian and neoclassical synthesis" which is going back to J.R. Hicks's article "Mister Keynes and classics" as a result came down to interpretation of a depressive situation as a special equilibrium case with part-time employment, and you can exit it using tools of macroeconomic policy. At the same time in the long-term plan, all neoclassical ideas of the market economy remained. As for J.M. Keynes's ideas concerning the uncertainty factor in economy, formations of expectations in the uncertain situation and the phenomena of instability put in the nature of the capitalist market economy, so they mostly appeared behind a board of orthodox options of Keynes—neoclassical synthesis (Pasinetti 2007).

These ideas evidently contradicted that the system picture of the market economy which was developed after the neoclassical revolution of the last third of the nineteenth century, having received a logical conclusion in theory of the general economic balance. Like a mechanistic picture of the Universe from Newton's physics, the market economy was represented by a certain ideal mechanism which optimum distributes resources for the satisfaction of the known set of requirements on the known set of technologies by means of the price mechanism of the full system of markets. In such abstract and logical world, many important aspects of reality just don't matter and can't be subjected to the scientific analysis. For example, in such abstract model doesn't matter how economic activity by economic agents at various levels of the economic system is organized and how connections between them is really established; the market value of the firm doesn't depend on the structure of its financing; there are no problems of information search or structuring contract relations; it is impossible to explain many phenomena of

scientific and technical progress; and, at last, here is no place to non-equilibrium static states and non-equilibrium dynamics.

The world economic crisis and stagflationary processes in the middle of the 70th revealed limits of practical tools for the state regulation of economic processes which had been developed by that time. The developed countries entered a strip of deep shifts in production, consumption, the economic mechanism in the conditions of a new stage scientific and technological revolution. The economic practice accurately showed that economic agents consider the mode of economic policy in decisions that demanded reflection both in theory, and in practice of the most economic policy. The neo-Conservative counterrevolution of 70–80 of the twentieth century led to an essential reorganization of macroeconomic theory. Everything possible was done to expel "the Keynesian demon" and in the greatest possible degree to return to classical postulates of economic theory and at the macro-level. The new classical macroeconomics which reached an ascendant position in world economic science and in programs on macroeconomics of the leading world universities entered a number of essential new moments into the analysis and started using a new class of macroeconomic models—dynamic stochastic general equilibrium models (DSGE models).

At all variety of these models, it is possible to allocate some mainframes which can be characterized as a firm kernel of the research program of all new macroeconomics (both for closed and for open economy) in I. Lakatos's definition today. Within one contribution, it is hardly possible to submit the review of various groups of DSGE models, and therefore, the talk in this study goes about the most general theoretical-methodological bases of new classics and new Keynesianism. First, the accurate description of microeconomic bases of macroeconomic processes entered by means that the theoretical-methodological unity of micro- and macroeconomics provided. The abstraction of the representative economic agent (a representative household, representative firm, government) in which all variety of economic entities came down to a certain standard micro-model was used for this purpose. Secondly, the economic behavior was supposed to corresponding basic postulates of neoclassical microeconomics. For formal modeling of this behavior, dynamic optimizing models in which criterion function of the expected usefulness taking into account optimized budgetary restrictions have been used. Thirdly, information imperfections of the market economy based on decentralized economic processes have been taken into account. Each economic agent does not possess information on the economic system, and in general, he obtains information in the course of economic activity which belongs to this activity (prices of release, prices of production factors, public economic information). But according to basic postulates of neoclassics, he uses all information optimum, including for forecasts of rather future events. He can make mistakes in these forecasts, but these mistakes have no systematic character. At the same time, the representative agent has unconditional advantages over all real economists and predictors as he builds the forecasts on the basis of the right economic model known to him! These representations formulated considerably autonomously at the boundary of the 50th–the 60th years in economic

science as a hypothesis of rational expectations and in financial economy as a hypothesis of the effective market became the essential block in this research program in macroeconomics. But how these representations differ from ideas of aware economic agents on the economic system (though more difficult procedure of receiving and processing of all available information here)? Fourthly, all macroeconomic sizes in dynamics turn out from microeconomic optimal solutions of economic agents by aggregation. Here, we do not need word separate assumptions of dependences of macroeconomic sizes as it was in IS-LM models for the closed economy or IS-LM-BP for the open economy. At the same time, the comparison of models to reality quantitative assessment of parameters in the micro-model of the representative agent can be received from microeconomic researches (so-called calibration of models). At last, fifthly, theorists followed again the idea of the market balance which is provided with the mechanism of flexible prices after any shocks which are implemented in economy (Minford 1992).

This theoretical platform has been used for intellectual justification of important provisions concerning opportunities of public impact on macroeconomic processes. First, all business cycle began to be treated as a strictly equilibrium phenomenon in which phases (including recession) the market situation is the result of optimal solutions of economic agents within appropriate dynamic programs (theory of a real business cycle) (McCandless 1992). At the same time, sharp changes of actual parameters of the system (productivity, preferences, etc.) act as sources of economic fluctuations. Secondly, for the economic system with specified properties the inefficiency of macroeconomic policy tools to stabilize a macroeconomic situation in the conditions when economic agents optimize the behavior taking into account all available information, including information on economic consequences of state regulation measures (the theorem of inefficiency of macroeconomic policy), announced in the conditions of democratic regime theoretically, has been shown (Minford 1992).

New classical macroeconomics did not deny a role of public influence at all, but has subjected to essential revision of the idea of its forms. The main attention has been paid to structural factors—accumulation of the physical and human capital, maintenance of conditions for competition—and institutional factors—following to firm rules and norms instead of discretionary intervention in economic processes.

New methodological tools became standard in macroeconomics and begun to be used by representatives of various theoretical directions including the neokeynesian direction. New Keynesian macroeconomics used prerequisites of market imperfections to justify expediency of a short-term state regulation of economic processes (the truth, at the same time, came to the forefront credit policy, and the value of budgetary tax policy was significantly smaller). Thus, the new methodology in itself has not stopped a theoretical discussion about forms and methods of a short-term countercyclical regulation at all.

Neokeynesian theorists have gone on the way of introduction of more realistic prerequisites to market models that allowed to receive interesting results about properties of market processes in the conditions of these or those market imperfections (e.g., existence of the exclusive power, phenomenon of asymmetric

information between economic agents, and existence of costs of search in labor market). The corresponding researches drew a much more difficult and contradictory picture of market processes in comparison with initial models of the general economic balance and early DSGE models of new classics, and these processes do not always provide Pareto optimum outcomes and in general sometimes make conclusions about instability of the most market balance. In such conditions, simplicity of theoretically reasonable recommendations for economic policy which provide the best of all possible conditions of the system (so-called first best solution) disappears, and the best decisions rather significantly depend on the specification of models (Ocampo et al. 2006, 2010). The bigger realism of neokeynesian theoretical designs and the need for theoretical justification of applied models for adoption of political and economic decisions led to increase in their importance in researches and training in the 90th–the 2000th years.

4.3 Crisis and Discussions of Economists

The global economic crisis has caused a wave of sharp criticism of the general bases of new macroeconomics which in principle belong also to new classics, and to new Keynesianism.

Criticism. In the sharpest and extraordinary emotional form, the main critical remarks were formulated by one of the largest economists–foreign affairs specialists Nobel laureate Professor Paul Krugman. He noted that created new macroeconomics cannot:

- Predict approach of economic recessions (they are reduced to unpredictable shocks in dynamic stochastic models of the general balance). But at the same time, P. Krugman made a reservation that it is *the smallest of problems* of the dominating theory. At the same time, we will notice that in principle, the endogenization of shocks is possible. But how can we correlate logically such attempts to the concept of balance which is one of corner blocks of new macroeconomics?
- Explain their economic nature (they are reduced to exogenous shocks);
- Formulate substantial recommendations about their overcoming (recession is equilibrium phenomenon where the interests of all economic agents are as balanced, as in any other phase of the business cycle!).

In the emotional form, Krugman called the last thirty years “a dark era in macroeconomics” when earlier accumulated knowledge of depressive economy was forgotten (Krugman 2009).

The developed criticism of the dominating system of ideas contains also in the last publications of another outstanding modern scientist of the Nobel laureate Professor Stiglitz (2011). As specific moments in his critics, it is possible to note the following provisions. First, scientific theory has to give the chance of predicting the

phenomena on the basis of understanding the internal nature of studied processes. At the same time, predictions should not be understood simply—for example, as strictly deterministic. They can have a probabilistic nature (e.g., in quantum physics there is a ratio of uncertainty of W. Heisenberg), to specify the general directions for the development of economic processes (as it was in the classical political economy). But the science can be hardly limited to the explanation of the last phenomena or reduce a task only to formal models deprived of a qualitative substantial explanation approximating quantitative data. In the latter case maybe it is enough to see an astrologist? Secondly, by the present moment there are several important spheres of economic reality where the limitation of dominating theoretical designs is already rather obvious both to theorists and creators of policy—questions of discrete macroeconomic policy, the rule of monetary policy taking into account properties of a modern financial system, actually regulation of the financial sector and—globally important question—economic problems of scientific and technical progress in the market economy (Sherstnev 2012a, b).

Ignoring of the financial sector in the market economy and features of its own functioning in modern macroeconomic models became the separate direction of criticism (Adam and Vines 2009; Woodford 2009). Financial shocks always accompanied the cyclic process in the capitalist market economy, but in the last one and a half decades these shocks have assumed qualitatively other scale. They have in many respects an autonomous character, make considerable and fast impact on real processes in economy, and promptly extend between interconnected national farms in the globalized world economy.

Protection. Supporters of new macroeconomics have made a number of performances in protection of prevailing ideas, but at the same time all basic argument remained in a standard theoretical-methodological framework. First, they theoretically specify that it is impossible to predict economic shocks, and therefore, there is no such opportunity now, and it will not be in the near future. In particular, such position was formulated for general public by Professor Robert Lucas ("The Economics" 2009). According to him, there cannot be a formula using which it would be possible to calculate what actions would happen in a week because if such formula existed, then as soon as such information became public, falling of share prices would happen immediately. Such position is proved in the world of rational agents and perfect information, but confusion is caused by the thought of impossibility that such a formula can exist or possibility to distribute results of calculations using this formula, as well as the position that if it "isn't present now, and won't be ever in the near future". We should follow the rule: Never say never! We will notice by the way that such attempts are already made using a mathematical apparatus of theory of accidents (Arnold 1990). Secondly, from the empirical point of view attempts to connect recession (in any case, in economy of the USA) with negative shocks of the offer of work are made again (Ohanian 2010). In response to similar statements, P. Krugman ironically asked a question whether it is necessary to consider Great Depression as Big Vacation. Thirdly, the problems of instability in the market economy (which in crisis conditions are hardly possible to be ignored) are offered to be solved by means of stable regulating norms. In general, the

problem of instability of the market economy is a very sensitive place for all neoclassical direction. Theorists of this direction make attempts to search for reasons of instability in defects of the state economic regulation and state economic policy, "excesses" of the financial sector, but not in imperfections of the price mechanism on coordination of economic activity, reproduction problems in the real economic sector in any way. So, the Nobel laureate Professor Edmund Phelps considers that the correct state regulation is able to lower instability costs, including financial instability connected with the phenomena (as always, it is not a big deal—just formulate norms of such correct regulation!) (Phelps 2009). Fourthly, further attempts to approach DSGE models to reality due to inclusion of various aspects of behavior of economic agents (e.g., habits in consumption) and bigger attention to imperfections of the economic system connected with functioning of the financial sector (financial tensions) are made.

4.4 The New Macroeconomic Ideas for Economic Policy?

The development of science assumes constructive criticism of existing representations which goes together with the formation and discussion of new ideas. These processes have affected also macroeconomics during the real economic crisis. At the same time, participants of discussions address also the ideas which were formulated earlier, but substantially remained beyond the scope of mainstream, having at the same time certain prospects of further development. What ideas can serve as new blocks in the development of macroeconomics?

Neoaustrians: usefulness of macroeconomics. It is necessary to notice that existence of macroeconomics as a science is not conventional in the world economic thought. So, representatives of the Neoaustrian School of political economy (L. von Mises, his best-known pupil Nobel laureate F.-A. von Hayek 1996) on the basis of the principle of methodological individualism in general denied existence of any steady regularities at the level of all economic system which could be and have to be subjected to the strict scientific analysis (Phelps 2009). Theorists of this direction put in research focus individual decisions of independent individuals who choose the best means to achieve the goals in the conditions of decentralized economic processes.

Theorists of this school in general deny applicability of mathematics and statistics in economic researches as in developing economic systems, there are no *constants* (analogs of physical constants serving as parameters in functional dependences in physics) and *uniform sets in any relation* (in other words, in the simplified look the physical model of ideal gas and the statistical device adequate to it aren't analogs for the economic system developing as a result of creative activity of the person).

This position is extreme (though more actively articulated in crisis situations for world economic science and practicians of economic policy) and isn't accepted by most of the economists. But at the same time, it is necessary to notice that world

economic science in many respects has just ignored the above-stated methodological arguments without their serious critical analysis and formulation of clear counterarguments. Meanwhile, the radical methodological criticism is implemented by neoaustrians of dominating formal modelling approaches which raise a very important question of compliance of mathematical and statistical methods,—the majority of which were created in the course of development of natural and technical sciences,—to the essential nature of economic processes dominated by purposeful creative activity of the person which can be hardly reduced to the set computing program.

Keynes: uncertainty and expectations. The world economic thought addresses theoretical heritage of J. M. Keynes again, and first of all, those ideas which are connected with uncertainty factors in economic processes and processes of formation of economic entities' expectations in such situation. In recent years, there is a growth of number of publications within various branches of Keynesianism. For the system representation of key ideas, it is possible to recommend the book by the prominent British economist Lord Skidelsky (2010).

The economic environment is characterized by a big variety of information imperfections; economic agents don't and can't have full knowledge of the world around. They have to make plans and make decisions on the basis of expectations in the uncertain situation. The problem of stabilization of expectations is closely connected with stabilization of economic processes in the market economy. But the research of expectations and processes of their formation demands research of limited rationality and psychological factors in behavior of economic agents, obvious accounting of specified aspects in the analysis of real economic behavior of the person. This way is tried to be used for a substantial explanation of a phenomenon of bubbles in commodity and financial markets and their consequences for macroeconomic processes (Akerlof and Schiller 2009).

Within the above-stated ideas of Keynes, the special attention is drawn by a single question about stability of the financial sector and sources of violation of such stability (a hypothesis of financial instability of H. Minski). Economists and creators of economic policy persistently try to formulate such regulations which would guarantee stability of the financial sector in general and a banking system in particular taking into account financial regularities of the unstable market economy.

Schumpeter: business, economic development. Another circle of ideas is connected with the fact that the developed market economy by the most nature is *the dynamic, non-equilibrium, developing system.* There are constantly new communications, relations, formal and informal rules, there are new goods and services, the old ones will be transformed, and new technological processes and new organizational structures are formed. It is clear, that at any moment economic agents can't have all information on *current events* in the economic system, and they in principle can't have *future scientific, technical, and social knowledge* because this knowledge will be recognized only in the course of practical activities in the conditions of decentralized economic processes. The attempt to understand processes of economic development made economists to come back to the ideas of Y.A. von Schumpeter, which were formulated in the first third of the twentieth century.

Y.A. von Schumpeter raised a question of mechanisms of economic and scientific and technical development in the conditions of the private market economy, driving forces, and concrete incentives of these processes, and he also presented approaches to the solution of the question. These ideas which carry on tradition of classics of political economy and then K. Marx's ideas—to put in research focus sources and driving forces of economic development and high-quality changes in the market capitalist economy (sources of wealth of the people in dynamics), generated a huge stream of literature in the second half of the 20th century, and draw attention of researchers to this day. The specified ideas serve as a starting point for the development of evolutionary macroeconomics and the corresponding formal modeling of macroeconomic processes as evolutionary processes in which time and history matter (Nelson and Winter 1982). These ideas got support in domestic literature in the 90th, in particular, in works of the academician S.Yu. Glazyev. It is interesting that "The Economist" in the years of the last crisis additionally presented the special heading "Schumpeter" about the role of innovations in economic processes, though earlier questions of technological progress had been deprived of attention on pages of this magazine for the Great Recession context. So the way forward is via innovation?

Economy as a network of participants. At last, an important independent aspect during the functioning and development of the economic system is *the process of formation of communications between economic agents and properties of this process*. The economy can be presented as a network of participants who establish connection and interact by means of market exchange (economic theory of networks), and this network can be created in various ways and predetermine various outcomes at the macroeconomic level. This aspect is put in the forefront in "Kiel memorandum," received a wide resonance, which calls for revision not only theoretical ideas of market processes, but also for use other mathematical methods in macroeconomic researches which allow understanding properties of network structures in economy (Colander et al. 2009).

The authors of Dalemsky group in general support bigger pluralism in economic researches and in teaching economic theory. At present, very interesting developments on network structures in the banking sector are carried out at Kiel Institute of World Economy in Germany. The network approach is also used for research of communications of managers of banks and non-financial companies—it can remind domestic experts of the senior generation some discussion subjects, popular during the Soviet era, in the Soviet political economy.

5 Conclusions

These ideas have not been created in complete concepts yet, but they draw attention of researchers from the point of view of prospect. It becomes clear that the mechanistic picture of the market economy which follows from theory of the general economic balance and modern dynamic models of DSGE models can

hardly form the intellectual basis of reasonable economic policy (and especially at management of developments). In general, it is possible to tell that macroeconomics still represents a big field of a theoretical and methodological debate, and the crisis has considerably increased its sharpness in comparison with the previous twenty years. At the same time, it is necessary to emphasize once again that the current state of macroeconomic theory doesn't allow making any unambiguous recommendations for macroeconomic policy *without concrete economic conditions*. Any attempt to develop the certain fixed set of recipes (as, for example, the set of guidelines of "The Washington consensus" formulated at a boundary of 80–90) will be generally almost unproductive.

Also, the prospect of *discretionary* rules for the state regulation which will counteract in the *developing social and economic system* to the instability phenomena is represented not really clear. Probably, in the conditions of increase in density and intensity of social and economic communications (this phenomenon in the Marxist theory is characterized as nationalization of work and production) inevitably there is a question to update decentralized economic processes which are inevitably connected with uncertainty and incorrect expectations accompanying it, institutes and mechanisms of public regulation, management, and control. But their concrete combination is result of adverbial modifiers of place and time. Unfortunately, mankind hasn't found the Philosophers' stone yet and, respectively, all disease medicine and universal economic policy as its private manifestations.

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Part II
Problems and Development Prospects of Innovation-Oriented Economy

Assessed Probability of Risks in Dependence on Innovative Project Description

A. D. Kornilova, N. V. Shekhova, N. N. Belanova and E. V. Savoskina

Abstract Development and implementation of the innovation project involve significant risks, which require taking measures to assess the probability of risks and identify possible losses. In this work, the systematization and risk assessment of innovation activity were carried out using the example of organizations of the Russian Federation. In the course of this study, the authors revealed that the greatest risks are associated with the non-return of borrowed funds (75.28%), lack of external investment (71.99%), operational (technical) problems (76.03%), and failure to sell the product or technology of the innovation project (71.59%). All these threats are inherent in basic risks of the innovation project. Among the specific risks can be identified the risk of conservation—78.02%, and the risk of imitation of competitors by the company's patented innovations, copying of the innovation project—62.03%. Calculation of average risk values shows that, depending on the nature of innovation activity, the level of the probability of risks undergoes significant changes. So, for example, the greatest changes in values are peculiar to specific risks (72.63–39.39%). The smallest dynamics of average values is typical for risks securing property rights (55.7–62.66%). According to the results of calculations, the authors proposed measures for risk reduction with the greatest probability. In addition to traditional methods (hedging, limitation, insurance, etc.), it is advisable to use special measures such as protection of information on innovations, staff development, external consulting, verification of prospective partners for innovation, and improvement of quality management systems.

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1 Introduction

In modern conditions, the performance of the organization depends on many factors, but the indispensable condition is its innovation activity, which allows providing competitive advantages and taking a competitive market position. Innovation activity entails high risks, which is the loss of resources or inadequate income and the appearance of additional costs in comparison with the planned option. Innovation risks have an objective basis due to the instability of the external environment and the uncertainty of its impact on the innovation process and its results.

The analysis of the views of economists on this issue shows that the major contribution to the study of modernization and innovative development was made by Asaul (2010), Chirkunova et al. (2016), Qazi et al. (2016), and Subbotin et al. (2017). Successful implementation of the innovation project involves timely identification and risk management.

Risk assessment and analysis are based on a well-developed risk classification. The active research in the field of risk classification was carried out by Karzhaev (2003), Kulikova (2008), and Golichenko (2015). Risk assessment and analysis are an important stage in risk management. There are quantitative and qualitative methods of risk assessment. Qualitative methods include the method of expert assessments, the method of rating assessments, etc. Quantitative methods include the method of adjusting the discount rate, the scenario method, the decision tree, the probability analysis of distributions, the Monte Carlo method, etc. Risk assessment and calculation of innovation are in the works of Artemenko (2002), Pribytkova (2005), Pomuleva (2012), Rudnik and Deptula (2015), and Farooq et al. (2018). In general, it can be noted that in the works of Russian economists, insufficient attention is paid to risk assessment of innovation activity. This is mainly compensated by using foreign forecasting and assessment methods. Difficulties arise due to the need to identify and justify the factors affecting innovation risk, rank them according to the degree of significance, as well as a large number of indicators that need to be quantified and estimated, which often requires the involvement of expert groups and can lead to a subjective nature of research. The above-mentioned provisions stipulate the need to improve risk assessment and analysis of innovation activity.

The goal of the study is to assess risks of the investment project. Proceeding from the goal, it is supposed to solve the following tasks:

- Identify the features and elements of the innovation project, implement the systematization of investment projects based on various criteria; consider the main stages of the innovation project development and the direction of innovation activity;
- Identify and systematize innovation risks, assess the probability of each type of risk and the entire set of investment risks for the investment project.
- Assess risks of the innovation project and develop methods for reducing these risks.

2 Materials and Methods

The methodological basis of the research is the system approach, which allows considering innovation activity as a holistic object, including a multitude of elements (from the innovation problem to the optimal version of the innovation project implementation and risk factors assessment).

This contribution is based on the methodology for calculating risks, developed by the Investment and Financial Group and the Russian Financial Corporation. The tasks to be performed in the course of quantitative risk analysis are: compilation of the exhaustive list of risks; determination of the weight of each simple risk in their entirety; probability of events applied to each simple risk; and determination of scoring for all project risks.

Thus, the following research methods were used in the work: formal-logical (deduction, induction, justification, and argumentation); abstract-logical (when setting goals, research tasks, and justifying a working hypothesis); empirical (observation and experimentation); economic-statistical (identifying risks in innovation and assessing the level of their impact on the innovative product), economic and mathematical. Data processing was performed using the Microsoft Office software package (Excel, Word).

3 Results

The project is a set of interrelated activities aimed at creating unique products or services in terms of time and resource constraints. Innovation projects have a number of features, which include:

- a sign of changes is the main content of the project;
- a sign of limited time;
- a sign of limited resources;
- a sign of novelty and uniqueness of the project;
- a sign of the complex influence of direct and indirect factors affecting the process and results of the project;
- a sign of the specific organizational structure for the period of project implementation;
- a sign of differentiated projects of the enterprise.

Depending on the types of innovation projects, a large number of interested parties (stakeholders) may participate in their implementations, which form the environment of the project. In the professional literature, various types are presented, and however traditionally, they are divided into internal and external, or near and far. Classification of main types of innovation projects can be based on several criteria (Table 1).

Table 1 Classification of innovation projects

Classification criteria	Types of innovation projects	Features of innovation projects
By the level of scientific and technical significance	Modernized	The prototype or the basic technology does not change radically
	Innovative	The new product differs from the previous one (new qualities are added)
	Advanced	The product is based on advanced technical solutions that have never been used before
	Pioneer	New materials, structures, and technologies are used that perform the old and new functions
By the scale of tasks to be solved	Mono-projects	Performed by one organization or even one department; differ in the setting of the unambiguous innovative goal, implemented in a strict time and financial framework, a coordinator or project manager is required
	Multi-projects	Combine a multitude of mono-projects (several dozen) aimed at achieving a complex innovative goal; require a coordinating unit
	Mega-projects	Multi-purpose integrated programs that combine a number of multi-projects and hundreds of mono-projects linked together by one tree of goals; require centralized funding and guidance from the coordination center
By duration	Short term	1–2 years
	Medium term	Up to 5 years
	Long term	More than 5 years
By the type of innovation	Creation of a new product	Different types of innovations are implemented depending on the stage of the life cycle in projects, they are aimed at achieving specific goals, and various methods of managing them are applied
	Creation of new technologies	
	Access to new markets	
	Connection to new sources of raw materials	
	Development of a new management structure	
By the type of innovation activity	Research	Innovation projects cover all stages of innovation activity associated with the transformation of scientific and technical ideas into a new or improved product
	Scientific and technical	
	Production update	
	System update	

Source Authors, compiled on the basis of works by Kornilova (2016), Chirkunova (2017), Korol (2017), Dmitrienko (2017)

The formation of innovation projects is to solve the most important problems that ensure a comprehensive system approach to the solution of scientific and technical problems, continuous management processes of creating, developing, producing and implementing innovations, justifying the selection of the most effective ways to achieve the project goals, balancing the resources necessary to implement the innovation project and effective management of a complex set of project activities.

The process of implementing targeted changes in accordance with previously developed rules, methods, and algorithms is the content of project management. An innovation project is a complex multifunctional dynamic object, and therefore, the management system must be flexible and capable of allowing adaptation to changes. In this connection, innovation project management is understood as the process of making and implementing management decisions related to specific goals, organizational structure, planning and monitoring of activities aimed at implementing an innovative idea.

In the generalized form, the management cycle is represented by two stages. In general, the process of managing the content and implementation of the innovation project can be presented in Fig. 1.

The innovation project is a variety of investment projects and has a number of distinctive features. Innovation projects are lengthier in terms of time, are highly

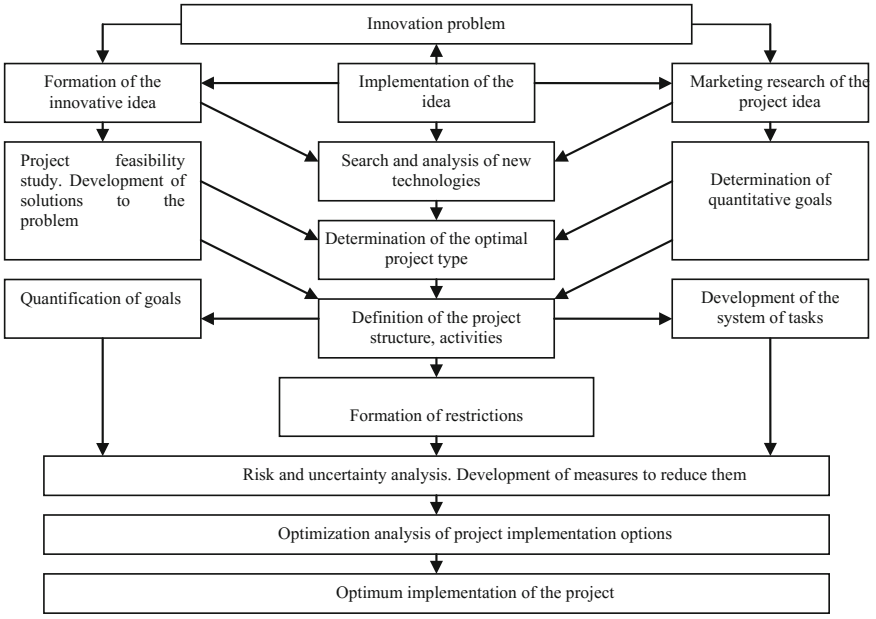

Fig. 1 Contents and main stages of the innovation project development. *Source* Authors, compiled in accordance with Russian State Standard GOST R 54869-2011 "Project management. Requirements for project management" (GOST R 54869-2011 2018)

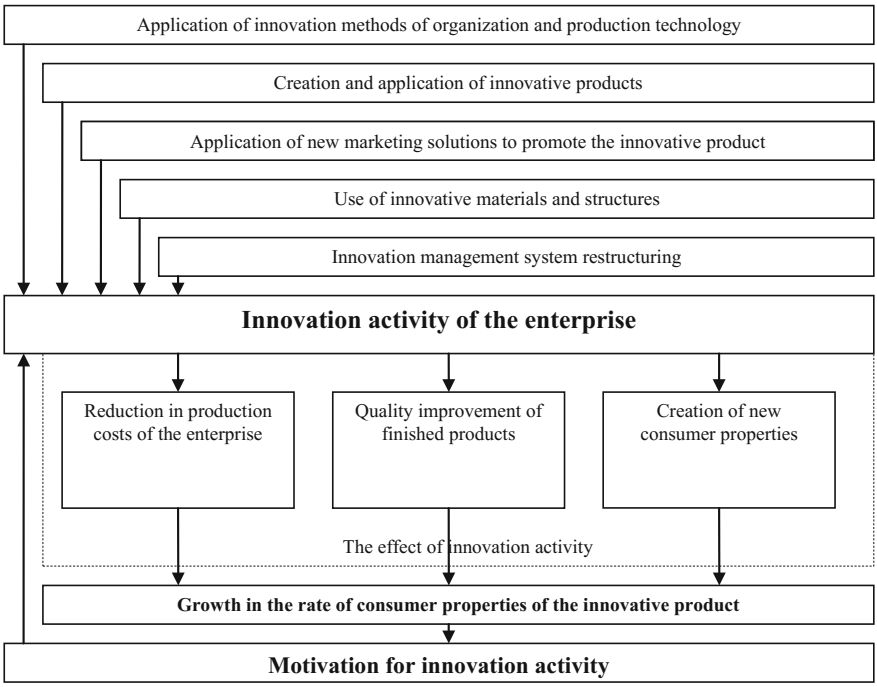

Fig. 2 Directions of innovation. *Source* Authors

uncertain and predictable by a number of parameters, and accordingly, are of a risky nature. This justifies the need for their thorough examination and assessment when planning the financing (Kornilova 2016).

The directions of innovation activity in construction can be presented in the form of a scheme (Fig. 2).

Difficulties in project decision making are due, first, to a significant degree of uncertainty about the future conditions in which the project will be implemented, and secondly, to the possible inconsistency of comparative assessments of alternative project options. The uncertainty factor of future project conditions leads to risks for investors and the need to take measures to reduce them (Belanova 2016).

At its core, the innovation risk is an economic category that depends on political, social, economic, environmental, technological situations and is an estimated quantity, the quantitative estimate of which may be the probability of the unfavorable outcome when investing in the production of new goods and services, in the development of new technology that may not find the expected demand in the market, as well as investing in the development of managerial innovations that will not bring the expected effect.

The innovation risk should be understood as an estimated probability (loss) of at least a portion of its resources, a loss of planned revenues (profits) from the innovation project, the value of a portfolio of financial assets, or the emergence of additional costs (Chirkunova 2017).

The innovation risk of the company implementing the innovation project is manageable. Risk management associated with the introduction and promotion of innovation is difficult, taking into account a high proportion of uncertainty. However, risk management tools can provide an analysis of innovation risks and their systematization (Table 2).

To assess uncertainty and risks, the following methods are recommended:

- verification of sustainability, which involves the scenario development to implement the project (pessimistic, most likely and optimistic) and calculate the break-even point;
- adjustment of project indicators and economic standards, replacement of their projected values with expected ones;
- formalized description of uncertainty using a logical scale or scoring system.

Most risk assessment tools are based on a scoring system: The expert places a certain number of points for each of the risk groups or for each risk in a separate group, and then, the risks are weighed and an overall risk assessment of the project is displayed. Based on this assessment, a conclusion is made about the project risk group and whether to finance it. The project risk assessment must necessarily be reflected in project calculations: All indicators should be determined taking into account the risk adjustment.

Research of risks in innovation activity and assessment of its impact on the amount of capital investment of the customer-builder when creating the innovative product was carried out on the basis of the criteria ranking methodology. The choice of this approach is based on the principle of exclusion and is determined by the properties of the object for risk assessment of R&D (Kudryashova 2014). The research involved research institutes (scientific research institutes), which occupy a certain niche in the scientific sphere. The specific gravity of each risk was determined on the basis of its ranking according to the nature of innovation activity (Table 3) (research (RE), scientific and technical (ST), production update (PU), system update (SU) in linking the duration of their implementation:

- Short-term—duration 1–2 years;
- Medium-term—duration up to 5 years;
- Long-term—duration more than 5 years.

To analyze the probability, the scale of risks is taken into account: P1 is a pessimistic option; L2 is the most likely option; O3 is an optimistic option. Each option was calculated by the formula 1 of the total probability:

Table 2 Systematization of risks

Types of risks	Examples of risks
Main risks	Risk 1. Risk of failure to sell new products and technologies of the company due to insufficient material, technical and raw material's base; shortage of raw materials
	Risk 2. Business risks associated with the variability in production costs
	Risk 3. Marketing risks associated with the sale of a new product and the insolvency of the buyer, short payment or late payment.
	Risk 4. Risk of incorrect forecasting of the situation and wrong initial data
	Risk 5. Risk of non-return of borrowed funds
	Risk 6. Risk associated with the implementation of the innovation project
	Risk 7. Operational risk
	Risk 8. Risks of unforeseen costs and income loss
	Risk 9. Risk of enhanced competition
	Risk 10. Risk of non-return or insufficient level of external investment
Specific risks	Risk 11. Risk of wrong R&D direction
	Risk 12. Scientific and technical risk (incompleteness and inaccuracy of information on the dynamics of technical and economic indicators, parameters of new technology)
	Risk 13. Risk of a negative scientific result
	Risk 14. Incorrect risk assessment of prospects to carry out R&D and (or) ROC
	Risk 15. Risk of choosing the wrong innovation project
	Risk 16. Risk of low scientific qualification of the personnel
	Risk 17. Risk of non-certified new products and technologies
	Risk 18. Risk of conservation associated with the fact that the environment surrounding the company is constantly changing, while the risk of conservation can lead to disharmony between the company and the external environment
Risks to secure property rights	Risk 19. Risk of insufficient patenting of technical and marketing decisions of innovations
	Risk 20. Risk of protests against patents defending fundamental technical, design and marketing decisions
	Risk 21. Risk of legal and illegal imitation by competitors of the company's patented innovations

Source Russian State Standard GOST R 54869-2011 "Project management. Requirements for project management." (GOST R 54869-2011 2018)

Table 3 Probability of major risks

Name of risks	Probability of risks				Average probability (Cv)
	RE	ST	PU	SU	
Main risks					
Risk 1	83.7	91.37	75.46	35.83	71.59
Risk 2	82.47	75.28	62.29	34.25	63.57
Risk 3	86.28	76.12	53.45	37.2	63.26
Risk 4	70.16	60.39	59.25	56.02	61.45
Risk 5	93.16	84.15	63.67	60.14	75.28
Risk 6	89.26	70.25	67.46	35.19	65.54
Risk 7	87.63	79.16	84.23	53.1	76.03
Risk 8	91.32	81.75	53.91	38.41	66.34
Risk 9	3.37	14.27	81.14	71.9	42.67
Risk 10	86.46	73.27	59.02	69.24	71.99
Specific risks					
Risk 1	63.27	69.26	62.82	25.89	55.31
Risk 2	81.36	86.51	38.01	36.34	60.55
Risk 3	95.42	76.85	67.11	27.17	66.63
Risk 4	76.54	63.47	29.37	17.46	46.71
Risk 5	76.89	77.88	43.27	29.48	56.88
Risk 6	65.94	67.24	53.36	52.38	59.73
Risk 7	41.6	46.35	79.36	61.74	57.26
Risk 8	79.99	91.03	76.42	64.67	78.02
Risks to secure property rights of the innovation project					
Risk 1	52.57	54.19	55.55	58.29	55.15
Risk 2	56.34	62.87	57.21	57.95	58.59
Risk 3	58.18	49.95	69.37	71.73	62.30

Source Authors. (The calculation was based on data collected from the documents: Monitoring the effectiveness of innovation (http://www.rvc.ru/upload/iblock/596/RVC_ITMO_05.pdf); Scientific, technical and technological expertise of projects; Analysis of the Russian market (http://www.rvc.ru/upload/iblock/f44/RVC_project_expertise.pdf); National report on innovations in Russia 2016 (http://www.rvc.ru/upload/RVK_innovation_2016_v.pdf); Case study: Innovation management in Russian companies (http://www.rvc.ru/upload/iblock/0dd/Management_of_Innovations_in_Russian_Companies.pdf), and grouped for each of the risk groups)

$$V(A) = V(L1) \cdot V_{L1}(A) + V(L2) \cdot V_{L2}(A) + V(L3) \cdot V_{L3}(A) \quad (1)$$

The results are summarized in Table 3.

Obtained data on the probability of innovation risks during the project tell us about the prevalence of the probability of risks associated with the non-return of borrowed funds (75.28%) and/or short payment or insufficient level of external investment (71.99%); with a high probability that technical systems of the project will fail (76.03%); the failure to sell the product, the technology of the innovation

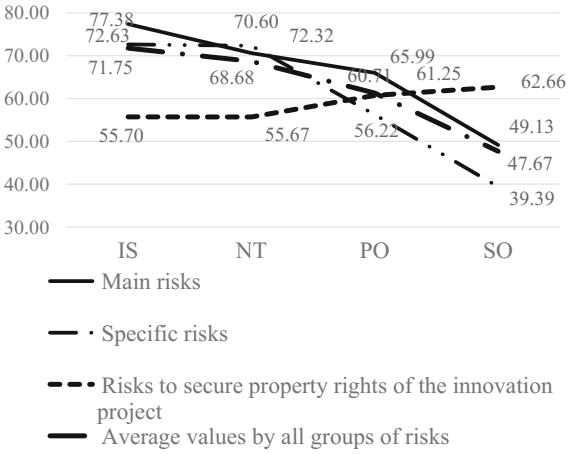

Fig. 3 Average values of risks by innovation activity. *Source* Authors. The data of average values for Table 3, grouped by types of risks and by all groups of risks in the context of innovation activity

project due insufficient material, technical and raw material's base, and the shortage of raw materials (71.59%). All these threats are inherent in the basic risks of the innovation project.

Among the specific risks can be identified the risk of conservation, due to the fact that the environment surrounding the company is constantly changing, which can lead to disharmony between the company and the external environment—78.02%. All research institutes also indicate a high probability of legal and illegal imitation by competitors of innovation patents, the copying of the innovation project—62.30%.

The calculation of average risk values by innovation activity (Fig. 3) shows that, depending on innovation activity, the level of the probability of risks undergoes significant changes. So, for example, the greatest changes in values are peculiar to specific risks from 72.63 to 39.39%.

The dynamics of average values for risks to secure property rights from 55.7 to 62.66%.

The graph clearly shows the dependence of the probability of risks on the innovation project (IP). The highest total values are inherent in research projects—77.38. About the risky event, there is nothing definite to say when implementing an IP in the framework of the system update.

The overall rate of a decline in the probability of innovation risks is the following:

– research risks in relation to scientific and technical decline by 9%;
– research risks in relation to the production update decline by 15%;
– research risks in relation to the system update decline by 37%.

Thus, it can be concluded that the greatest unpredictability is characteristic for research innovation projects, which implies from an economic point of view, a greater amount of financial loss to the economic entity and a decrease in the level of

profitability. Therefore, research IPs are attractive only in case of state support at all stages of innovation activity or use of public–private partnership mechanisms as incentives for such projects (Belanov 2014).

The resulting average risk values by innovation activity will allow developing financial, social, organizational and management tools and models depending on the type of innovation technology being introduced (Domnina et al. 2016).

Next, we will rank investment risks in terms of priority and determine the weights with which each simple risk is part of the company's overall risk that implements IP. We introduce the notation:

SRi simple risk, $i = 1,\ldots, n$;
n a total number of innovation risks ($n = 21$);
Gj a priority group, $j = 1$, p, $p < n$;
Wj a weight of simple risks by priority groups Gj, $Wj > 0$, $\Sigma Wj = 1.0$; Nj—a number of risks included in the priority group Gj

Twenty-one risks (Table 2) are grouped into four priority groups ($p = 4$) by the increase in the importance and influence of factors. Let us make the assumption that the first priority is four times more powerful than the fourth.

Sequence of calculations:

1. We will assess the priorities of risks, i.e., the importance of each individual event in the totality of risks. Then, the change in the percentage is determined by the change in the risk factor (Likhach and Savoskina 2015). It is important that such general requirements as nonnegativity of weighting coefficients and equating their sum to unity are observed.
   According to the authors' assumption, the first priority is four times more significant than the last one; that is, according to the formula: $W1/Wp = 4$.
2. The weight of the group with the lowest priority is made by formula 2.

$$\begin{aligned} Wp &= 2/[p(f+1)] \\ W4 &= 2/[4*(4+1)] = 0,1. \end{aligned} \tag{2}$$

The calculation of the weight values for the remaining three groups is determined by formula 3:

$$\begin{aligned} Wj &= Wk[(p-j)f+j-1]/(p-1) \\ W3 &= 0.1*[(4-3)*4+3-1]/(4-1) = 0.2; \\ W2 &= 0.1*[(4-2)*4+2-1]/(4-1) = 0.3; \\ W1 &= 0.1*[(4-1)*4+1-1]/(4-1) = 0.4. \end{aligned} \tag{3}$$

The weights of simple factors are determined by formula 4:

$$\begin{aligned} Wi &= Wj/M \\ W1 &= 0.4/6 = 0.067;\ W2 = 0.3/5 = 0.06; \\ W3 &= 0.2/5 = 0.04;\ W4 = 0.1/5 = 0.02 \end{aligned} \tag{4}$$

The results of calculations are summarized in Table 4, on the basis of which we determine the overall risk assessment.

The impact of the entire set of innovation risks is 66.09 points (high), the group for G1 and G4—66.09 points (the lower limit of high risk). Comparing with the five-level scale 0–100 points, the risk of the innovation project is estimated as possible (60–80 points), which means that the risk can be short term with a frequency of once a month (National Standard of the Russian Federation 2011). For example, comparing innovation and investment risks, we obtain the following comparison: 66.09 > 54.15 (Pribytkova 2005; Likhach and Savoskina 2015).

Table 4 Overall risk assessment of organizations

Priority group	Name of risks	*Wi*	Probability, *Cv*	Score, *Wi* Cv*
G1 = 0.4	Risk of conservation associated with the fact that the environment surrounding the company is constantly changing, and the risk of conservation can lead to disharmony between the company and the external environment	0.067	78.03	5.20
G1 = 0.4	Risk of non-return of borrowed funds	0.067	75.28	5.02
G1 = 0.4	Operational risk	0.067	76.03	5.07
G1 = 0.4	Risk of short payment or insufficient level of external investment	0.067	72.00	4.80
G1 = 0.4	Risk of legal and illegal imitation by competitors of the company's patented innovations	0.067	70.46	4.70
G1 = 0.4	Risk of the failure to sell new products and technologies of the company due to insufficient material, technical and raw materials' base, shortage of raw materials	0.067	71.59	4.77
G2 = 0.3	Risks of unforeseen costs and income loss	0.06	66.35	3.98
G2 = 0.3	Risk of the negative scientific result	0.06	66.64	4.00
G2 = 0.3	Risk associated with the implementation of the innovation project	0.06	65.54	3.93
G2 = 0.3	Business risks associated with variability in production costs	0.06	63.57	3.81
G2 = 0.3	Marketing risks associated with the sale of a new product and insolvency of the buyer, short payment or late payment	0.06	63.26	3.80

(continued)

Table 4 (continued)

Priority group	Name of risks	*Wi*	Probability, *Cv*	Score, *Wi* Cv*
G3 = 0.2	Risk of incorrect forecasting of a situation and wrong initial data	0.04	61.46	2.46
G3 = 0.2	Scientific and technical risk	0.04	60.56	2.42
G3 = 0.2	Risk of low scientific qualification of the personnel	0.04	59.73	2.39
G3 = 0.2	Risk of non-certified new products and technologies	0.04	57.26	2.29
G3 = 0.2	Risk of choosing the wrong innovation project	0.04	56.88	2.28
G4 = 0.1	Risk of insufficient patenting of technical and marketing decisions of innovations	55.15	0.020	1.10
G4 = 0.1	Risk of protests against patents defending fundamental technical, design and marketing decisions	58.59	0.020	1.17
G4 = 0.1	Risk of wrong R&D direction	55.58	0.020	1.11
G4 = 0.1	Incorrect risk assessment of prospects to carry out R&D and (or) ROC	46.71	0.020	0.93
G4 = 0.1	Risk of enhanced competition	42.67	0.020	0.85

Source Authors, the data of Table 3, processed on the basis of the methodology developed by the Investment and Financial Group and the Russian Financial Corporation

Thus, in the implementation of innovation activity, the organization forms a risk above the average level; the risk is likely to take place (Golichenko 2014). Therefore, the implementation of commercial innovation projects in the current micro- and macroeconomic situation in the country is not very effective, and it is necessary to adapt existing approaches to the formation of the structure of funding sources. In this case, a scenario-based approach to shape the structure of funding sources, taking into account risk reduction measures and the use of joint investment contracts, as well as the further development of forms of public–private partnerships (Savoskina and Burlakova 2017) is a highly effective method of constructing optimal schemes for financing innovation projects.

For each innovation project, based on risks that have a high probability, it is necessary to develop measures for their management (Lane et al. 2017; Belanova 2016). Traditional methods of risk reduction are:

– Diversification (allocation of investments for various innovation projects that are not related to each other): Based on the specifics of the implementation of each innovation project, industry (regional) specifics, the probability of risks for different projects will vary, but risks cannot be eliminated completely, as the influence of macro-environment factors can negatively affect the results of all innovation projects);

- Distribution of risks among participants of the innovation project (this increases the reliability of the innovation project, with the maximum responsibility for each type of risk to be transferred to the participant who is more in control of it);
- Limitation (determination of the maximum amounts of expenses, credit);
- Hedging (insurance of risks from unfavorable changes in prices for inventories under contracts and transactions in the future, taking into account probabilistic price changes and pursuing to reduce the negative consequences of their changes);
- Reserve for unforeseen expenses;
- Insurance, etc.

In addition to them, it is advisable to use special measures:

(1) Planning and forecasting of innovation activity;
(2) External consulting on legal, technical, and economic problems;
(3) Verification of prospective partners for innovation;
(4) Protection of information about innovations;
(5) Staff development in accordance with the needs of innovative solutions;
(6) Diagnostics of employees' readiness for innovative changes;
(7) Improvement of quality management systems.

The highest risks for the innovation project need to be analyzed in more detail. Consider the risks that have received the greatest score in analyzing and assessing risks of the innovation project (Table 5).

4 Discussion

Summing up the results of the conducted research, it can be said that the mathematical justification of the risk assessment on the one hand allows expanding the evidence base of calculations, on the other—gaining an additional opportunity to recheck and confirm the judgments made in the course of practical activity.

The practical significance of the research is to take into account and assess risks with regard to the innovation design, which allows them to be used in the practical work of relevant government bodies and commercial structures implementing innovation projects and working in the innovation field.

Obviously, the proposed procedure for the risk allocation, description and assessment requires a more comprehensive study of the possibility of risks, and the assessment of damage, but at this stage, it will allow further:

(1) Emphasizing and detailing a number of independent risk-forming factors in innovation activity that have a critical impact on the results of the innovation project;
(2) Assessing the probability and degree of threat of each of the factors with a more accurate definition of damage;

Table 5 Risk management

Types of risks	Reasons of risks	Methods of risk reduction
The risk of conservation associated with the fact that the environment surrounding the company is constantly changing, and the risk of conservation can lead to disharmony between the company and the outside environment	Errors in calculations Miscalculations in assessing the timing of the implementation Rapid aging of innovations Non-compliance with customer requirements Miscalculations in the development of the marketing concept	Research and consideration of macro- and microenvironmental factors of the organization Planning and forecasting of innovation activity Insurance Diversification
Risk of non-return of borrowed funds	Miscalculations in projected income-expenditure flows Deterioration of financial situation Change in macro-environment factors	Establishment of borrowing limits Insurance Diversification of the loan portfolio and risks
Operational risk	Miscalculations in assessing production opportunities Lack of technology Insufficient technical level Incompatibility with the technological structure	External consulting on technical problems Staff development in accordance with the needs of innovative solutions Improvement of quality management systems Distribution of risks between all participants of the innovation project
Risk of short payment or insufficient level of external investment	Insufficient return on invested capital High investment risks	Obtaining guarantees Developing profitable offers for investors
Risk of legal and illegal imitation by competitors of the company's patented innovations	Imperfect legislation Unfair behavior of competitors Lack of proper control by the organization	External counseling on legal issues Verification of prospective innovation partners Protection of information about innovations
The risk of the failure to sell new products and technologies of the company due to insufficient material, technical and raw materials' base; shortage of raw materials	Miscalculations in assessing necessary resources Unreliability of suppliers Excessive concentration of the enterprise on a limited choice of technologies Increase in prices for resources	Diversification of suppliers Provision of reserves Hedging

Source Authors

(3) Carrying out the analysis of the project results with a consistent change in critical factors;
(4) Choosing the optimal management option for each type of innovation risks: take, evade, reduce, and transfer.

5 Conclusions

Innovation activity involves significant risks. The analysis and evaluation of investment risks are based on rationale and systematization of risks. The authors of the study outlined the main types of innovation risks and divided them into three groups: the main risks, specific risks, and risks to secure property rights. The conducted research and risk assessment show that among the main risks, the operational risk, the risk of non-return of borrowed funds, the risk of the failure to sell new products and technologies, and the risk of insufficient investment are most likely to occur. Among the specific risks, the key is the risk of conservation; among the risks to secure property rights is the risk of imitation of innovations. In the contribution, the risk assessment is based on ranking according to innovation activity (research (RE), scientific and technical (ST), production update (PU), and system update (SU), in relation to the duration of implementation. The greatest unpredictability is characteristic for research innovation projects, which implies from the economic point of view, a greater amount of financial loss to the economic entity and a decrease in the level of the profitability.

The instability of environmental factors and uncertainty of their impact on design decisions lead to a high probability of risks and losses for investors, so it requires developing measures to reduce them. The contribution presents an integrated approach to risk management. The authors revealed the main causes of the probability of risks and suggested methods for reducing them.

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Ecology, Innovation, and Quality of Life: AB OVO USQUE AD MALA

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Abstract With the development of scientific, technical, and socioeconomic processes in industrialized countries in the second half of the twentieth century, a new multidisciplinary scientific direction was "brought to life" and was related to the effective use of the results of research and development aimed at improving the quality of human life—innovation. Naturally, the quality of life of a person cannot be considered in isolation from the state of the natural environment in which this person lives, works, and rests. The goal of the study is to show a close interaction, apparently, of the main sciences of the twenty-first century—ecology and innovation and integrated influence on man. In the contribution, the aspects of innovation activity in ecology (ecological rationing, new methods of bioindication and biomonitoring, waste utilization, ecological audit of the territory, public health, etc.) are considered in detail. The issues of innovation management of nature protection activities aimed at improving the quality of life of the population are discussed in detail. The authors examined "from start to finish" aspects of the interaction between innovation and ecology. The main conclusion is that a program of

Latin subtitle of the article ("from egg to apple", "from beginning to end").

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step-by-step innovation activity is needed that can describe the content and sequence of the planned measures and set the ultimate goals of the reform of the environmental management system, activities.

1 Introduction

The scientific, technical, and socioeconomic development of industrialized countries in the second half of the twentieth century "brought to life" a new multidisciplinary (interdisciplinary, supra-disciplinary) scientific direction related to the effective use of the results of research and development aimed at improving the quality of human life. Naturally, the quality of life of a person cannot be considered in isolation from the quality of the natural environment in which this person lives (it is obvious that the quality of the habitat directly affects the development of the population's demographic potential and the health of the population, and it is an indicator of the attitude toward future countries). It would seem that it was environmental and innovation activity that should become the main one when the economy of our country moves to a qualitatively new level postulated by its leadership.[1]

Moreover, many provisions of this kind of leadership are prescribed in a number of state documents (the Constitution of the Russian Federation (adopted on December 12, 1993), the Concept of National Security of the Russian Federation (approved by the Decree of the President of the Russian Federation of December 17, 1997 No. 1300), the law of the Russian Federation "On Environmental Protection" No. 7-FZ of January 10, 2002, the Environmental Doctrine of the Russian Federation (Government Decree No. 1221-r3 of August 31, 2002). However, the analysis of scientific literature illustrates that, unfortunately, much less attention is paid to this problem than, for example, directly to innovation in industry or education.

The goal of this study is to show, as far as possible, "*ab ovo usque ad mala*" ("from egg to apple", "from beginning to end") a close interaction of, apparently, main sciences of the twenty-first century—ecology and innovation (Zibarev 2011). The invasion of the term "ecology" and various environmental concepts (as well as "innovation"), often losing biological meaning in different branches of knowledge, indicates the need to determine the conceptual apparatus.

The interests of the economy, on the one hand, and the conservation of nature, on the other hand, should be balanced and should be guided by a long-term

[1]June 21, 2012. Chairman of the Government of the Russian Federation Dmitry Medvedev spoke at the third session of the plenary session of the UN Conference on Sustainable Development "Rio + 20." In particular, he said: "Society, economy and nature—are inseparable. That is why we need a new development paradigm that can ensure the welfare of society without excessive pressure on nature."

perspective. At the same time, innovative growth and growth of the energy-efficient, so-called green economy, which is certainly beneficial to all countries, is necessary."

President of the Russian Federation V. V. Putin said at a meeting of the Council for Strategic Development and Priority Projects (Novo-Ogaryovo, July 5, 2017): "The digital economy is not a separate industry. In fact it is a way of life, a new basis for the system development of public administration, economy, business, social sphere, the whole society. The formation of the digital economy is a matter of national security and independence of Russia, the competition of domestic companies… It is really compared with breakthrough reforms that at different historical stages allowed Russia to take a serious step forward and strengthen its position in the world. These reforms include the construction of railways in the late nineteenth century and the electrification of the country in the first half of the twentieth century" (http://tass.ru/ekonomika/4389411). The program for the development of the digital economy in Russia was approved by the decree of the Government of the Russian Federation on July 28, 2017 (No. 1632-r).

2 Materials and Methods

Innovation is a field of knowledge covering the issues of methodology and organization of activities aimed at commercialization of accumulated knowledge, technologies, and equipment. The result of innovation activity is new or additional goods (services) with new qualities. It can be said that this is an "economic" definition; but the relationship between people is not limited only to the economic sphere, "the place of our country and each of us depends not only on mineral resources, availability of production capacities or personal savings, but above all on the ability to create and actively introduce new useful ideas in all areas of the human activity" (Konovalov 2005). In this context, the criterion of innovation is the emergence and consolidation of new qualitative characteristics of the updated system.

Innovative project—as well as the concept of "innovation", is an integrating system, including the problem, its new solution, design, and production, economic and legal support. Such a project is aimed at both preserving the competitiveness of the individual enterprise and ensuring public interest.

Ecology is the science of the leadership of living organisms and their communities with each other and with the environment (Rosenberg 1999, 2010, 2013). From the point of view of anthropocentrism, ecology is perceived to a greater extent as a science that "serves" the human being depending on the change in his/her economic or social status than the natural science discipline.

The quality of the environment is the degree to which natural conditions correspond to physiological capabilities of a man. The scientists distinguish the healthy natural environment (or comfortable), in which the health of a person is normal, and the unhealthy one, in which the state of health is disrupted. Naturally,

the principle of anthropocentrism is also true with respect to the history of the rationing development of the quality of the environment: considerably earlier than others, the norms of acceptable environmental conditions (first of all, production) were established. This was the beginning of work in the field of sanitary and hygienic rationing. However, a man is not the most sensitive of biological species and the principle of "protected man–protected ecosystems", generally speaking, is incorrect.

Environmental damage is damage to ecosystems as a whole or to their individual components. Environment damage, calculated in natural units of measurement, corresponds to the concept of "environmental harm" and includes pollution, contamination of the natural environment, depletion of natural resources, destruction, damage to natural objects, components of agro-ecosystems, destruction of ecological links, disturbance of ecological balance in ecosystems, etc. Environmental damage, expressed in value terms, is actual and possible losses in their quantitative expression, including lost profits (i.e., income, and additional costs of eliminating adverse consequences for the life of humans, animals, plants and other living organisms, the state of ecological systems, natural complexes, landscapes and objects) caused by a violation of standards for the environmental quality, as a result of negative impacts of economic and other activities, as well as technogenic accidents and catastrophes, and by the restoration of the disturbed state of ecosystems (Evlanov et al. 2011).

Environment rationing is normalization of the anthropogenic impact on the ecosystem within its ecological capacity, which does not lead to a violation of self-regulation mechanisms. The main criteria for environmental rationing are the preservation of the biotic balance, stability, and diversity of the ecosystem. A new look at environmental rationing is an important element of innovation activity and therefore the authors dwell on it in more detail.

3 Results

Some innovative approaches to environmental management:

New methods of bioindication and biomonitoring. An important component of sustainable development of regions is sustainable development of large river basins. Using the example of the Volga River Basin, the largest river in Europe and the most man-made river in Russia (the basin area is 1.36 million km^2 and includes territories of 39 entities of the Russian Federation and two of Kazakhstan, with more than 40% of the Russian population living here) the authors illustrated the methods of bioindication and biomonitoring of anthropogenic influences (Bukharin et al. 2010; Rosenberg et al. 2010a, b):

– A complex assessment system of the environment well-being on the dyscrasia (morphogenetic, cytogenetic, immunological, physiological, toxicological, and biochemical) development of organisms—BIOTEST (Zakharov 2000);

- Original microbiological methods for assessing water bodies well-being using the analysis of microbiological connections of associate cohabitation of hydrobionics;
- Risk assessment of invasions of alien species into inland water bodies, information systems for invasive species, which have been tested in the Volga Basin as the main Northern European invasive corridor.

Environment rationing. It should be noted that environmental rationing is a key problem in the formation of environmental safety. More than two decades ago, Russia posed the question of the need to determine permissible environmental loads and adequate restrictions (rationing) of existing anthropogenic impacts, taking into account the totality of possible harmful effects of many factors and natural specifics of facilities. The Law on Environmental Protection, among others, prescribes the rationale and use of two types of standards in practice (articles 21, 22, 27):

- Environmental quality standards—"are established to assess the environmental well-being in order to conserve natural ecological systems, the genetic fund of plants, animals and other organisms";
- Standards for the permissible environmental impact (including standards for the permissible anthropogenic load)—"shall be established for business entities and other activities with a view to assess and regulate the impact of all stationary, mobile and other sources of environmental impact located within specific territories and (or) water areas."

In the "Concept of long-term socioeconomic development of the Russian Federation for the period until 2020", under the heading "Environmental safety of the economy and human ecology" one of the directions is a gradual reduction in impact levels on the environment of all anthropogenic sources using a new system for rationalizing the permissible impact on the environment, stimulation of modernized production processes, aimed at reducing energy intensity and material consumption, creating a balanced environmentally oriented model of economic development, and environmentally competitive industries. The target orientations of this concept and the main activities of the Government of the Russian Federation are to reduce specific levels of environmental impact by 3–7 times (depending on the industry) and reduce the level of environmental impact by 2–2.5 times.

At the meeting of the State Council of the Russian Federation on May 27, 2010 (at a water station in the village of Vnukovo near Moscow), with the agenda "On the improvement of state regulation in the sphere of environmental protection," Dmitry Medvedev declared that the theme of nature protection "should become fashionable and prestigious not only for environmentalists" but also for the whole society, but he also focused on legislative provision, including problems related to environmental rationing.

On March 30, 2011, the Government of the Russian Federation held a meeting "On a set of measures to improve the environmental situation in Russia," at which the Chairman of the Government of the Russian Federation, V. V. Putin outlined the following main problems in the field of ecology:

- Impact on the environment as a result of intensive development of economic activities, transport, industrial infrastructure;
- Impact of "archaic industries" that do not meet modern environmental requirements;
- Littering of soils with production and consumption wastes, nonuse of these wastes as secondary raw materials.

The main reasons for these problems from the point of view of V. V. Putin are the imperfection of the environmental regulation system, the inefficiency of the state's management and control functions, weak incentives for using modern clean and green technologies; he also noted *the need for legislative change*s in the following areas:

- Rationalizing the impact on the environment through the introduction of the best available technologies. At the same time, such technologies should be financially accessible and cost-effective to enterprises.
- Economic incentives to modernize enterprises, the use of energy-saving and environmentally friendly technologies.
- Increasing responsibility for enterprises that do not comply with the law and violate established rules (http://www.geotochka.ru/index.php).

Ecological rationing involves taking into account the so-called maximum permissible load on the ecosystem. A load is considered acceptable, under the influence of which the deviation from the normal state of the system does not exceed natural changes and, therefore, does not cause undesirable effects in living organisms and does not lead to deterioration in the quality of the environment. Unfortunately, as it often happens in our life, it is much easier to write a law or to give a fundamental definition than to develop a methodology for measuring private indicators, enshrined in the law. For example, who can give a seemingly uncomplicated definition of the "normal state of the ecosystem" and what its "range of natural changes" is? Therefore, by now only some attempts to substantiate "environmental occupational exposure limit", mostly for communities of fisheries are known.

In the world practice, the concept of critical loads has been widely developed as a necessary guide to the rational limitation of anthropogenic impacts. At the UN workshop, the term of "critical load" was defined as "a quantitative assessment of effects of one or more pollutants below which there is no significant adverse effect on specific sensitive environmental elements in accordance with current knowledge" (Nilsson and Grennfelt 1988). Taking into account the known problems of cumulation of small impacts and the development of chronic (delayed) consequences, the magnitude of the critical load can be characterized as the maximum inflow of pollutants, which does not cause irreversible harmful changes in the structure and functions of ecosystems during a long (50–100 years) period.

Methods of waste disposal. In accordance with the Law "On Environmental Protection" (Article 54), production and consumption wastes are subject to mandatory collection, use and disposal, the conditions and methods of which

should be safe for the environment. In the Federal Law "On Production and Consumption Wastes" of June 24, 1998 No. 89-FZ, one of the main principles of economic regulation in the field of waste management is the reduction of the amount of waste and its involvement in economic circulation. The main directions of the "Environment Doctrine of the Russian Federation" in the field of ecology are "the development of systems for the use of secondary resources, including waste processing." "Over the past five years alone, the total volume of waste generated in Russia has grown 1.5 times and amounted to more than 3.5 billion tons. The most common method of waste disposal is burial, which leads to a permanent loss of up to 90% of useful products that have real demand in the market, while the content of valuable components in the waste is not often close to its content in extracted raw materials," said the president of Kalmykia, K. N. Ilyumzhinov, the head of the working group on improving the state regulation system in the sphere of the environment at the meeting of the State Council of the Russian Federation on May 27, 2010 (http://special.kremlin.ru/transcripts/7872).

The authors mentioned only a few new effective technologies for waste processing. For example, the nonprofit partnership "Ecology" in Cheboksary is the largest enterprise in the Chuvash Republic that is able to solve the problems of waste disposal in a complex way, possessing modern equipment and technologies (a wide range of industrial, oil, construction, medical, biological, and pharmaceutical waste is disposed of).

Another example of new technologies in waste processing is demonstrated by the Foundation for the Promotion of Research and Development of New Types of Environmental Technology "The World of Man" (Togliatti, Samara Region) (Zibarev 2011, 2012). For example, in the course of the production activity of LLC "Tolyatikauchuk", slurry of spent aluminum–chromium catalyst is formed, which has been stored for almost 20 years in a slurry storage facility on the territory of the enterprise. In connection with its filling, the project of a new storage facility with the area of about 34 thousand m^2 was prepared. This is an extensive waste collection route; the "Human World" foundation together with the Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan has the technology of processing (intensive approach) these alumina-containing catalysts, the implementation of which will reduce the volume of waste and "recycle" chromium and aluminum almost on the industrial scale.

The automated information system for managing payments for negative impact on the environment. The payment for the negative impact on the environment is established by the Law on Environmental Protection (Article 16); the procedure for the calculation and payment of environmental payments and their maximum amounts is prescribed in Government Decree No. 632 of August 28, 1992, "On Approving the Procedure for Determining Payment and its Limit for Pollution of the Environment, Waste Disposition, Other Types of Harmful Impact." The fee is charged for the following negative impacts:

- Air emissions of pollutants and other substances from stationary and mobile sources (vehicles) (including air, sea, inland navigation vessels, space objects), other objects operating on gasoline, diesel fuel, kerosene, liquefied (compressed) oil or natural gas);
- Discharges of pollutants, other substances, and microorganisms into surface water bodies, underground water bodies and catchment areas;
- Location of production and consumption wastes;
- Pollution of subsoil, soil;
- Other types of negative impact on the environment (noise, heat, vibration, electromagnetic and radiation effects, etc., currently there are no approved rates for this type of negative impact, and therefore, no fee is charged).

There are several automated information systems known: the Krasnodar ECO-Administrator (http://www.airsoft-bit.ru/index.php/programecologs/111-eco-admin), the programs of Ltd "BIT-Kazan", Ltd "ECOcenter" in Voronezh, Ltd NPP "Aviainstrument" in Kirov, Ltd "ECOPROMPROEKT" in Nizhniy Novgorod, and others (http://www.aieco.ru/programms_info_pay10.html). Their implementation, in compliance with all the requirements, regulations and guidelines contained in regulatory legal acts at federal and regional levels, allows for effective environmental management in the territory.

Environment audit of the territory. Environmental audit (EA) is defined as "objective, independent analysis, evaluation, development of appropriate recommendations and proposals on the actual results of any environmentally significant activity conducted by small groups of independent specialists in a short time" (Snakin 2000). Obviously, it is most preferable to develop EA in the direction based on a systemic integrated approach to define goals, nature, organization, and procedures of EA as an organizational and legal mechanism for ensuring the security and investment attractiveness of the enterprise or other eco-audit facilities. At the same time, the criteria for assessing environmental safety of the object are reduced to socio-ecological and economic characteristics of nature management—the volumes of pollutants entering the environment, the scale of seized resources, the damage to nature and society, and taking into account the feedback—the impact of polluted environment on the eco-audit facility.

Environmental audit of the territory (EAT), as a special case of EA, is a tool for solving problems related to the environmental well-being on the territory with anthropogenic impact of different scale (city, other administrative formation, river basin, etc.). The EAT procedure is determined by features of the territory—infrastructure, geographic and climatic characteristics, features of the economy, social sphere, ecological situation, etc. The implementation of the EAT promotes the investment attractiveness of the region.

In order to obtain a comprehensive picture of the ecological situation in the studied area within the framework of the EAT, it seems expedient to base it on the information data with indicators of the ecological status of territories of different

scale (Rosenberg 2009; Kostina 2015). The problem of environmental audit within the boundaries of administrative zoning requires the solution of the following complex tasks:

- Definition of audit sections taking into account cartographic capabilities of aerial and space imagery;
- Selection of key indicators characterizing the assessment of the regional economic activity;
- Presentation of a set of cartographic indicators that determine the environmental performance of agro-industrial enterprises and the entire region;
- Analysis and evaluation of environmental indicators included in audit data.

The following sections of regional environmental audit are proposed: legal, economic, ecological, cartographic.

Environmental audit of the territory is one of the new and promising tools for regulating activities in the sphere of nature management and environmental protection. At the same time, the EAT is one of the priority directions for ensuring the requirements of ISO 14000 international standards for the development of environmental management systems in these territories, including conservation of wildlife. The experience of implementing the EAT using the expert information system REGION developed in the Institute for the Analysis of the Russian Academy of Sciences, which allows creating ecological atlases and individual maps, is available for territories of different scale: for the Volga Basin, the Samara Region (partially for the Ulyanovsk, Nizhny Novgorod Regions, the Republic of Bashkortostan), Togliatti (Gorelik et al. 1996; Rosenberg 2009).

Public health as an indicator of sustainable development. The health of the population, expressed in various indices, is almost invariably present in almost all indices of sustainable development[2]: the human development index, the "ecological trace" index, the "public health" index (the latter directly reflects the spread of environmentally caused diseases, while the clearest dependence is revealed between the quality of the environment and respiratory diseases, and intestinal infections), etc. (Bobylev et al. 2002; Tarasova and Kruchina 2006; Kostina et al. 2014, 2016).

Here the authors illustrate the parameters of "public health" as indices of sustainable development, using the example of natural focal disease in the Samara Region (Kuznetsova and Zueva 2015). According to the data of Rospotrebnadzor, there are such natural focal and zooanthroponous infectious diseases in the Samara Region as hemorrhagic fever with renal syndrome (HFRS, annual disease more than 80%), tick borreliosis or Lyme disease, tick-borne encephalitis, leptospirosis,

[2]All the pros and cons of using indices for assessing sustainable development ("indexology") have been repeatedly considered (14, 17). The problems of aggregating various indices into a single index were also considered in the report of the UN Commission on Sustainable Development (18). The main difficulty in aggregating information into indices is to determine the weights of the original indices without loss of significance and without excessive subjectivity. With the increase in the level of aggregated information, the complexity of weighing incomparable quantities increases.

tularemia, rabies, in recent years began to fix the fever of the West Nile. This research has shown, for example, that the incidence of HFRS in the Samara region stably exceeds the average for the Russian Federation by almost three times (15.28 per 100,000 population); the incidence of tick-borne borreliosis in the Samara region is generally lower than the average for the Russian Federation (for the period from 2000 to 2014, it tends to decrease noticeably, and in recent years, in 2012 and 2013, this level does not exceed in the region 0, 19 per 100 thousand population, which is 6 cases per year).

The economic consequences of the costs to the health of the population of Russia from environmental pollution were discussed in detail in the work of Bobylev et al. (2002), and the damage caused by the incidence of viral hepatitis C in the Samara Region and the effect of reducing the "temporary disability of the population" with reduced emissions to the atmosphere and the discharge of contaminated water per inhabitant are presented in the works of the following authors (Rosenberg et al. 2010a, b; Kuznetsova and Lazareva 2017).

With the help of the REGION EIS, a comprehensive assessment of the health well-being of the population of the Volga Basin was made and regression equations were obtained which allowed, in particular, forecasting the change in the parameter of "temporary disability of the population", with a 20% reduction in air emissions and polluted water discharge per inhabitant; "the temporary work capacity of the population" decreased by 1.3%, which in monetary terms for the entire Volga Basin is estimated at about 1.8–2 billion rubles per year only in accordance with Federal Law No. 255-FZ "On compulsory social insurance in case of temporary incapacity for work." This is the lower estimate of the "cost of the issue" for reducing air emissions and discharging polluted water by 20% (Rosenberg et al. 2010a, b). The economic damage from the incidence of viral hepatitis C in the Samara Region for 2014 amounted to about 60 million rubles (Kuznetsova and Lazareva 2017).

4 Discussion

Innovation in environmental management. In the modern innovation economy (knowledge economy), the center of interest is quickly shifted to intangible assets or intellectual capital. According to World Bank analysts, the national wealth of developed countries is only 5% of natural resources, 18%—material, produced capital, and the main place—about 77%—is taken by knowledge and ability to dispose of them (World Development Report 2005). Knowledge and intellectual resources act as the main condition for economic growth, ahead of factors such as labor, capital, and natural resources. The organization of their use, the embodiment of products, services, and innovations refers to the most complex problems of modern management, the solution of which requires new approaches to both management and management training. That is why management of intangible resources is becoming the leading paradigm of twenty-first century (United Nations Division for Sustainable Development 2001).

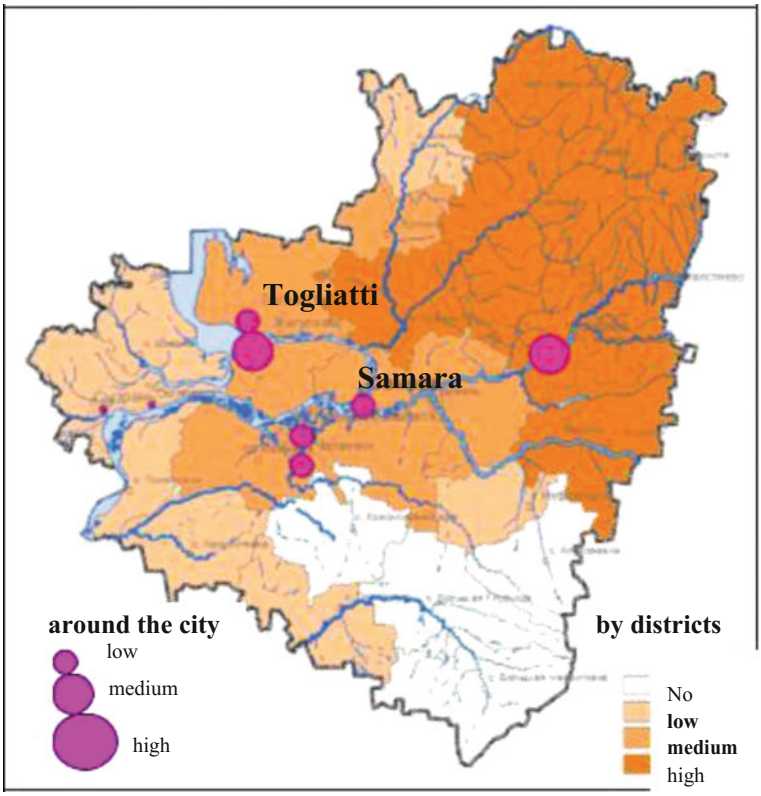

Fig. 1 Incidence of HFRS in the Samara Region. *Source* Kuznetsova and Zueva (2015)

In Russia, the attempt to "enter" this paradigm resulted in the plans to build a "tech city from scratch"—Skolkovo. The proposed innovation center should simultaneously carry out research on all five priorities presidential directions for modernization of the Russian economy: energy (energy saving), information technology, telecommunications (based on space technologies), biomedical (mostly pharmaceutical), and nuclear technologies. True, there is an opinion that these directions should not be carried out together in a relatively small area, because they all require completely different means, technological and infrastructural costs, level of control, and security. And one more feature of this project—we can say that this is a "project from the top" (first a tech city, then its facilities) (Fig. 1).

In the context of this work, first of all, we should talk about ensuring environmental safety in the conditions of any modernization of the economy—unfortunately, in the "Skolkovo project" these important (especially for Russia) problems

were not found.[3] This became the foundation of the Institute of Economics and International Relations of the Russian Academy of Sciences to take the initiative and create a non-commercial partnership "Interregional Association for Environmental Security" (NP "MOEB")—a kind of the "Skolkovo project", but with a "bottom-up movement." Ambitiousness of this project is not in the technical and construction creation of a certain (attractive for science and innovation) urban infrastructure, but in creation of an equally attractive "intellectual infrastructure." The ideological basis of such an association is recognition of the fact that the exchange of knowledge occurs not only with the help of sale and purchase (the knowledge market). The management system of the association includes such elements as identifying, attracting, retaining, and stimulating creative workers creating all conditions for their effective work. To this end, the NP "MOEB" unified, at the first stage, a dozen academic organizations, universities, small- and medium-sized businesses, public organizations of the Samara Region and the Chuvash Republic in order to assist members of partnership in their activities aimed at protecting the environment, for the development and introduction of necessary technologies aimed at neutralizing the harmful impact on the environment and rehabilitation of anthropogenically deformed territories.

From the authors' point of view, one of the basic mistakes in the current management system of socio-ecological and economic systems is that the object of management is an enterprise and not a territory or a natural complex. For ecological objects—forests, fields, animals, it does not matter who influences them, it is important that the total impact does not exceed a certain limiting value. For example, in the USA, the pollution control scheme is known as an "ecological bubble": companies at an open auction buy out emission allowances within the total emission limit. If an enterprise reduces emissions, the unnecessary quotas can be sold on the exchange. If all quotas are disassembled, it is impossible to increase the emissions of existing enterprises or build new enterprises. Thus, the environmental situation determines industrial policy, and not vice versa, as it is happening in Russia.

5 Conclusions

So, in accordance with the Latin subtitle of the contribution, the authors examined the aspects of the innovation and ecological interaction "from start to finish." The main conclusion that can be drawn is that the country needs a program of step-by-step innovative actions, describing the content and sequence of measures planned and setting the ultimate goals of reform of the environmental management

[3]The problems of rational nature management and the list of critical technologies of the Russian Federation—technologies for monitoring and forecasting the environmental well-being, preventing, and eliminating its pollution were among the priority areas for the scientific, technological development.

system. Work in this direction is very big. And, as a specialist in the strategy of marketing opportunities and leadership, Professor Gene N. Landrum said, "large-scale innovations are never created by those who want to save their own peace" (Landrum 1993).

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Empirical Indicators of Innovative Readiness of the Population: Experience of the Application of the Bogardus Scale

A. V. Rostova and Y. A. Urgalkin

Abstract The study analyzes the possibilities of applying the Bogardus scale for analyzing the population's readiness to adopt innovations. The study used Bogardus scale, which was adapted for the purpose of scientific research to study the innovative openness of the population. Theoretical and methodological principles of the value and activity approaches and the theory of everyday life and the phenomenological paradigm were used as a theoretical and methodological basis. Based on adapted Bogardus scale, the following indicators are defined and used: innovative openness, acceptability, isolation, and restraint. The index of innovative readiness of the population of the Samara region is determined, and also the socio-demographic characteristics of each of their groups of the respondents are analyzed. The dominance of innovative isolation among the inhabitants of the region and the lack of interrelation between socio-demographic characteristics and the level of openness to innovation have been revealed. The scientific novelty of the research consists in isolating four main positions in the population structure: openness, acceptability, isolation, and restraint in relation to innovations. According to the research results, in general, the population is characterized by innovative isolation, which indicates an understanding of the inevitability of changes in the life of the country and the city, but the unwillingness to accept changes in one's own life. The weak influence of socio-demographic characteristics on the degree of openness of the population to innovation indicates, on the one hand, the homogeneity of the population's attitudes, and on the other, on deeper mechanisms of determination. The main provisions and conclusions of the study can be used in scientific and pedagogical activity when considering questions about the openness of the population of the region to innovations.

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1 Introduction

The interest in the problem of innovative development is quite high today. Research in this direction leads to the idea that an important component of this process is the problem of innovative openness and readiness for innovation on the part of the population.

There are a lot of developments in this direction. However, their overwhelming majority is centered on the innovative receptivity of organizations and enterprises. At the same time, one of the most numerous groups of consumers of innovation, the population, is overlooked.

Turning to the history of analysis of this problem, we cannot fail to mention the following studies.

Having not used the notion of "innovations" before, G. Tard researched the importance of inventions in social progress, the sources of their origin, as well as the attitude of society to inventions and innovations, and analyzed the problems of mastering innovations by the individual in the process of socialization. The scientist drew attention to the fact that the development of innovations, the perception of the new, often occurs not through adaptation, but in the struggle between tradition and innovation (Tard 2011).

As it is known, the concept of "innovation" was introduced into economic science by Schumpeter (2008). The scientist considered innovations as a means of overcoming economic crises. In his works, the author emphasized the important role of the entrepreneur in initiating innovative processes.

In terms of expanding the perspective of understanding innovations in the sociological context, the ideas of Weber (1990) were important. The category of charismatic innovation allows us to show how the process of cultural change is taking place.

V. Thomas and F. Znaniecki identified three types of personality, depending on their activity orientation: philistine, bohemian, and creative. According to scientists, the development of public life and culture is carried out through creative individuals, capable of innovation and invention (Thomas and Znaniecki 2006).

R. Merton in his works described five types of adaptation of the individual in society, among which there is also innovation involving the use of institutionally prohibited, but often effective means to achieve the goal (Merton 1992).

P. Drucker considered innovation from two perspectives: on the one hand, as a certain kind of human practice; on the other, as the basic principle of "entrepreneurial society." The scientist formulated the basic principles of innovations and also pointed to their main sources (Drucker 1985).

The diffuse model of Bass (1994) makes it possible to assess the degree of penetration of innovations due to two types of behavior—innovators and imitators.

E. Rogers in his works singled out the main subjects—consumers of innovations—and showed that with a sufficient number of so-called "early consumers" (innovators), the process of spreading innovations becomes irreversible (Rogers 2010). E. Hagen described the characteristics of the innovative and traditional personality (Lapin 2008).

It should be noted that today research devoted to the problem of innovation is carried out mainly in an economic manner. The emphasis here is on financial indicators and the increasing level of competitiveness. There is a lack of sociological analysis of this problem from the position of the human approach. After all, innovation is not only a permanent introduction of innovations, but, as A. A. Meshkov noted, "a complex socio-cultural process and a socio-psychological phenomenon" (Meshkov 1996).

Among the studies of recent years, the following deserve special attention. The works of N. I. Lapin provided a comprehensive review of scientific foundations and applied aspects of innovation. The most valuable in light of this research is a detailed description of the role and function of the main actors of innovation. As the author rightly notes, the market stage, that is, the supply of innovations to consumers, has been studied less than the remaining stages of innovation activity. The decisive role here, according to the author, is the expansion of the need for an innovative product (Lapin 2008).

In the works of Yu. A. Karpova, such a concept as an "intellectual resource" was disclosed and mechanisms of managing the intellectual resource of subjects of innovation activity were described in the conditions of permanent social changes. The personal aspect of innovation in the works of Yu.A. Karpova received a very thorough study (Karpova 2004).

M. Malkina drew attention to a number of fundamental problems in the implementation of innovation. Among other things, there is a need to form an appropriate psychological and cultural environment; the lack of demand for innovation, not only from firms but also from specific consumers (Malkin 2005).

S. A. Ilyinykh and E. V. Mikhailova, based on the sociological study of small businesses, considered the innovative susceptibility of personnel and fairly rightly note that the main problem of managing the introduction of innovations is overcoming resistance (Ilyinykh and Mikhailova 2015).

However, despite a rather large number of works devoted to the research of innovations, there is a lack of research from the standpoint of the human approach, that is, the attitude of the population toward innovations, their willingness to accept innovations in their daily lives, the degree of openness, or, on the contrary, the isolation of the population in relation to changes.

Thus, the goal of the research was to identify, based on the use of Bogardus scale, empirical indicators of innovative openness of the population and to identify its socio-demographic determinants.

2 Materials and Methods

In 2016–2017, in the Samara region, the authors conducted a sociological study using the questionnaire, which was devoted to measuring the level of acceptability of innovations. In the course of the study, taking into account 97% confidence level and ±4% confidence interval, 705 respondents were interviewed, who represent the population of the Samara region by gender, age, and types of settlements.

In the course of the research, the authors hypothesized about the determination of the level of innovative openness by socio-demographic and socio-economic characteristics. Thus, it was assumed that innovative youth is predominant among young people, people with higher education, and also with an income level above the average; a more closed position is occupied by middle-aged people, with an average income; isolation is typical for people of pension and pre-retirement age, with low incomes and education.

As a tool, Bogardus scale was used (Bogardus 1959). As it is known, the scale of measuring social distance was developed by E. Bogardus in 1924; in the course of many years of work, various modifications were created, including the scale of educational, racial, property, religious distance, etc.

In this study, the scale was adapted to the goals and objectives of the project. The 8-point scale was constructed according to the cumulative principle, which allows determining the value of the distance level in relation to innovations being introduced. The respondents were asked: "I am fully prepared to accept innovations…" and were proposed to assess the degree of readiness for innovations in the following indicators: 1 point—for yourself; 2 points—in the family; 3 points—in the circle of friends; 4 points—at work; 5 points—in the city; 6 points—in the country; 7 points—in the world; 8 points—in general nowhere.

Based on the presented indicators, the closest position is the willingness to accept innovation for oneself personally (1 point), while the maximum distance is the lack of readiness for innovation in general (8 points).

The results were processed in the following ways: First of all, the average score was calculated on the 8-point scale, which shows the overall level of openness of the population to innovations—we designated this indicator as the index of innovation readiness (IR). Depending on the value, this index can occupy four positions: innovative openness, innovative acceptability, innovative isolation, and innovative restraint.

In addition to calculating the index, the indicators were calculated in accordance with the socio-demographic characteristics of the respondents, as well as the percentage of the groups examined above. If the index gives a general idea of the population's readiness for innovation, the percentage ratio allows us to analyze the qualitative composition of each population group. Data processing was carried out using SPSS 2.0.

3 Results

The respondents who were ready to accept innovations for themselves and in the family and in the circle of friends were classified as the most open-minded population. The index of this position is no more than 2 points (IG $\leq$ 2) and is designated as "**innovative openness**".

The somewhat remote position is taken by the respondents who noted their readiness to accept innovations in the circle of friends and at work. The authors labeled it as **innovative acceptability** (2 < JIIG $\leq$ 4), which is interpreted as a lack of desire to accept innovation in one's own life, but at the same time there is no denial. An example of such a position may be the adoption and approval of the decision of friends and colleagues to migrate to another city, but they deny this decision for themselves.

The position of **innovative isolation** is occupied by the respondents who indicated the possibility of accepting innovations in the city and the country, which corresponds to the index 4 < GIG $\leq$ 6. This index should be interpreted as follows: The respondents are ready to accept innovations at the city and country level, but they want to be isolated from them. In the course of the study, the authors identified innovative isolation of the population of the Samara region in relation to such innovation as the provision of water meters and electricity meters via the Internet. So, 41% use this innovation constantly and another 14% from time to time; in extreme cases, 11% of the respondents use this function and 35% do not use this feature at all. In other words, the respondents consider this innovation to be very useful, but they do not hurry to use it themselves.

Innovative restraint (6 < JIIG $\leq$ 8) is interpreted as an unwillingness to include changes even in the territory of one's own country. The Russians occupy a position of innovative restraint with regard to the Unified State Exam. Despite the existence of this examination in the country since 2002, the opinion about it has not received any positive dynamics.

Thus, according to the study by the All-Russian Public Opinion Research Center ("Russians about the USE" 2017), more than half of the respondents (57%) expressed their opinion that they would like to return to the examinations in the former format—separate final and entrance examinations. Moreover, compared to 2007, the number of those who negatively assess the replacement of the entrance examinations for the Unified State Exam from 30 to 43% has increased ("Russians about the USE" 2017).

Among the main reasons for this position was the view that the quality of education has seriously deteriorated (70%); the Unified State Exam does not take into account the individual characteristics of students (68%); the verification of students' knowledge became formal (67%) ("Russians about the USE" 2017).

4 Discussion

The results of the survey showed the uneven distribution of the respondents' opinions.

Despite the fact that a rather large number of the respondents—21%—are ready to accept innovations for themselves, most of the answers were concentrated at the other end of the scale: 20 and 21% are ready to accept innovations exclusively in the city and the country, respectively (Fig. 1).

As a result of the study, the index of innovation readiness was 4.4 points, which characterizes the population as an innovatively isolated one (Fig. 1). In other words, the population agrees with the existence of innovations where they do not directly concern the respondents themselves. In particular, the respondents are ready for changes in the city and the country.

In more detail, let us look at the qualitative composition of each group.

The gender composition of these positions is not very different. Only in the group of "innovative isolation," the difference is more than 10%, and in the group "innovative acceptability" men predominate (Fig. 2).

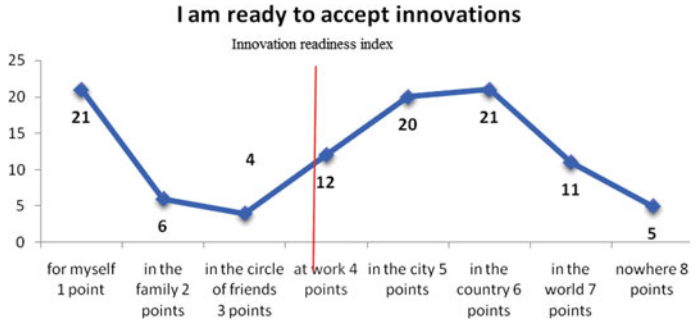

Fig. 1 Degree of acceptability of innovations in %. *Source* Authors

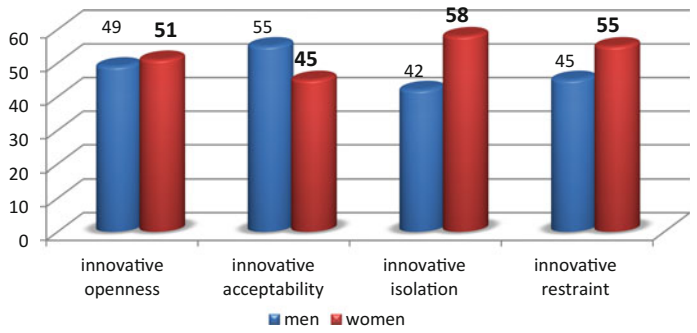

Fig. 2 Gender composition of groups. *Source* Authors

Age composition. Characterizing the age composition, it should be noted the following: Almost one-third of the group "innovative openness" was made up by the respondents aged 46–55; slightly less—22%—young people aged 26–35. The groups "innovative acceptability" received similar characteristics (31%—46–55 years, 23%—26–35 years) and "innovative isolation" (34%—46–55 years, 22%—26–35 years).

The composition of the group "innovative restraint" is slightly different. Despite the fact that the same age group has the predominant position here (36% at the age of 46–55), there are no significant differences among the other age groups: The answers were distributed approximately equally.

Carrying out the analysis of distributions of each age group separately, it should be noted that the respondents' answers at the age of 18–25 are more concentrated in the group of "innovative openness"—19%. At the age of 26–35 , the groups "innovative acceptability" and "innovative restraint" are equally represented—22 and 23%. Respondents aged 36–45 were equally divided into two groups—"innovative openness" and "innovative acceptability"—20% each, respectively.

In the age category of 46–55 , "innovation isolation—36% was prevailing, the respondents' opinions at the age of 56+ were distributed evenly among all groups.

Family status. During the analysis of the obtained data, there was no significant difference between the groups of the respondents. The composition of each family group was homogeneous.

Educational composition. The respondents with secondary education were divided into two opposite groups—the respondents were equally classified as "innovative openness" and "innovative isolation." The respondents with higher education were evenly distributed among all groups. Interesting data on the respondents with a scientific degree—only 1% of such respondents were in the group of innovative openness.

Self-assessment of income level. On this basis, no significant differences were found. The only exception is the respondents who rated their financial situation as "very difficult": Most of the answers were focused on the position of isolation and restraint.

5 Conclusions

Summarizing the study, it should be noted that:

1. The concept of the index of innovation readiness is formulated, and its main indicators are defined.
2. The use of Bogardus scale has made it possible to isolate four main positions in the population structure: openness, acceptability, isolation, and restraint in relation to innovation.

3. In general, the population of the Samara region is characterized by innovative isolation, which indicates an understanding of the inevitability of changes in the life of the country and the city, but unwillingness to accept changes in one's own life.
4. The identified weak influence of socio-demographic characteristics on the degree of openness of the population to innovations shows, on the one hand, the homogeneity of the population's attitudes and, on the other, the deeper socio-psychological mechanisms of determination.

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Innovation and Investment Activities in Businesses as a Determining Factor of Development of the Russian Federation

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Abstract The relevance of the studied issue is caused by the fact that the modern system of institutes in business forms prerequisites for development of innovation and investment activities of firms. Along with heavy commitment to financial investments, the level of non-financial investments into research and development with their subsequent commercialization is insufficient in our country. Investment activity influences the economic growth rate, increases employment, profitability of households. This contribution is aimed at analysis of the existing system of institutes in business and also development of recommendations for optimization of these institutes in the course of innovative economic development of the Russian Federation. The main methods, implemented in the course of the research, are system analysis and scientific abstraction. They determine a possibility of identification of interrelations and interdependence of the following categories: knowledge, technologies, creation of an innovative product. These categories in the modern economy cannot be considered separately from a business institute. Results: the system analysis of innovative development of countries is carried out, and the place of Russia is defined. The level of society intellectualization is defined on the basis of indexes. It allows making recommendations for improvement of a measurement system aimed at formation of the modern economy of knowledge. It will result in changes in the institutional system: The main goal should be proper introduction of innovation and investment activities in entrepreneurship. The results of the scientific research can be applied to formation of programs of innovative development of business at the federal, regional, and local levels. It will allow optimizing the existing system of business institutes, which can become a decisive factor in innovative, social, and economic development of Russia.

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1 Introduction

1.1 Establishing a Context

One of the most important processes, happening in the last decades in economies of the majority of the developed countries, is the intellectualization process. It is characterized by increase of people, occupied with intellectual labor, growth of a share of new knowledge and their transformation into the main productive force and the main production factor (Mikhailov and Karova 2014), introduction of absolutely new technologies and also transition to an essentially new type of economy, which is characterized as post-industrial economy (Mikhailov 2016).

Such notions as "smart economy", "innovative economy", "economy of knowledge", "new economy" can be met rather often on an equal basis with the notion of post-industrial economy. In fact, all of them designate the same. Their differential peculiarity is only the role of knowledge in economy: knowledge—a complete product, knowledge—a production factor, knowledge—a basis for economic growth.

The notion "new economy" was popular in the end of the XX century and involved transition from traditionally industrial to the post-industrial economy based on technologies. The "new economy" was characterized by the rapid growth of productivity and technological changes, related to computers. In its modern form, it is defined as "the economy based on knowledge, it is a global, entrepreneurial, information and technological and innovative economy."

All these terms emphasize the importance of knowledge and technologies, and the "new economy" also highlights entrepreneurship and globalization (Mikhailov et al. 2016).

1.2 Reviewing the Literature

The notion of institutes is widely investigated by such representatives of a foreign scientific thought as North (1931), Williamson (1985), Alcian and Demsetz (1972), Commons (1931), etc.

The concept "economy of knowledge" was introduced into the economic science by F. Machlup, in the book "Production and Dissemination of Knowledge in the USA" (1962). Bell (1999), Bowen (1968), Drucker (1985), Polanyi et al. (1957) also dealt with these issues.

For the first time, the categories "businessman" and "business" were used and considered by economists Kantillon (2004), Veblen (2007), Schumpeter (1982).

Domestic economists like Glisin et al. (2013), Yakovets (2015), Kuzyk (2004) have devoted their works to the research of innovative processes. Skarzhinckii (2004) emphasizes the role of a private property institution in implementation of innovation and investment activity. The economists Sherer and Ross (1997) allocate

patent protection of innovations. Porter (2001) carried out extensive research on influence of competition on innovations and impact of innovations on retention of competitive advantages.

1.3 Establishing a Research Gap

Scientific research in the field of development of the Russian modern business focuses on theoretical and practical issues related to formation of the institutional environment, where innovation and investment activity of firms is carried out. Scientific developments in the field of development of the Russian modern business raise the theoretical and practical questions connected with formation of the institutional environment in which innovative investment activities of firms is carried out.

Intensification of the modernization process of the Russian economy becomes a priority task for the foreseeable future. It involves strengthening of market institutes and creation of a model of innovation and investment activities of enterprises. The main attention in contributions, publications is given to technological and economic issues: increase in efficiency, decrease in expenses, strengthening of competitiveness of enterprises, improvement of the quality of output, and to other similar indicators. However, the issue about creation of a new business model in conditions of innovative development still remains insufficiently developed. Despite the made efforts, Russia nevertheless is behind the borders of the developed intellectual economy. This process requires bigger attention toward intellectualization of the production activity.

The research purpose is the system analysis of the existing intellectualization process in Russia and also development of recommendations for optimization of the system of business institutes in innovative development of the economy.

1.4 Evaluating the Study

The conducted research has revealed that despite the created system of business institutes in the Russian economy, they are insufficiently effective. It leads to deceleration of innovative development of Russia, limits access to technologies, reduces inflow of investments. The level of development of small and medium business in Russia remains very low. The number of enterprises, engaged in this sphere, reaches 850 thousand–1 million in recent years. The share of employed people at small- and medium-sized enterprises is 10–16% of the total number of occupied population. The branch structure is rather primitive: the bulk of small- and medium-sized enterprises still work in trade and public catering—more than 50%. Innovative business in this sphere practically does not develop; the share of entities

of small and medium business in the scientific and technical sphere does not exceed 1.5–2% (VCIOM URL: https://wciom.ru/index.php?id=236&uid=116082).

2 Materials and Methods

Research methods

In the course of the research, the following methods have been used: theoretical (system analysis, synthesis, generalization, method of analogies, scientific abstraction); methods of mathematical statistics and graphic representation of the results.

Research stages

The research was conducted in two stages:

- At the first stage, there is a theoretical analysis of the existing methodological approaches in economic scientific literature, thesis papers; the problem, the aim, and the research methods are emphasized, and the research plan is made.
- At the second stage, the analysis of the research problem is carried out, theoretical and practical conclusions are specified, and the received results are generalized and systemized.

3 Results

In conditions of intellectual economy, investment aimed at creation of hi-tech goods and services, especially information and communication technologies, are the most rapid growing component of financial investments. Non-financial investments into research and development, training of labor force, computer programs, and technical expertise are also important. These tendencies lead to changes both in economic theory and in economic reality.

Investment into knowledge is the key to long-term economic growth by means of stimulation of more effective methods of industrial organization and creation of new and advanced goods and services. Thus, there is a possibility of sustainable growth of investment, which can lead to economic growth in the country. Economic growth, in its turn, is one of the most important indicators of quantitative development of economy at national and world levels. The main goal of economic growth is growth in prosperity and increase in the national wealth. It means that the bigger production capacity of the country is and the higher the economic growth rates are, the higher the level and the quality of life are.

The world organizations have developed various indexes for assessment of ability of the country to accept, to create, and to spread knowledge.

In 2004 within the special program "Knowledge for Development", the World Bank Group created a complex indicator—"Knowledge economy index" consisting of 109 indicators, united in four main groups:

1. Index of economic incentive and institutional regime (EIR);
2. Index of education and training;
3. Index of innovation and technological adoption;
4. Index of information and communications technologies (ICT) infrastructure.

The assessment methodology of knowledge offers also two more summary indexes—The Knowledge Economy Index (KEI) characterizing the development level of the country in relation to the economy of knowledge and The Knowledge Index (KI) characterizing the potential of the country in relation to the economy of knowledge.

According to the latest release, published by the World Bank according to the results of 2012, the Russian Federation was in the 55th place. It rose by 9 positions in comparison with previous year (Table 1).

One of the leading information and analytical agencies Bloomberg also calculate their innovative index. When calculating Bloomberg Innovation Index 2017, seven indicators were considered: expenses on research and development, productive efficiency, concentration of hi-tech companies, prevalence of higher education, added production value in percentage correlation with GDP, activity regarding registration of patents and a number of researchers per 1 million citizens over 50 countries, which provided data.

According to this index, in 2017, Russia takes the 26th place, having lost 14 points (Table 2) in comparison with 2016. The Bloomberg analysts explain this falling by sanctions, imposed by world powers against Russia in 2014–2015, reduction of energy prices, which resulted in devaluation of the ruble. Russia takes the third place according to the indicator of efficiency of higher education and at the same time shows considerable losses on an indicator of density of high technologies (loss makes 16 positions –from the 8th to the 24th place).

One more index is the Global Innovation Index. This index is calculated and published in conjugation with the Cornell University (USA), the Business school INSEAD (France), and the World Intellectual Property Organization. The global index includes 81 indicators, united in seven subgroups, which, in their turn, are united in two groups (Fig. 1).

On June 15, 2017, the GII-2017 wad presented in the United Nations Headquarters in Geneva. Switzerland, Sweden, Netherlands, USA, and the UK head the rating of the leading countries' innovators. Switzerland heads the overall rating of GII for the 7th year in a row. The countries with high-income level possess twenty-four of the first twenty-five places. An exception of this row is China, which takes the twenty-second place. Following the results of this research, Russia is in the 45th place from 127 countries. It is two positions lower in comparison with the

Table 1 Calculation methodology of the Knowledge Economy Index in Russia in 2012

Name of the indicator	Unit	Weights of index/ indicator in the KEI 2012	Reporting period	KEI 2012	Rank 2012
Knowledge Economy index (KEI)	Point	100.0	–	5.78	55
Economic incentive and institutional regime (EIR)	Point	25.0	–	2.23	117
Tariff and non-tariff barriers	Point	8.3	2011	68.2	–
Regulatory quality	Point	8.3	2009	−0.46	–
Rule of law	Point	8.3	2009	−0.77	–
Innovation and technological adoption	Point	25.0	–	6.93	41
Royalty payments and receipts US$/pop.	US$/ pop.	8.3	2009	32.43	–
Patents granted by USPTO/ Mil. people	Units per Mil. people	8.3	2005–2009	1.28	–
S & E journal articles/Mil. people	Units per Mil. people	8.3	2007	98.2	–
Education and training	Point	25.0	–	6.79	44
Average years of schooling	Год	8.3	2010	9.69	–
Gross secondary enrollment rate	Percent	8.3	2009	84.81	–
Gross tertiary enrollment rate	Percent	8.3	2009	77.19	–
Information and communications technologies (ICT) infrastructure	Point	25.0	–	7.16	45
Total telephones per 1000 People	Units per 1000 people	8.3	2009	1940.0	–
Computers per 1000 people	Units per 1000 people	8.3	2008	130.0	–
Internet users per 1000 people	Units per 1000 people	8.3	2009	420.0	–

Source The data of the World Bank and the Ministry of Communications and Mass Media of the Russian Federation. Retrieved from http://minsvyaz.ru/ru/activity/statistic/rating/indeks-ekonomiki-znanij/#tabs|Compare:Place. Accessed 12 April 2018

Table 2 Rating of innovative economies: Bloomberg Innovation Index 2017

2017	2016	Change of the position	Economy	Amount of points	Research and development intensity	Added production value	Productivity	Density of high technologies	Efficiency of higher education	Concentration of studies	Patent activity
1	1	0	South Korea	89.00	1	1	32	4	2	4	1
2	3	1	Sweden	83.98	5	11	15	7	18	5	6
3	2	−1	Germany	83.92	9	3	16	5	12	16	9
4	5	1	Switzerland	83.64	8	6	2	11	16	14	4
5	7	2	Finland	83.26	4	13	20	15	5	3	5
6	6	0	Singapore	83.22	14	5	12	17	1	6	12
7	4	−3	Japan	82.64	3	9	28	8	27	9	3
8	9	1	Denmark	81.93	6	17	5	13	22	2	11
9	8	−1	USA	81.44	10	22	10	1	34	20	2
10	11	1	Israel	81.23	2	30	30	3	20	1	18
26	12	−14	Russia	65.24	31	48	42	24	3	27	16

Source Bloomberg terminal. Retrieved from https://www.bloomberg.com/news/articles/2017-01-17/sweden-gains-south-korea-reigns-as-world-s-most-innovative-economies By Michelle Jamrisko and Wei Lu, 17 January 2017, Accessed 16 June 2018

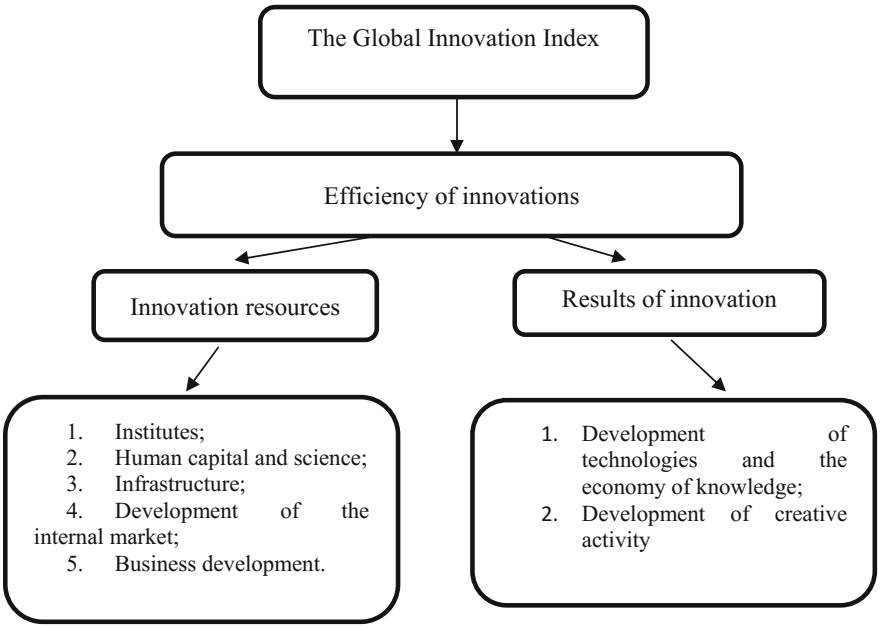

Fig. 1 Structure of the Global Innovation Index. *Source* Authors, based on the Global Innovation Index (GII 2017) and Innovation Feeding the World (IFW 2017)

previous year. It is explained by deterioration in positions of the Russian universities in the international ratings, reduction of a number of the quoted works, and amount of made patent applications. Also weaknesses and strengths of Russia are presented in Table 3 from the point of view of the GII 2017.

Nowadays innovative development becomes an imperative of business existence.

Creation of a new model of business functioning is the purpose of modernization of the economy in Russia. In this model, the state should determine development vectors, so that the Russian business at any levels of enterprise community was interested in solution of innovative tasks.

The term "business" initially showed a special entrepreneurship function. Business is a special type of economic activity, which is based on an independent initiative, responsibility and an innovative enterprise idea (Schumpeter 1982).

The complexity of tasks, connected with increase in innovation and investment activity of business, presupposes the system theoretical understanding of happening social and economic transformations in economy in light of institutional development.

In the majority of works, devoted to studying of functioning of economic institutes, allocation of some problem as the main one is an initial prerequisite for such analysis. The neo-institutional theory brings to the forefront: incompleteness of information, limitation of computational capabilities of a person, opportunism of

Table 3 Russian strengths and weaknesses according to the GII 2017

Strengths	Weaknesses
Employment of women with higher education (second place from 127 countries)	Political stability and absence of terrorism (112)
Size of internal market (6)	Influence of knowledge (111)
Amount of patent applications for useful models, made by national applicants to patent offices of the country (8)	Growth rate of GDP per capita (110)
Trade, business struggle, and market size (12)	GDP per unit of energy consumption (108)
Graduates with scientific and engineering specialty (13)	Innovative connections (105)
Students/teacher ratio in secondary education (14)	Supremacy of the statute law (104)
Employees, engaged in the sphere of knowledge-intensive services (15)	Quality of regulation (102)
Amount of patent applications for inventions, made by national applicants to patent offices of the country (15)	Political environment (100)
Payment for use of intellectual property assets (16)	Efficiency of logistic activities (96)
Gross coverage ratio of higher education (17)	Investments (95)
Creation of knowledge (22)	Regulatory environment (94)
Hirsch index for citable documents (22)	Ecological certification by ISO 14001standards (94)
	Net inflows of direct foreign investments (94)
	Transactions with venture capital (90)
	Global entertainment and media markets (48)

Source Authors, based on the data of National Research Institute «Higher School of Economics», Institute for Statistical Studies and Economics of Knowledge, GII-2017, Innovations feeding the world and Russia. https://issek.hse.ru/news/206860724.html. Accessed 20 Mar 2018

behavior of economic entities, incompleteness of contracts (Alchian and Demsetz 1972), specificity of assets, and the interdependence of economic agents caused by this specificity (North 1931; Williamson 1985). It does not allow an economic system to provide effective implementation of market advantages, its stimulating opportunities.

Modern development of business is the multifactorial phenomenon. The theoretical analysis of entrepreneurship allows emphasizing several research aspects, including influence of institutional relations on formation and development of business.

It is especially sensitive in regard to entrepreneurship as it presupposes initiative activity in conditions of freedom, including decision making. Uncertainty, necessity to make decisions, their inconvertibility, financial, psychological, and social risk act as a uniform problem for economic agents—businessmen. Consequently,

insufficiency of the market system should be filled with other coordinating and stimulating mechanisms—institutes.

As a result, there are such conditions for business activity and functioning of markets, which form responsibility of everyone toward the society, and control of society over all agents of the market system, including the state institutes (Commons 1931).

Innovation and investment activity in business implies a necessity to create new advantages for a firm constantly. First, constantly take care of extended reproduction and other kinds of activity permanently. It is necessary "to move forward" all the time; otherwise, competitors will repeat the progress. Secondly, to keep success it is necessary to use advantages of a low rank effectively. For example, the low-paid labor force or raw material resources can be easily obtained or copied by a rival firm.

Thirdly, it is necessary to use also high-order advantages, such as patent technology, differentiation based on unique goods and services, reputation of a firm. Such advantages require specialized personnel, the corresponding technical equipment, and capital investment. It will be much more difficult for a rival firm to reach them, because it requires long-term and intensive capital investments in production capabilities, in carrying out research and development, or in marketing sometimes connected to risk.

In this case, the "knowledge" factor becomes a strategic resource, enabling to influence on innovation and investment activity of firms effectively. The institutes, which are capable of forming, developing, using knowledge, human opportunities are the main in the modern economy.

In the last decade, there is active work on formation of institutes of business development on federal and regional levels. At the same time, this development takes place in conditions of high extent of innovative changes, instability of development of factors of external and internal environment. Poor development of the intellectualization process in business reflects the fact that small- and medium-sized enterprises create only 11–12% of gross domestic product, while in the developed countries this indicator reaches 50–60% (Doing Business 2017). As a result, despite a variety of the created programs, innovative business incubators, technology parks, etc., there is no coordinated system of the real support to the real sector of small and medium business. For many subjects of this sphere, these programs remain inaccessible, complicated, demanding overcoming of many administrative barriers.

Russia is in process of transition to the following innovative stage of development in view of GDP growth per capita for the last years.

4 Discussion

"The economy of knowledge" is the result of full recognition of the role of knowledge and technologies in the economic growth of the country. Knowledge, embodied in a person (his intellectual capital) and in technologies, always took the central place in economic development.

It is considered that F. Machlup introduced the notion «economy of knowledge» in the book "Production and Dissemination of Knowledge in the USA", (1962). He considers the economy of knowledge as the economic sector, including numerous types of human activity, united in five main groups: education, research and development, mass media, information facilities, and services. According to the scientist's estimates, in 1958, this economic sector gave a contribution about 29% in GNP of the USA. F. Machlup based his conclusions on the following provisions: "knowledge is something known to somebody -" and "production of knowledge is a process by means of which somebody learns something that was unknown even if it is already known to others" (Machlup 1962).

There are also other concepts (Veselá and Klimová 2014). One of them divides economy into two sectors. The first one is the knowledge-intensive sector consisting of those branches, where firms use advanced technologies, high education level, and the qualified labor force. The second sector consists of branches with lower education level/qualification of workforce, which use "traditional" production processes.

According to the other concept, the main sight and the analysis are aimed only toward the hi-tech sector, which plays a key role in the whole economy. Growth, based on knowledge, includes not only creation of new sectors, but also internal transformation of sectors, which already exist (Cavusoglu 2016). However, the fact that modern economies are more knowledge-intensive, should not exclude a contribution to growth of the developed economy of "low-technology" sectors, such as production of foodstuff, woodwork.

5 Conclusions

At the present time in Russia, some steps are taken for creation of conditions for development of innovation and investment activities in business. The Scientific and Technological Development Strategy of the Russian Federation for 2017–2025 is approved. The purpose is ensuring independence and competitiveness of the country due to creation of an effective system of build up and the fullest use of intellectual potential of the nation (The concept of long-term social and economic development of the Russian Federation 2008).

For achievement of this purpose, it is necessary:

- To create possibilities for indication of the talented youth and creation of successful career in the field of science, technologies, and innovations, providing development of intellectual potential of the country;
- To create conditions for carrying out research and development corresponding to the modern principles of organization of scientific, research and technological, innovative activity and the best Russian and world practices;
- To create the effective system of communication in the field of science, technologies and innovations, providing increase in susceptibility of economy and society to innovations, having created conditions for development of the knowledge-intensive business;
- To create the effective system of communication in the field of science, technologies and innovations, providing increase in investment attractiveness of the sphere of research and development and also efficiency of capital investments in the specified sphere, effectiveness and relevance of research and development;
- To promote formation of a model of international, scientific, and technological cooperation and international integration into areas of research and technological development, enabling to protect the identity of the Russian scientific sphere and the state interests in conditions of internationalization of science, and to increase efficiency of the Russian science due to mutually advantageous international interaction.

Current situation, connected with development and assimilation of innovative technologies, remains unsatisfactory.

This is shown by the presented ratings: Public expenditures on support of introduction of innovations are very small, low systematic of the policy on maintenance of innovative activity, weak infrastructure resulting in impossibility of introduction of new knowledge in production of new, more advanced goods and services. The innovative development strategy, which depends on intellectual resources, becomes the main tendency of economic development of the Russian Federation.

The conducted study of various development aspects of investment and innovation activity in business demonstrates that it is necessary to develop a complex of mechanisms of political, legal, organizational, economic plan for realization of this strategy. At the present time, this work is carried out, but it often remains unsystematic, without accurate definition of a domestic model of formation and development of innovative business.

The purpose of the contribution is to show reasonably and justifiably that it is possible to overcome the existing problems due to development of a complex of institutes, which will allow turning knowledge into innovation and investment business activity. The results of the scientific research can be used into practice when developing a complex system of measures for creation of the specified conditions.

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Readiness to Changes as One Entrepreneurial Value of the Innovation-Oriented Economy

S. I. Ashmarina, V. V. Mantulenko and E. P. Troshina

Abstract The relevance of this contribution is caused by the fact that following the growing need of development of small business in Russia, the organizations, representing small business, more often stop their functioning, than appear in the market as new players. According to the authors, an important challenge is the fact that the barriers, hindering development of small business, arise because of the developed negative attitude of the Russian society to a figure of an entrepreneur and business activity in general. Entrepreneurship is a phenomenon, which is not free from morals and values: The propensity to create serious business for the long-term perspective requires a set of value orientations, which determine what should be made and how it should be made. The purpose of this study is consideration of the existing approaches to understanding of the phenomenon of entrepreneurship from the point of view of value orientations, which are the basis for business activity in conditions of innovative development of the global economy. The results of the conducted research on the relevant values are presented in the work. The role of such valuable entrepreneurial quality as readiness to changes, necessary for formation of a new mode of thinking of the modern business community, is considered in this contribution. By results of the conducted research, the authors offered a model of this integrative characteristic, which can be the basis for purposeful process of preparation and retraining of entrepreneurs (including future ones) for development of the entrepreneurial culture of the region in the context of requirements of the innovative economy.

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1 Introduction

Entrepreneurial activity in Russia made a difficult way of development. Throughout this period, it was not always perceived by the population positively, and there were periods when business in our country was beyond the law. Many experts note that we are only in the beginning of formation of a new enterprise culture. Russian business community of a new type is rather young (Kosharnaya 2010). In the present time, this type of activity gets full support from the state. However, the attitude of the population toward businessmen is still ambiguous, while some people are positive to entrepreneurship in general, highly appreciating entrepreneurial spirit and respecting people, who could create their own business. Others associate entrepreneurs with swindlers, who illegally enrich themselves at the expense of the other part of country's population. Sometimes, businessmen are considered as outcasts, a social group with such features as dishonesty and greed of gain. Undoubtedly, in this case the marginality means a certain special status of entrepreneurs, which is understood as an intermediate state, a condition of inconsistency. It is mainly explained from the point of view of development features of the market economy and entrepreneurship as a phenomenon in conditions of our country. However, it is impossible to deny the importance of valuable orientations of different groups of the population, influencing on this issue.

It is considered that good businessmen earn money. Great businessmen earn whole lot of money. But outstanding businessmen do something bigger, than just earning money (Haden 2016). These are those few people, who possess the qualities, which are not reflected in balances and reports, but having a significant effect on life of colleagues, subordinates, professional communities, and the whole branches.

Several researchers (Christensen 1997; Farrell 2014; Fuglsang et al. 2008) came to the conclusion that, together with productivity and efficiency, innovations are fundamental to development of entrepreneurship in modern conditions. Undoubtedly, innovative activity was always important, but the last decades have shown that there is no effective development of economic entities without constant advance (Ashmarina and Khasaev 2015). Information technologies have created global commodity and service markets, where business struggle can proceed from any party. The first one, who sees new opportunities and uses them, wins this competition and gains competitive advantages of the highest order (Drucker 2002).

Obviously, the figure of an entrepreneur, a businessman was always perceived ambiguously that is connected with special position of entrepreneurs themselves, their specific qualities, and the sphere of their activity. Entrepreneurial values also undergo changes in the development process of the market relations and are influenced by both global international and local, regional tendencies and processes.

2 Materials and Methods

The research methods are the system analysis, expert evaluation methods, polling and interviewing, modeling.

The main research methods are

- The first stage was implemented by means of analysis of the existing approaches to entrepreneurial values and entrepreneurship as values from the philosophical, sociological, economic, and psychological points of view.
- The second stage included monitoring and diagnostic work, development of the model of readiness of entrepreneurs to changes, and the complex of the most significant values in the enterprise environment is investigated.
- At the third stage, the results of diagnostics are processed and analyzed, and objectives for a further investigation phase are formulated.

3 Results

3.1 Theoretical Basis of the Considered Issue

Considering the essence of values, it should be noted that understanding of both key purposes and ways of their achievement is the basis of this category. These are the fundamental standards, principles, guiding ideas, which provide development of any society, direct certain individuals and help us to choose this or that behavior in vital situations (Lapin 2010).

Internal content of any culture, including entrepreneurial, is based on a certain set, system, values, uniting needs, motives, and interests of certain representatives of various social groups.

There are various classifications of values. For instance, values can be divided by the principle: values—purposes and values—means. The first one is called terminal, and the second one is tool. Traditionally, it is considered that target values are steadier and have higher status in comparison with values–means (Vasyanin 2012).

Terminal value is manifestation of relation of a subject to the current situation, to the surrounding reality and the carried-out activity. Values–means represent the mode of life, behavior of this or that social group, human factors and trappings, distinguishing this community and its certain representatives from all others. In relation to entrepreneurs, we can speak about those value orientations, which allow them to be solved on the basis of their own business, and determine their relation to the business, which they start, and to that social group, which they seek to come into.

There are basic values, which are formed in the childhood and youth, and we try to stick to them throughout all our lives. However, we understand that value is not some static element. On the contrary, practically any value system represents a dynamic system because there are values, which change and transform to force of these or those external events.

Various life situations, including the crisis ones, make us to leave the comfort zone and to start to change something. Together with these changes, our values can also change (Zotova et al. 2016). Eventually along with emergence of new events and phenomena in our life, new values can also appear. Nevertheless, experts believe that in the process of growing-up there are not many such events, which are able to change our basic attitudes. It appears that it is referred to the change of the developed system of value attitudes as a result of weakening of ones and strengthening of others.

Depending on social and cultural system, where values are formed, they can be subdivided into traditional, liberal, modern, and universal. There are also integrating and differentiating values, approved and denied. The same value can perform different functions in different situations and at various development stages of the society, an organization, a certain person. It is considered that the more universal character the value has, the more integrating its force is (Vasyanin 2012).

In conditions of the innovation-oriented economy, readiness to changes should be an essentially important value orientation of the business community.

Exactly, this quality can become fundamental in the new value system of the business world, considering the turbulent nature of the external environment both at the individual level and at the level of organization in general. Readiness to changes is a difficult construct, the integrative characteristic, consisting of four main units of elements (Mantulenko 2016a, b), which are closely interrelated with each other: information, target, motivational, and activity (Fig. 1).

It means the following: If we want to change, first of all, we have to know what occurs around us, what are the current trends, what direction we could choose for our development. It is also important for us to establish competently the purposes of our further development and to develop a trajectory of our movement to them.

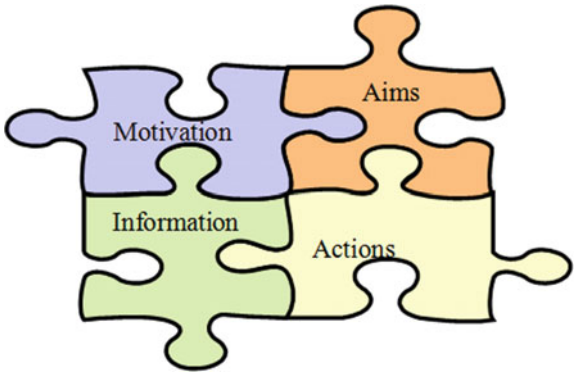

Fig. 1 Model of readiness of entrepreneurs to changes. *Source* Authors

Concrete, real steps, actions behind which there are these or those motives and incentives are necessary for progress forward.

The problem of readiness to changes is more often considered in the sphere of change management. It should be noted that change management process is rather difficult, and the fragmentary study of this phenomenon does not allow considering its influence on the process of formation of values in full. At the same time, further studying of readiness of the entrepreneurial environment to changes and analysis of this characteristic as one of the most significant qualities of modern entrepreneurship in conditions of innovative economy is considered relevant (Zotova and Mantulenko 2017).

3.2 *Study of Entrepreneurial Values and Readiness of Entrepreneurs to Changes*

In 2015–2017, the authors conducted the research on value orientations of businessmen of the Samara region with the help of polling and interviewing. By means of random sampling technique, 300 entrepreneurs, living in the regional center, in Samara, and in other residential places, were interviewed. Among the respondents, more than 60% are engaged in business activity more than 10 years, 21%—from five to ten years, 15%—from one to five years, and less than 4%—less than one year.

Answering the question about their entrepreneurial values, the respondents demonstrated rather broad dispersion of opinions; however, independence and financial well-being (profit), which gained approximately equal number of points, are the leading positions.

The entrepreneurs, who participated in the poll, consider their work as self-valuable life purpose and as means for earnings. In other words, work and activity act at the same time as terminal and as tool value. Quite often, business is considered as the value, which is close to the value of "family"; in particular, it takes place when it is a family business, which connects several generations.

The obtained data confirm big load of entrepreneurs (nonstandard work day, week); at the same time, respondents denote big importance of the temporal factor for them (in personal and professional plan), allocating time as a separate value, having universal and specific professional importance.

Estimating our own position in the society, entrepreneurs were divided into two rather equal groups. The first one considers its position prestigious, at the same time showing the importance of the value of "status." Representatives of the second group consider their position ambiguous, connecting it with the social and cultural factors, influencing their business, and social standing of entrepreneurs themselves. There were also those, who found it difficult to answer this question or refused to comment on it.

Among values, which were also noted as especially significant, are: commitment to excellence (technical, organizational, etc.), initiative, responsibility, self-development, order, and others. Many of the respondents interpret some qualities (courage, strength of mind, vision, honesty, respect, trust, and honesty) as values (Mantulenko 2016a, b).

The polling showed that, as a rule, both entrepreneurs and their companies, represented by key employees, are well informed about the existing ways of possible changes and improvements of the activity. Businessmen note that they are able to work with information; they understand the purposes of innovative development and the need of changes. At the same time, they quite often have a number of tools and resources for achievement of the stated goals; however, the sphere, where serious difficulties were really diagnosed, is motivation.

In our opinion, the issue of motivation always somehow deals with values, with the main ideas and principles, and categories, which help to make these or those decisions, create the team spirit of companies, their entrepreneurial culture. They direct businessmen and set a course of their personal development. Thus, businessmen experience the greatest difficulties with a motivational component of readiness to changes.

The growing social responsibility of business in Russia became a positive tendency. Almost a half of the interviewed entrepreneurs indicated that they regularly spend some available funds on helping orphanages, charity foundations, animal shelters, on support of sport, cultural, and other socially important events. Thus, it is possible to note that well-being as the entrepreneurial value gets on with morality and sacrifice.

3.3 Entrepreneurial Values and Qualities in Conditions of Innovative Economics

According to the research results of Michael Morris, Professor of Business Department and Head of the Entrepreneurship Program of the University of Florida, respondents were offered to choose the most important competences for implementation of entrepreneurial activity in Russia (Morris et al. 2013). The main group (53%) distinguished the following abilities: recognition and assessment of the perspective, creative solution of problems, attraction of resources from outside, ability to make shift with own means, creation of networks/communications and their management, risk mitigation and its management, ability to learn by experience. At the same time, some interviewed expressed opinion about the need of teaching similar skills at the university. Therefore, there is a necessity for the formation of entrepreneurial competences within applied (administrative and economic) disciplines in higher educational institutions. It will help to receive not only a qualified specialist, but also a potential entrepreneur, capable of creative thinking and effective meaningful actions.

Among especially necessary qualities for a modern entrepreneur, the respondents also noted the following ones: managerial abilities, business acumen, social skills, and discipline. These characteristics can be quite often met in foreign studies of this sort, where researchers consider them necessary not only for modern representatives of the business community, but also for entrepreneurs in general. The important place among such valuable entrepreneurial qualities is taken by readiness to take a risk. It is quite explainable as risk and a certain share of adventurism were always peculiar to entrepreneurship as a social group, they mainly determine propensity to business activity, desire to change something around themselves, and sacrifice something for the sake of something more valuable and significant.

However, among respondents there are those entrepreneurs, who are generally engaged in management of functioning business, its systematic development, but not in producing new ideas and their launch. It is connected with high risks in case of failure and, respectively, risk is not at the first place among necessary qualities. But in the regional business community, there are also others: Those, who, creating innovative goods and services, do not separate work from constant risks: Here, we fully observe readiness of entrepreneurs to changes.

Considering entrepreneurial values in conditions of innovative orientation of the modern economy, it was especially important to understand the role of "innovation" as the value for regional business. The research results show an ambiguous position of this aspect in the entrepreneurial environment. Less than a half of the respondents estimated this quality as extremely necessary for a modern entrepreneur; however, for several years innovation is considered as the main factor of success of business. Such results can be explained from several positions. Firstly, we faced the fact that this quality did not appear to be quite clear for some participants of the poll. As a result, further studying of this issue requires accurate and united definition of this term. Secondly, quite a big part of the respondents is engaged in the sphere of trade and services, where we are talking about small improvements for ensuring bigger competitiveness. Besides in Russia, there are still a lot of rather free market niches, where it is possible to create successful business, just implementing already checked ideas. Thirdly, innovations are so diverse and versatile that something, what is innovative for one organization, can be already known experience for another.

The modern entrepreneur should not necessarily produce any goods or services independently. He can be a person, who fills so-called structural holes with new social contacts, receiving a certain financial benefit for himself (Radayev 1993). Modern entrepreneurs drive to money and profit as a sustainable strategy united with values of his company, business, care about reputation, power, status and recognition, independence, efficiency, and many others. Some experts believe that business is the value in itself.

4 Discussion

The majority of modern writers define "entrepreneur" as a "businessman," forgetting about differences in the present risk, use of innovations, entrepreneurial profit, which were mentioned by Josef Schumpeter and others.

According to J. Schumpeter, the outsiders, selfish, and even asocial people, who want to serve their own idea more, than to the mankind often become entrepreneurs (Schumpeter 2008).

Everett Rogers, the author of the famous concept of diffusion of innovations, thought that inventors do not comply with rules so much, so that they are often considered as subjects of extremely deviant behavior (Rogers 1995).

Undoubtedly, the reputation, if the company has it, opens access to the loan capital, but it also connects entrepreneurs to some extent. Therefore, in this concept a modern, innovation-oriented business becomes a certain departure from the accepted standards.

Along with division of values on integrating and differentiating, differences in social and demographic characteristics of respondents should not be forgotten. In this connection in the 1960s–1970s, M. Rokich conducted large-scale research on values in the USA, and it allowed revealing and analyzing connection of various values with such variables as sex, age, social status, income, education, race, political convictions (Rokich 2009).

The authors analyzed the received results and obtained only one obvious dependence. Thus, tool value "independence," ability to be "individuality," becomes less significant with increase in experience of conducting entrepreneurial activity.

Dependence of valuable preferences on sex, age, and education is represented to an interesting subject for studying, but entrepreneurial activity, which is important for us, is not reflected here.

We consider that further studying of dependence of value orientations of entrepreneurs on their experience in business activity is necessary as well as rapid changes, which characterize civilization development at the present stage.

5 Conclusions

Position of entrepreneurs in society was always contradictory. There are some reasons for that like constant debt bondage; life for the sake of the better future; a big gap between the predicted and current income; and the increased risks and constant possibility of failure.

A modern entrepreneur faces the mass of various problems: firstly, restiveness of innovations. The majority of people do not like innovations and consider them as something strange and often negative (Mantulenko 2016a, b). It is quite explainable because the basis of each order is sustainability, stability of the system, structures of

institutes and relations. The first reaction of the majority of people to innovations is rejection. And entrepreneurs are the first, who experience it to the full extent. They feel social strain, even hostility especially from the traditionally adjusted social groups. That is why a businessman is, first of all, a person, who is capable to act, regardless of such attitude. He is someone, who can go against usual orders, against established rules (Radayev 1993).

Our society can have many potential entrepreneurs, but only few of them become successful and are able to manage companies effectively for maintenance of steady growth of business. It is possible if they have culture, a set of values, which supports innovations and initiatives, and if they are flexible and are ready to changes (Zotova and Mantulenko 2017).

In our opinion, entrepreneurship is not only setting up your own business; it is a fuller life. It is propensity to make the world better by determination of your own purpose and its further application to a subject, which is rather interesting for you personally. It is a mode of thinking, at which a person looks for opportunities, creates values, extends the convincing point of view, and maximizes the limited means in the chosen business. So, it is possible to be an entrepreneur, if you open a new enterprise, head a growing company, organize this or that business in corporation, manage the work of the state institution, or develop a program of change for you subdivision.

All of us study differently. In the course of getting the entrepreneurship education, it is possible to not only use the recognized literature on the business theory, but also apply the analysis of practical situations, student's business incubators, consulting projects for small business, "live" cases (communication of an entrepreneur with students in audience), business plans and competitions, projects of social business at the place of residence (Troshina et al. 2016).

Summarizing all the above-mentioned, it is possible to draw the following conclusions. Firstly, it is necessary to increase empirical studying of entrepreneurship, owing to a big role of this social group in economic, political, and social spheres of life of the society. Secondly, the respondents are inclined to estimate the qualities, necessary for a modern entrepreneur, proceeding from their own experience and market realities. Thirdly, in the process of its development domestic entrepreneurship forms a new value system, which is based on individualism, personal liberty, the principle of equal opportunities, etc. At the same time, it is necessary to consider that progressive standards and values of the western entrepreneurial culture will not be acquired until the life of the society does not change qualitatively (Kosharnaya of 2010). Fourthly, on the basis of large universities it is necessary to develop and implement business programs of different education levels (bachelor, magistracy, programs of additional education, for those, who already implement commercial business), because development of entrepreneurial competences is an important factor of successful career and realization of personal ideas and projects of a graduate.

The readiness to changes should become the key characteristic of the modern business. It is recognized by the majority of respondents. Along with that, entrepreneurs note the existence of problems in the sphere of a motivational component

of this integrative characteristic. It indicates the need for purposeful work of researchers and practicing business coaches in this direction.

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Part III
Prospects for the Digitalization of the Economy

Comparison of Neural Networks and Regression Time Series When Estimating the Copper Price Development

M. Vochozka and J. Horák

Abstract In recent years, the primary copper ore stock has been cut sharply and the price of crude copper has been rising. On the other hand, thanks to a huge industrial interest, the production of copper products has increased significantly over recent years. It is therefore clear that the prediction of the copper price is very important. A variety of techniques, such as statistical methods—regression time series or artificial neural networks—are used for prediction. The aim of this contribution is to perform a regression analysis of the copper price development on the New York Stock Exchange using the mentioned linear regression and neural networks, expertly compare both methods, and identify the more suitable one for a possible prediction of future copper price developments. Input data includes copper price data from January 2006 to April 2018. First, linear regression is performed, and then, neural networks are used for regression analysis. A total of 1000 neuron structures are generated, five of which with the best characteristics are kept, and these are then further worked with. From the linear regression, the curve obtained by the spline function appears to be best, and the neural networks have all been proven to be usable in practice.

1 Introduction

Copper is a chemical element with a chemical designation of Cu and an atomic number of 29. This is an especially soft and ductile metal with very high thermal and electrical conductivity (Augustin et al. 2016). According to Palza et al. (2015), copper is mainly used as a conductor of heat and electricity as a building material and as a component of various metal alloys, used in jewels, used in the production

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of coins and constants used in strain gauges and thermocouples for temperature measurement. Copper has good electrical, thermal, and corrosion properties, but its use is limited to mechanical properties (Singh and Gautam 2017).

Copper is considered to be a noble metal element that has a reddish color and has been used by humans for centuries. It is a ductile metal with hundreds of applications in a wide range of consumer and industrial applications. Demand for copper production has increased considerably over the years due to rapid growth in sectors such as electricity and electronics, plumbing, construction, architecture, transport, lifestyle, consumer, and health products (Baral et al. 2014). This is confirmed by Isa et al. (2017), who maintains that the production of copper products has increased considerably over the years, especially due to the huge industrial interest. This situation has caused a sharp drop in the primary copper ore stock, and the price of crude copper has therefore begun to increase. This has led many researchers to develop a new alternative material to overcome the aforementioned problems (Cloutier et al. 2015).

At present, Chile is the world's largest copper producer, Peru is second, and China is the third largest. Interestingly, China has a leading position on the demand side, which represents more than 40% of world demand. Above all, a sharp increase in demand from China led to the rise in copper prices between 2003 and 2008. The copper price rose again from the end of 2008–2011, after a drastic decline due to the global financial crisis of 2008 (Investing News 2018).

It is clear from the above that the prediction of the copper price is very important. Various techniques are used to predict the copper price, most notably regression time series or neural networks. In terms of artificial neural networks, these can be used for classification, regression, etc. Their advantage lies above all in the ability to work with large data, accuracy of results, or the ease of use of the acquired neural network (Zhuge et al. 2017). The disadvantage, however, is the way of creating individual models of artificial neural networks (Rowland and Vrbka 2016). A further disadvantage of neural networks is their demand for large input data, according to Stehel et al. (2016), because a lot of test observations are needed to create such data, which is very uncomfortable for users. The advantage of neural networks is that they are able to analyze complex patterns very quickly and with high precision and are flexible in their own use (Santin 2008). For example, neural networks can be used to recognize images, time series prediction, understanding and generating languages, etc. (Boguslauskas and Mileris 2009).

The aim of this contribution is to perform a regression analysis of copper price developments on the New York Stock Exchange using linear regression and artificial neural networks and then to compare the two methods and select the more appropriate one for predicting the future development of the copper price.

2 Materials and Methods

The input data for the analysis are available on the New York Stock Exchange Web site or World Bank (2018), etc. Copper prices between January 3, 2006, and April 20, 2018, will be used for analysis. In total, we will be using 2892 pieces of copper price data. The price of copper is announced once a day on the days it is traded (except weekends, public holidays, Christmas, etc.). Table 1 lists the basic descriptive characteristics of the data.

An interest to us will definitely be the development of copper prices over time. Figure 1 shows the spread of the values in each section of the monitored time period.

Table 1 Characteristics of the data file

Descriptive characteristic	Value in USD
Minimum value	127.40
Maximum value	463.75
Average value	305.32
Spread	4266.20

Source Authors

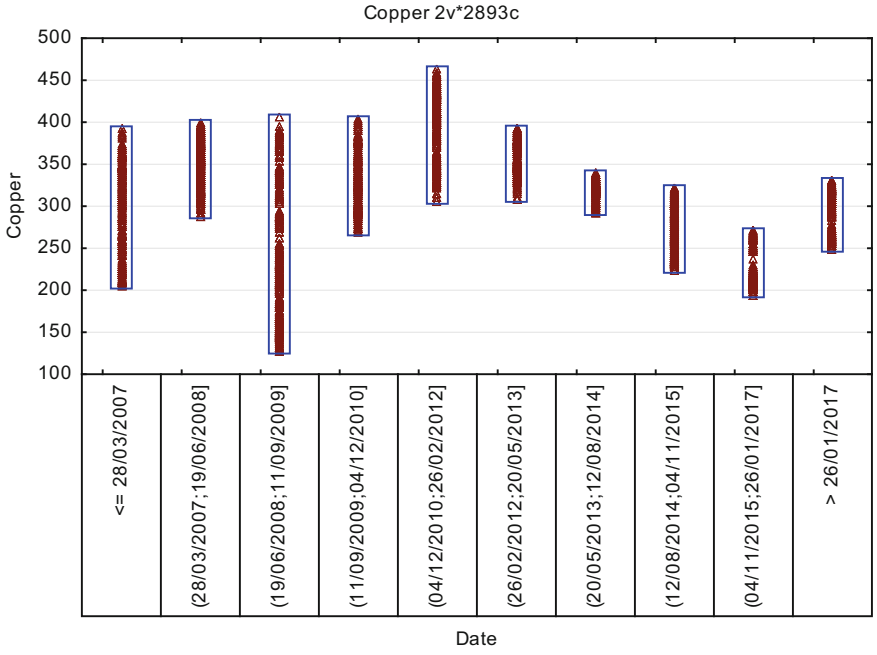

Fig. 1 Copper price spread graph. *Source* Authors

Data processing will be done using DELL's Statistica version 12. First, a linear regression will be performed, followed by a regression analysis using artificial neural networks.

Linear regression will be performed on the data sample under investigation for the following functions:

- Linear,
- Polynomial,
- Logarithmic,
- Exponential,
- Multiparameter of weighed distances,
- Multiparameter of negative-exponential smoothing.

However, the correlation coefficient, i.e., the dependence of the copper price on time, will be calculated beforehand. We will work with a level of significance of 0.95.

Consequently, regression will be carried out using neural structures. We will generate multilayer perceptron networks (MLPs) and neural networks of radial basis functions (RBFs). Time will be set as an independent variable. We will determine the price of the commodity—copper as the dependent variable. We divide the time series into three sets—training, testing, and validation. In the first data group, 70% of the input data will be used. Based on the training set of data, neural structures will be generated. In the remaining two sets of data, we always leave 15% of the input data. Both of these groups will serve to verify the reliability of the found neural structure or the model found. The time series delay will be set to 1. We will generate a total of 1000 neural networks, of which five displaying the best characteristics will be kept. The hidden layer will contain at least 2 neurons, at most 30. In the case of RBF networks, there will be at least 21 neurons in the hidden layer, at most 30. For networks, we will consider these distribution functions in the hidden layer and in the output layer:

- Linear,
- Logistic,
- Atanh,
- Exponential,
- Sinus.

Other settings are left by default (ANS—automated neural network). In conclusion, the results of linear regression and regression using neural networks will be compared. Comparison will not take place in the form of residue analysis (minimum, maximum values, dispersion of residues, etc.), but at expert level and experience of the assessor, an economist.

3 Results

3.1 Linear Regression

Corresponding correlation coefficient determines the significant statistical dependence of copper on the development over time. A point graph was constructed (see Fig. 2), where the points were intersected by a regression curve, in this case linear. The line parameters are shown in the figure.

The solid line represents a regression function. Figure 3 represents the intersection of a point graph with a polynomial function.

As in the case of a linear function, in this case, the solid line represents a regression curve. Figure 4 shows a copper price point graph intersected by a logarithmic function.

Figure 5 provides a point graph of copper prices intersected by an exponential function.

Figure 6 provides a point graph of the copper price development intersected by a least amount of square-weighted distance function.

Figure 7 provides a graph of copper price intersected by a function achieved by the smallest square negative-exponential smoothing method.

Graph of copper prices intersected by a function obtained with the regression curve—the spline function—is shown by Fig. 8.

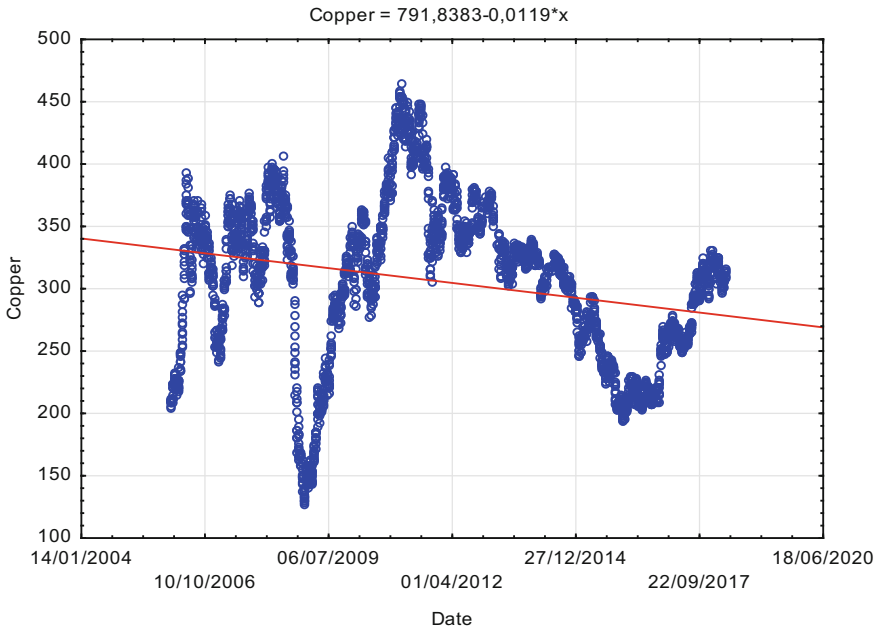

Fig. 2 Copper price graph intersected by the regression curve—linear function. *Source* Authors

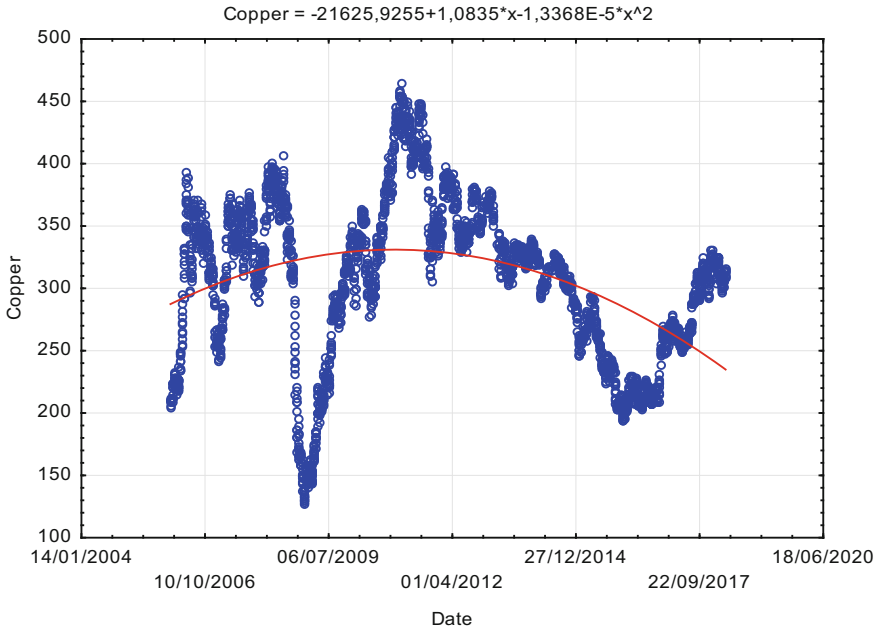

Fig. 3 A copper price graph intersected by a regression curve—a polynomial function. *Source* Authors

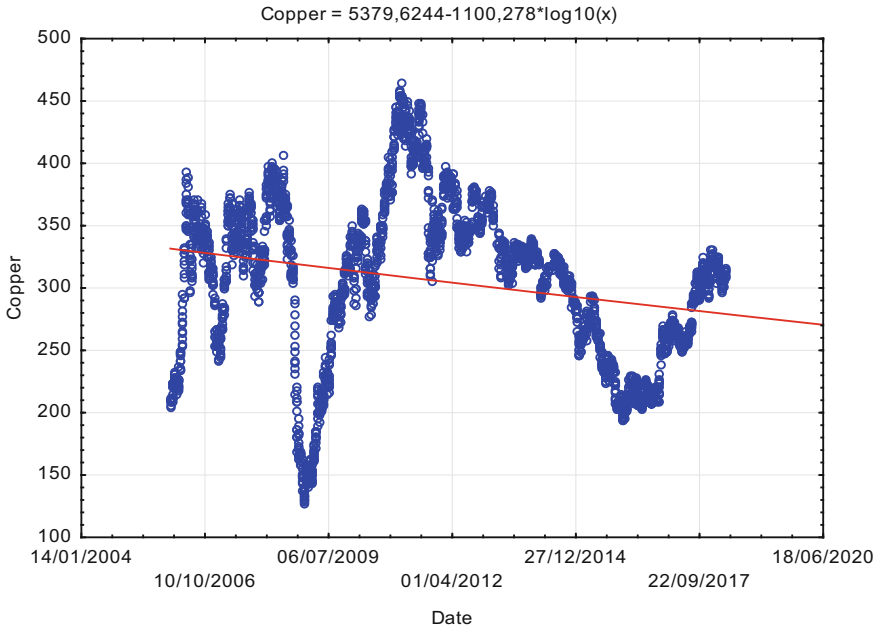

Fig. 4 A copper price graph intersected by a regression curve—a logarithmic function. *Source* Authors

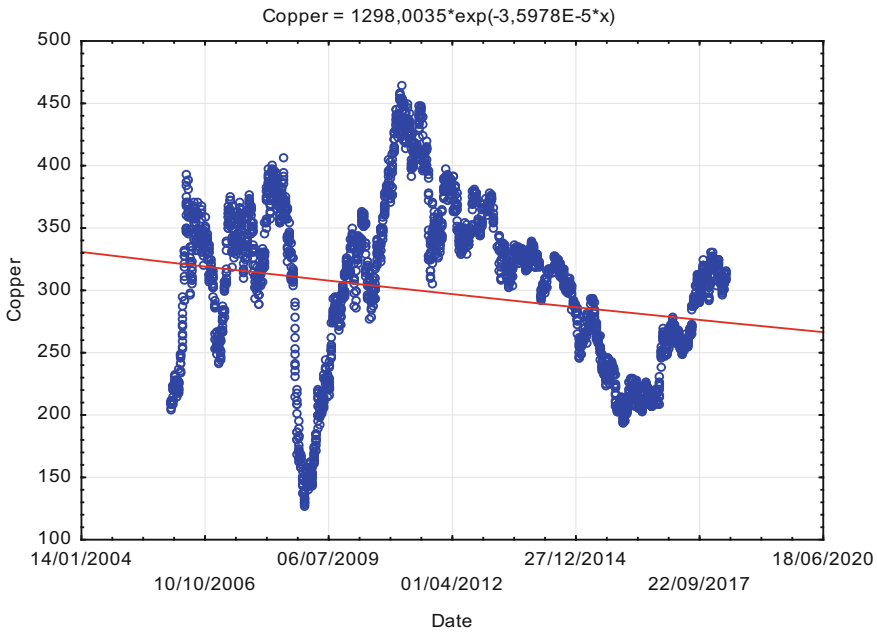

Fig. 5 Copper price graph intersected by a regression curve—exponential function. *Source* Authors

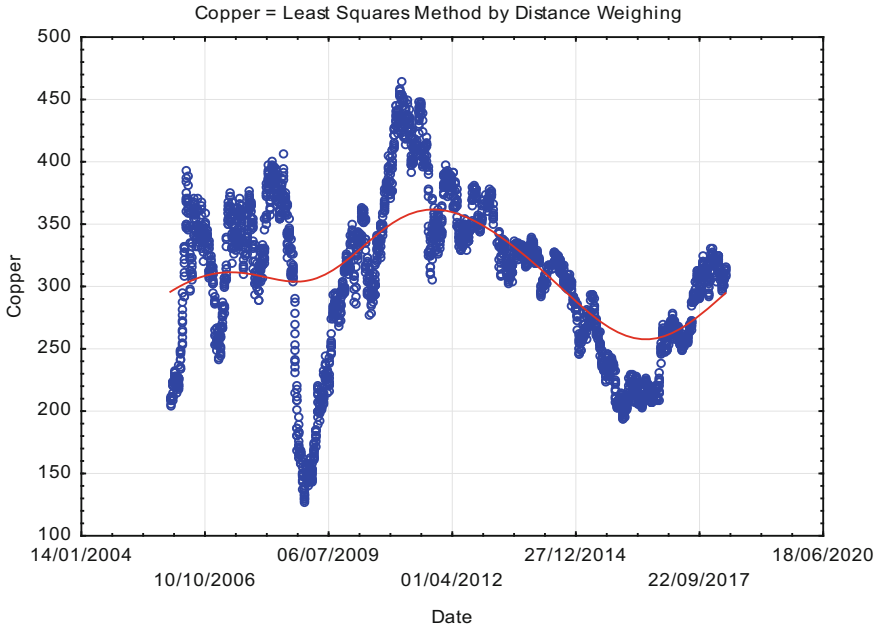

Fig. 6 Copper price graph intersected by the regression curve—the least square-weighted distance function. *Source* Authors

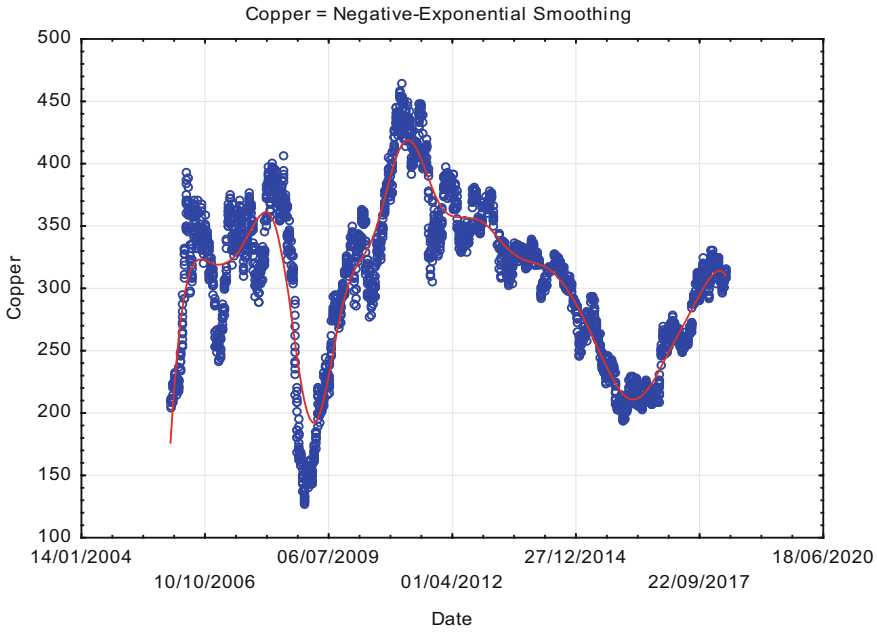

Fig. 7 Point graph of copper price interested by a regression curve—negative-exponential smoothing. *Source* Authors

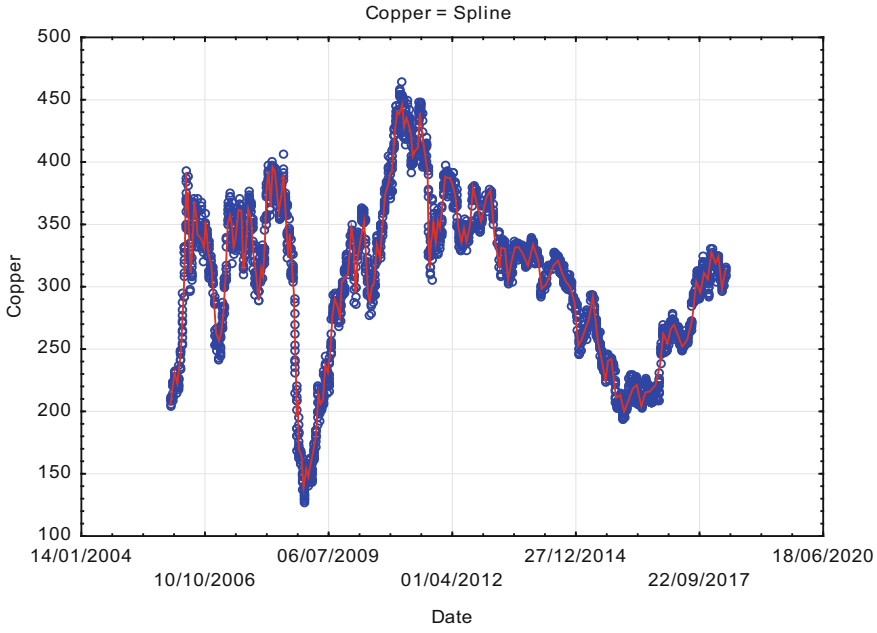

Fig. 8 Copper price graph intersected by the regression curve—spline function. *Source* Authors

As noted above, the correlation coefficient indicates a significant statistical dependence of the target variable on the development over time. If we only evaluated the results by the optical comparison of the copper price and the regression curve shape, while taking into account the simple linear regression, we could certainly say that the curve obtained by the spline is closest to the development. Next, the smallest square curve is followed by negative-exponential smoothing and the curve also obtained by also the smallest square method, in this case weighed distances. All three are copying the basic development of the copper price. Very roughly, this is the case with a curve obtained by the smallest square-weighted distance method, which at least deviates from real development, but cannot capture the global extremes of such development. The curve obtained by the smallest squares method by negative-exponential smoothing tracks closer to the global extremes of copper price development and is certainly more accurate than the curve obtained by the smallest square-weighted distance method. As mentioned above, the curve obtained by the spline function best suits the global extremes, but also the local extremes of this development. Optically, the function appears to be effective in predicting the copper price, albeit somewhat inaccurately.

3.2 Neural Structures

Based on the methodology, 1000 neural networks were generated. Five networks have been preserved, showing the best characteristics. Their overview is given in Table 2.

As can be seen, these are only MLP networks with one hidden layer. There is only one variable in the input layer—time. In the hidden layer, neural networks contain between 10 and 27 neurons. In the output layer, we have logically a single neuron and the only output variable—the copper price. For all networks, the quasi-Newton training algorithm was applied, each time in a different variant. Artificial structures differ in the type of hidden activation functions used. The third preserved network uses the logistic function, the others the hyperbolic tangent. In the output layer of neurons, all preserved networks use the sinus function.

Very interesting are also training, testing, and validation performances. In general, we are looking for a network that has performance across all data sets (we recall that dividing data into sets was random) ideally the same. The error should be as small as possible.

The performance of individual sets of data is expressed as a correlation coefficient. The values of the individual data sets according to specific neural networks are presented in Table 3.

The table shows that the performance of all stored neural structures is approximately identical and high in all cases. Slight differences do not affect the performance of individual networks.

Table 2 Overview of preserved neural networks

Name of network	Train. performance	Test. performance	Valid. performance	Training error	Testing error	Validation error	Training algorithm	Error function	Activ. of hidden layer	Output act. funct.
MLP 1-22-1	0.996	0.996	0.996	15.983	16.993	15.760	BFGS (quasi-Newton) 242	Sum of sq.	Tanh	Sinus
MLP 1-15-1	0.996	0.996	0.996	15.972	17.015	15.772	BFGS (quasi-Newton) 90	Sum of sq.	Tanh	Sinus
MLP 1-10-1	0.996	0.996	0.996	15.993	16.989	15.776	BFGS (quasi-Newton) 101	Sum of sq.	Logistics	Sinus
MLP 1-27-1	0.996	0.996	0.996	15.978	16.997	15.768	BFGS (quasi-Newton) 84	Sum of sq.	Tanh	Sinus
MLP 1-23-1	0.996	0.996	0.996	15.963	17.038	15.777	BFGS (quasi-Newton) 72	Sum of sq.	Tanh	Sinus

Source Authors

Table 3 Correlation coefficients of individual data sets

Network name	Training performance	Testing performance	Validation performance
MLP 1-22-1	0.996231	0.995947	0.996431
MLP 1-15-1	0.996233	0.995942	0.996428
MLP 1-10-1	0.996228	0.995949	0.996427
MLP 1-27-1	0.996232	0.995947	0.996429
MLP 1-23-1	0.996235	0.995936	0.996427

Source Authors

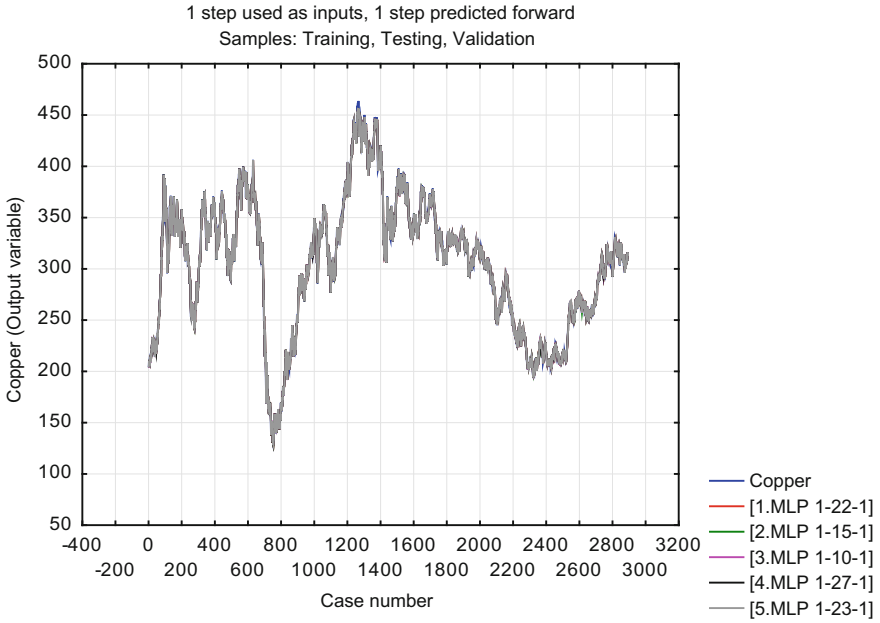

Fig. 9 Evolution of copper prices predicted by neural networks compared to the actual price in the examined period. *Source* Authors

Figure 9 is a graph showing the actual evolution of the copper price (shown in the figure as copper) and the prognosis of the generated networks (these are indicated by the order number given in table two and the number of neurons in each layer).

The graph shows that all neural networks predict the copper price development very similarly. However, the similarity between predictions of individual networks is not important, but similarity (or degree of consistency) with the real development of the copper price is. In this regard, it can be said that the preserved neural networks appear at first glance very interesting. They respect the global extremes of the curve evaluating the evolution of copper, but tend to register local extremes of this curve as well.

4 Conclusions

In general, each prediction is given by a certain degree of probability with which it is to be filled. As we predict the future development of any variable, we try to estimate the future development of this variable on the basis of previous years' data. Although we can include most of the factors influencing the target variable in the model, we always simplify reality, and we always work with a certain degree of probability that some of the predicted scenarios will be fulfilled. Even in the case of linear regression, as well as regression using neural networks, there is simplification —and quite substantial. We only work with two variables—input (time) and output (copper price). So, we completely ignore the other inputs, which undoubtedly have an influence on the final price of copper (the development of the national economy, the political situation of the state, the legal environment, market barriers, etc.). Even so, or precisely because there are a number of factors influencing the price of copper, we have to think whether working with time series does not simplify the development of the target variable too, or, on the other hand, the other variables are so insignificant that the input variable (time) and output variable (copper price) are sufficient. Since it is not possible to predict the occurrence of extraordinary situations and their influence on the copper price (perhaps in the short term, yes, certainly not long), simplification and creation of a relatively simple model are in place and the result is useful.

We can determine the copper price based on statistical methods, causal methods, and intuitive methods. In this case, we have been comparing statistical methods. However, they only gave us a possible framework for the development of the copper price. It is important to work with information on the possible future development of the economic, political, or legal environment. If we can predict its development, we can then project it into the price of copper. At the same time, however, the personality of the evaluator comes in place—an economist who, on the basis of his knowledge and experience, corrects the price determined by the statistical methods and specified on the basis of causal links.

The aim of the work was to perform a regression analysis of the copper price on the New York Stock Exchange using neural structures and linear regression, then compare the two methods, and determine the more suitable one for a possible prediction of the future price development of this commodity on the New York Stock Exchange.

Optically, the linear spline curve obtained by the spline function was the best. From the neural networks, all retained structures proved to be usable in practice. If we look at performance in terms of the correlation coefficient, only neural networks remain among us, with virtually no difference. Of course, there would certainly be an interesting residue analysis. It would help us undoubtedly identify the best of the preserved neural networks. This was, however, not the aim of this work.

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Evolution of the Venture Investment Market in the Information Economy of Russia

S. V. Domnina, O. A. Guzhova, N. V. Kozhukhova and Yu. A. Tokarev

Abstract The urgency of the issue under research is determined by the key role of innovations in the development of the modern Russian economy, especially in the context of import substitution and the development of digital technologies. In the scientific literature, there is a certain lack of research on a comprehensive statistical description of the venture investment market in the Russian Federation. The objective of this contribution is to study the venture investment market in the economy of the Russian Federation. Hypothesis is changing innovation and invention activity in the information economy is directly correlated with the business activity in the venture capital market (VC funds). The leading method to the study of this issue is statistical, which allows performing a comparative analysis to identify factors that influence the business activity on the venture investment market of the Russian Federation. The database is a time series of Rosstat statistical indicators and the Ministry of Economic Development of the Russian Federation for 2008–2016. The tendencies of the venture capital market in Russia were reflected in the crisis of 2014–2015. The volumetric performance VC funds began to decline after a previous successful period, with both the total volume of venture capital investments, and their average size. In the structure of the innovation activity of the Russian economy, technological innovations predominate, although their share is gradually declining since 2012. The previous trend toward the development of environmental innovations gave a way to organizational innovations.

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The indicator called "coefficient of the invention activity" in our country is very stable over time; however, the situation is negative when compared with the major world powers. In general, the hypothesis of the relationship between the change in the innovation and invention activity in the economy and the business activity in the venture capital market was confirmed. The materials of this work can be useful for government bodies when developing programs for regulating the economy and developing a national development strategy.

1 Introduction

1.1 Introduce the Problem

Scientific and technological progress makes states pursue an active innovation policy, as without it the probability of a scientific and technical backlog sharply increases. There is a risk that the country will become an outsider in the military sphere, the field of information and communication technologies, mechanical engineering, and also in the sphere of consumer goods for technical purposes.

However, any innovation is born not from scratch. It is preceded by scientific developments, bold technical solutions, patents, risky projects, and this activity requires certain financial costs, with no guarantee of return. This is the sphere of venture business and corresponding venture investments. Not every third-party investor is willing to risk his capital, which means that an important role in this sphere belongs to the state.

In the Russian Federation, there is an understanding of the importance of this task at the state level. The result was the development of the state program "Economic Development and Innovation Economy" (2014). Its structure includes priority projects in the areas of strategic development, which include the project "Small Business and Support for an Individual Business Initiative," as well as a number of subprograms, in particular, "investment climate," "development of small and medium enterprises," "stimulation of innovations," "creation and development of the innovation center Skolkovo," and others.

The objective of the study is a statistical study of the venture and innovative activity. The object of the study is the Russian Federation. The subject of the study is a quantitative description of venture and innovation activity indicators.

1.2 Literature Review

Venture investments traditionally occupy a special place in economic science. However, the questions of quantitative and statistical evaluation of this economic branch (including in the Russian Federation) were considered by a limited number of scientists.

From the point of view of the theoretical study of venture investment issues, we note the works of Berger and Udell (1998), Gompers et al. (2008).

The issues of development prospects for the innovation activity in certain economic spheres were researched in the works of Yangirova (2015), Baranov and Muzyko (2015), Egorova and Pokholkov (2015), and other scientists. The subjects of their research became such economic branches as pharmaceutics, agro-industrial complex, construction, education, medicine, and a number of others.

Regional and country aspects of the innovative development have been the subject of research by such authors as Dezhkina (2009), Kinnear and Ogden (2014), Šoltés and Gavurová (2014), Nikitin and Yuan (2015), Pece et al. (2015), and others. The most interesting is the innovative development in countries that have been following the socialist way of development for a long time, following the planned methods of the economy—the People's Republic of China, Poland, Slovakia, and others, as well as the countries of the "second echelon"—India, Australia, Canada, and others.

In the scientific literature, the issues of financing innovations, including from the positions of quantitative analysis, have received sufficient coverage. We can single out the works of Maslov (2015), Domnina et al. (2016), Chirkunova et al. (2016), Kosyakova et al. (2016), and other researchers. The research of venture capital investments in Russia can be found in works of Berkowitz and DeJong (2002), Glebova and Kotenkova (2014), Fazekas and Becsky-Nagy (2015), Nazarova (2016).

From the point of view of applying statistical methods, we can mention the works of Love et al. (2014), in which the authors applied the methodology of tobit and probit modeling in the study of dynamic interdependencies in innovation strategies; Glebova and Kotenkova (2014), where the authors proposed a methodology for calculating multidimensional estimation of the regional innovation potential; Vértesy (2014), who comprehensively analyzed the dynamics and structure of innovation in the aviation industry.

Another important subject of research was the venture capital and venture capital market. In this area, we note the works of Savaneviciene et al. (2015), Teker et al. (2016), and others. The relationship between the innovation and knowledge economy is shown in the work of Mehta et al. (2014).

In our opinion, there is a certain lack of research on a comprehensive statistical description of the venture investment market in the Russian Federation. This study is to partially eliminate this gap. Interest in this topic stimulates the deepening of the subject of research and the expansion of statistical methods.

2 Materials and Methods

The methodological basis of the study combines methods of trend, structural (vertical) and dynamic (horizontal) analysis, graphical, tabular, and other general scientific methods.

The study is based on official statistics. Their sources are the Unified Interdepartmental Information and Statistical System (EMISS), the Federal State Statistics Service (Rosstat), and the Ministry of Economic Development of the Russian Federation. Some of the data are drawn from Internet sources (for example, from ratings of independent agencies). The time series of the study is the period from 2008 to 2016.

To estimate structural shifts in the dynamics, the Ryabtsev index was calculated by the formula:

$$\mathrm{IR} = \sqrt{\frac{\sum (d2 - d1)^2}{\sum (d2 + d1)^2}},$$

where $d1$—the fraction of the side of the population in the base period; $d2$—the fraction of the side of the population in the current period.

3 Results

The general background of the venture investment market is determined by the innovation activity of the economy. It is characterized by the activity of business entities to invest in new projects. If such activity is low, then it is less likely that investors will be interested in this market.

For a more accurate quantitative estimation of the innovation market, we will draw on the state statistics that Rosstat provides us. As key indicators, we select statistical indicators—"innovation activity of organizations" and "coefficient of the invention activity".

The innovation activity is calculated as the share of organizations that carried out marketing, technological, and other innovations in the total number of organizations surveyed.

According to Table 1, the peak of the innovation activity of Russian organizations was in 2011–2012, when on average every tenth enterprise invested in innovations of various types. In general, until 2015, this figure did not undergo significant fluctuations in dynamics, which, given the sampling error, does not allow making reliable conclusions about the tendency to increase or decrease.

At the same time, according to data for 2016, we can already talk about the current trend toward a decrease in the innovation activity. And it happens on all structural elements of innovation. In the field of ecology, there is a situation when no business entity has reported on relevant innovations.

In Russia, a non-standard situation has developed—the sphere of IT technologies, which had to be at the forefront of the venture economy and technological progress, is considerably inferior to average Russian indicators of the innovation activity of organizations. This means that there are sectors of the economy in which the level of activity is higher. Such branch is, in particular, "extraction of minerals;

Table 1 Dynamics of the innovation activity of organizations in the Russian Federation

Years	2008	2009	2010	2011	2012	2013	2014	2015	2016
Innovation activity of organizations (%)	9.4	9.3	9.5	10.4	10.3	10.1	9.9	9.3	8.4
Including									
Organizational innovation	No data	No data	3.2	3.3	3.0	2.9	2.8	2.7	2.4
Marketing innovation	No data	No data	2.2	2.3	1.9	1.9	1.7	1.8	1.4
Environmental innovation	No data	No data	4.7	5.7	2.7	1.5	1.6	1.6	…
Technological innovation	No data	No data	7.9	8.9	9.1	8.9	8.8	8.3	7.3

Source Rosstat. Science and innovation. URL: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/science_and_innovations/science/#. Accessed 24 April, 2018

manufacturing industries; production and distribution of electricity, gas, and water." In it, the level of the innovation activity of organizations in the period under study exceeds 10% and in some years 11%.

At the same time, on the total costs for new technologies, the IT sphere confirms its right to be a leader in the venture market. If in 2010 it accounted for only 12.7% of the total costs for the country, then in 2011 there was a sharp jump—the share increased to 36.0%. This level is maintained even now, although the impact of the crisis in recent years is very tangible.

In addition, the IT sphere is still being kept afloat, annually increasing the volume of innovation costs. This has not been achieved in most other industries, including in the sphere of extractive and processing industries.

In the structure of the innovation activity, technological innovations predominate, although their share is gradually declining since 2012. The previous trend toward the development of environmental innovations gave way to organizational innovations. Note that the amount of shares does not lead to a total number of innovation-active organizations, since each surveyed enterprise can implement several types of innovations.

It makes sense to conduct research on the venture market when a large number of start-ups are supported by the corresponding invention activity of the population (Table 2). Let us consider the statistical indicator "factor of invention activity," which is calculated by Rosstat as the number of domestic patent applications for inventions filed in Russia, counting on 10,000 people.

This indicator in our country is highly stable in dynamics, but when compared with the leading world powers, the situation turns out to be negative. Thus, according to the WIPI in 2010 and the coefficient of the invention activity

Table 2 Dynamics of the coefficient of the invention activity in the Russian Federation

Years	2008	2009	2010	2011	2012	2013	2014	2015	2016
Coefficient of the invention activity	1.95	1.8	2.01	1.85	2.00	2.00	1.65	2.00	1.83
Rates of growth (% to the previous year)	–	−7.7	11.7	−8.0	8.1	0.0	−17.5	21.2	−8.5
Rates of growth (% to 2008)	–	−7.7	3.1	−5.1	2.6	2.6	−15.4	2.6	−6.2

Source Rosstat. Science and innovation. URL: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/science_and_innovations/science/#. Accessed 24 April, 2018

Table 3 Dynamics of volumetric performance indicators of VC funds in the Russian Federation

Years	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Amount of VC funds, mln. dollars (at the beginning of the year)	2474	2623	2898	3449	3721	4635	4361	3849	3637	3837
Number of VC funds (at the beginning of the year)	104	108	114	116	137	166	177	185	181	187
Amount of VC-investments, mln. dollars	162	124	153	272	376	285	150	150	125	…
Number of VC-investments	67	48	81	105	138	188	229	190	202	…

Source Analytical collections of RAWI (2004–2017). URL: http://www.rvca.ru/rus/resource/library/rvca-yearbook/. Accessed 24 April, 2018

(the number of international patent applications filed), Germany is the leader, which exceeds Russia by almost 50 times, and then, the USA come—they exceed Russia by more than 30 times and China by 2 times.

The authors' hypothesis is the following: The change in the innovation and invention activity in the economy correlates with the business activity in the market of venture funds (VC funds).

Table 3 shows the dynamics of volumetric performance indicators of VC funds in Russia for the period from 2008 to 2016. The starting point here is the year of the past financial crisis.

The booming of the VC Fund's activity was in a fairly prosperous period of 2010–2013. This is well illustrated by the chain (annual) rate of growth (Fig. 1). After 2013, a short-term decline in all volumetric indicators began. Statistics for 2016–2017 years gives hope for the emergence of the increasing trend.

The structure of the investment amount of VC funds in Russia is very heterogeneous in dynamics (Fig. 2). This heterogeneity is most noticeable in comparing

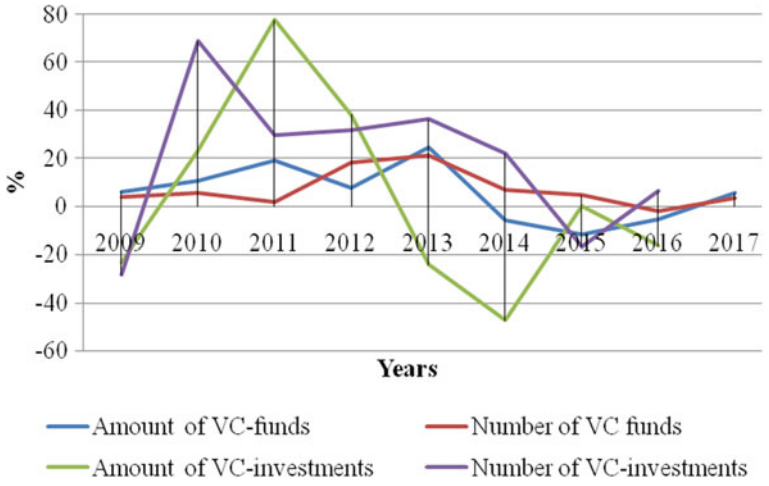

Fig. 1 Annual growth in the performance of VC funds in the Russian Federation. *Source* «Additional data to the Survey of the Direct and Venture Investment Market in Russia for the First Half of 2017»/ http://www.rvca.ru/upload/files/lib/RVCA-yearbook-I-2017-Russian-PE-and-VC-market-review-ru.pdf. Accessed 24 April, 2018

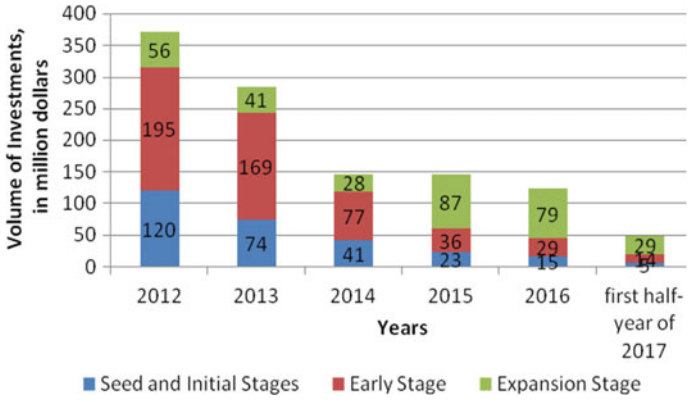

Fig. 2 Distribution of the investment amount of VC funds in the Russian Federation in 2012–2017. *Source* «Additional data to the Survey of the Direct and Venture Investment Market in Russia for the First Half of 2017»/ http://www.rvca.ru/upload/files/lib/RVCA-yearbook-I-2017-Russian-PE-and-VC-market-review-ru.pdf. Accessed 24 April, 2018

the structure of 2017 (first half) with data for 2012–2014. The values of the Ryabtsev index were more than 0.47, which indicates a significant level of structural differences. In 2015, the structure took the form that we see in later periods (the Ryabtsev index was about 0.05—this is a very low level of structural differences).

Table 4 Dynamics of the average amount of investments of VC funds in the Russian Federation

Years	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average amount of investments, mln. dollars	2.418	2.583	1.889	2.590	2.725	1.516	0.655	0.789	0.619
Rates of growth (% to the previous year)	–	6.8	−26.9	37.1	5.2	−44.4	−56.8	20.5	−21.6
Rates of growth (% to 2008)	–	6.8	−21.9	7.1	12.7	−37.3	−72.9	−67.3	−74.4

Source «Additional data to the Survey of the Direct and Venture Investment Market in Russia for the First Half of 2017» http://www.rvca.ru/upload/files/lib/RVCA-yearbook-I-2017-Russian-PE-and-VC-market-review-ru.pdf. Accessed 24 April, 2018

Changes in the structure affected all types of investments. We note a decrease in features of all venture investments in the seed (seed) and initial (start-up) stages. In 2012, the share of this type of investment reached almost one-third—32.4%, and in 2017 dropped to 10.5%. Also, investments in projects at the early stage (early) decreased significantly, from 52.5 to 29.1%. On the contrary, venture investors have become much more involved in projects during the expansion stage for these 5 years. In 2012, their share was very small—only 15.1%, but already in the current year, it reached 60.4%.

However, a more accurate performance indicator of participants in the venture investment market is the "average amount of investments" (Table 4). Its value for the decade ranged from 2.725 million dollars in 2012 to a minimum of 0.619 in 2016. The decrease was 74.4% by 2008.

As a result of the decrease in the average amount of investments attracted by the company, investors should, starting from 2013, more accurately assess projects, correctly draw up business plans and learn from Western partners.

To test the authors' hypothesis, we conducted a statistical analysis of the relationship. The indicator of the average amount of venture investments has the value of the pair correlation coefficient with the innovation activity $r = 0.714$, and with the coefficient of the invention activity $r = 0.426$.

The regression model demonstrated a direct dependence of the average amount of venture investments in the innovation and invention activity of economic entities:

$$Y = -11.64 + 2.45\,X_1 + 0.88\,X_2.$$

We will interpret the model parameters. With an increase in the innovation activity of enterprises (X_1) by 1 percentage point, the average investment amount increases by an average of $2.45 million per year with the average effect of other factors.

The increase in the coefficient of the invention activity (X_2) contributes to the growth of the level of venture investments by an average of 0.88 million dollars.

The coefficient of determination was 64.8%. This indicates a high quality of the model built.

Thus, the authors' hypothesis about the relationship between the change in the innovation and invention activity in the digital economy and business activity in the venture capital market has generally been confirmed.

4 Discussion

The development of the economy is closely connected with innovations and investments, including venture capital. The problem of venture business in Russia started in the eighties of the twentieth century, when the hope in this direction was entrusted to commercial banks. However, in the end, the situation developed in such a way that these expectations did not bring positive results. Only large-scale privatization in 1992 attracted the attention of foreign investors working in the field of venture capital.

In 1993, 11 regional venture funds were established in the Russian Federation, at the initiative of the European Bank for Reconstruction and Development. In March 1997, the Russian Venture Investment Association was established in Russia. In 2007, the first venture fund of 3 billion rubles was formed. The purpose of its creation is to attract investments in developing the company "Russian Venture Company" and the Bank "VTB 24" (Krayevsky 2011).

Venture investment is a kind of highly risky form of investing in new high-tech companies that do not have an access to the stock market yet to ensure their establishment, growth, and development in order to obtain profit in the event of a successful project. Venture fund is formed by introducing means to shareholders; then, the management company is selected, which will implement the operational management fund. Venture capital plays a special role in the sphere of small business—the most mobile segment of the economy (Berger and Udell 1998).

According to the Russian Venture Capital Association (RVCA), in recent years, the market illustrated a positive dynamics of new venture capital funds, which is associated with the activity of different initiators in creating venture capital funds (Genezis Capital, Flint Capital) (Nikkonen and Rodionov 2011).

Based on development trends of the Russian venture market in the period under review, it can be concluded that during this period skills of market participants improved, investors chose more reliable companies for investment and at each stage of financing they invested less, thereby reducing their risks. The venture industry in the Russian Federation has been gaining momentum.

The political situation in the country affected the market of venture investments in 2014–2015. Some decline in the business activity was replaced by a different

trend: Venture funds with Russian founders began to focus on foreign markets. As the reasons, it is possible to name rather low capacity of the Russian venture market and uncertainty of prospects for the economic development.

The analysis of industrial preferences of venture funds shows that it is premature to predict significant changes in the overall picture of the market in this aspect. About 55% of venture capital funds operating on the Russian market are funds investing only in the ICT sector, while only 13% are focused on the sector of real technologies (health, electronics, and chemistry).

In general, we can say that the Russian venture capital market is still quite young. Amounts of accumulated funds, amounts and number of transactions do not allow making long-term forecasts about the presence or lack of well-formed trends (Mohnacheva 2012).

The youth of this market attracts the attention of the state, which should not regulate and monitor its condition, shouldn't make development forecasts (Cydenova 2012). The estimation of the venture market indicates its gradual development, despite the crisis in the economy (Aliev 2015). For example, in 2016, Russian venture funds made 53 exits. This is more than 2 times higher than the level of 2015. The statistics confirm the growth of the Russian and global innovation market (Fazekas and Becsky-Nagy 2015). In our opinion, these facts illustrate a high innovation potential of the modern economy.

The innovation potential must be used to find ways to break the Russian economy out of the crisis. The situation with import substitution in the Russian economy is very acute. At this stage of the development, domestic industry and agriculture cannot fully meet the needs of the Russian population. In our opinion, it is not possible to achieve full import substitution, and it happens not because of limited capabilities of producers, but because there is a lack of new technologies.

The positive moment that was revealed in the course of this research was the growth of the companies' innovation activity in the Russian Federation, in particular—fundamentally new developed advanced production technologies. This suggests that the coming era of the information economy stimulates Russian business to increase the innovation activity, including in the sphere of risky projects. Extrapolation showed the continuation of this trend in coming years. The negative point is the slowdown in the pace of the innovation activity development due to the economic crisis of recent years. In addition, there is a gap between the development and implementation of innovations in practice.

5 Conclusions

This research has practical significance, because the analysis carried out can be used by the relevant government bodies when developing and adjusting the programs of the social and economic development of the Russian Federation.

This study can be continued in a spatial aspect, involving the expansion of geography. In each federal district and region of Russia, there can be features of the innovative development that require detailed study.

Thus, with due attention of the state to domestic scientists and their development, as well as with large-scale support of small business, it will be possible to say that the Russian economy will become truly innovative. This will attract additional investments (including venture capital projects), create new jobs, and improve the living standards of the population.

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Influence of Information Technologies on Production Efficiency: Estimation on the Basis of Algorithms for Machine Learning

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Abstract This contribution illustrates a brief description of information technologies as a factor of economic production. This issue is important today because there are no unequivocally recognized priority methodological approaches to estimate them against the background of the constant influence of information technologies on the economy. A methodology for obtaining a quantitative estimation of the impact of information technologies on economic production was developed and tested in the course of this study (using the example of statistical data on economic entities in Russia for the period from 2005 to 2016). This technique is based on principles of statistics and machine learning algorithms, which allow obtaining reliable results of estimates. The result of the contribution was classification models based on such machine learning algorithms as the nearest neighbors (k-nearest neighbors), logistic regression, and decision trees. This composite algorithm is able to make a decision on efficiency of one or another surveyed unit (enterprise of any type of economic activity) from the standpoint of its characteristics in the field of information technologies.

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1 Introduction

The economy, society, and information technologies are interrelated. At the global level, a serious statistical work has been carried out for some decades. The main purpose of the contribution is to estimate the development of information and communication technologies (ICT) and the intensity of their implementation in the economic and social life of the country. The statistical bodies of the United Nations reflecting the state of information and technological development in the countries of the world is the "ICT Development Index (IDI)". It characterizes various aspects of ICT development (their accessibility, the degree of use, and availability of skills in information technologies).

Based on values adopted by above index, the world can be divided into two groups of countries that differ from each other in terms of individual indicators by accessibility and use of information technologies. For the corporate sector, there are significant differences, for example, in the proportion of organizations that use computers in their activities; having broadband Internet access and websites; taking orders through a network and selling goods online. Households in these groups of countries are characterized by great differentiation in terms of penetration of wired and mobile telephony, as well as access to the broadband Internet.

These groups revealed a difference in economic indicators in order to confirm the interrelation between economic and information technologies, among which there is an average gross domestic product per capita, as well as an unemployment rate and Gini income concentration index.

There is relevance to a serious study of interconnections of economic and information technologies, and the first processes are consequences of the development of the latter ones. It is clear that it is necessary to express and analyze the laws of such interaction by constructing an appropriate mathematical-statistical model. This model should take input data on information and technological processes of the object under study and classify this object from the standpoint of its economic efficiency on the output.

The practical implementation of such a model is complicated by the fact that the decision must be made in the conditions of uncertainty about the process being analyzed. The authors analyzed the methods that are different from those ones which are traditionally used in the statistical analysis and impose a lot of restrictions on the data analyzed. These are algorithms for machine learning (Kabacoff 2013; McKinney 2011).

The analysis of information technologies in the economic context has a serious historical basis. In 1963, the German economist A. Jipp published the article "Wealth of nations and telephone density" (Jipp 1963). Analyzing the statistics of almost 120 countries of the world in 1959, Jeep constructed a graph of the dependence of telephone density on GDP per capita (later this chart was called "Jipp curve").

For many decades, the methodology for statistical analysis has been used in this area at the global and international levels and it was developed by such

organizations as International Telecommunication Union (ITU), Organization for Economic Cooperation and Development (OECD), United Nations Conference on Trade and Development (UNCTAD).

The methodology for information technology system management (IT Service Management, ITSM) based on Information Technology Infrastructure Library (ITIL) received a great deal of recognition in international practice (moreover, the Library was the basis for the development of ISO20000: 2005 quality standard, adapted in our country in the form of the standard GOST R ISO/IEC 20000 "Information technology, management of services"). However, it should be noted that the drawback of this methodology is its purely descriptive nature, which does not contain clear recommendations for calculating the statistical characteristics of analyzed processes (including the performance indicators of these processes).

The works of Abdrakhmanova et al. (2016), Gokhberg and Gaslikova (2000), Karyshev (2011, 2014), Minashkin (2014), Bakanach et al. (2016), Nath and Lirong (2017) and others are devoted to the problems of quantitative estimation of information and technological processes, in particular, their interrelations with the economy and society.

The working hypothesis is based on the fact that information (information and communication) technologies are serious economic and social factors. In other words, the development of information and communication technologies and their participation in the process of economic production directly affect its efficiency.

2 Materials and Methods

The construction of the classification model of objects by the level of their economic efficiency and based on the analysis of their information and technological indicators is presented in the form of two consecutive stages: preliminary and basic. At the preliminary stage, a system of factor indicators is formed from the sphere of information and communication technologies, and an indicator of economic efficiency is chosen as an objective characteristic. The principal components analysis (PCA) is applied to the formed system of indicators, which reduces data dimension, in order to convert a large number of initial correlated factors into a much smaller set of uncorrelated variables, which are called principal components. As a result, a new attribute space is formed—a new set of attributes that is substantially smaller in dimension than the original one, but it preserves the previous informative system of attributes.

The difficulty in choosing an indicator from the resultant subsystem of indicators is that it is necessary to identify the most relevant indicators and pass the corresponding classification marks to objects. It is logical to use clustering methods, from which the *k*-means method and the agglomeration method of hierarchical clustering were chosen.

At the main stage, algorithms for machine learning are applied to the data transferred to a new attribute space, the characteristic feature of which is not a direct solution of the problem, but fitting a set of similar tasks in the process of applying

them. The model is constructed according to the so-called marked up data, i.e., fitting sample (here, both input characteristics and output-target values are known). After that, the quality of the model is checked on a deferred, test sample.

The main task of the model is to search for such an algorithm from the whole machine learning algorithms, which best solves the problem of classification or regression recovery. In this connection, it is necessary to answer three main polls: (1) which algorithms to choose, (2) what the error functional is, and (3) what method of teaching to use.

The answer to the first question is quite obvious. As algorithms must solve the classification problem, the method of k-nearest neighbors, logistic regression, and decision tree is suitable because these are popular and reliable algorithms.

The method of k-nearest neighbors is the so-called lazy algorithm, because it does not result in any generalizing conclusions, but simply remembers the fitting sample. The meaning of the algorithm is that it assigns a class to the object to be classified, which is the most common among the k-neighbors of the given object.

Logistic regression is a special case of the generalized linear regression model and, despite its characteristic name, it is used to solve binary classification problems (with linearly shared classes). It is understandable that this statistical model is suitable for predicting the probability of the event. In our case, it is the status of economic efficiency.

The decision tree belongs to logical methods of classification and is an acyclic (i.e., with no directed cycles) graph, in which there are two types of vertices. A vertex of the first type is connected to two child vertices (this is an internal vertex), the second type is not connected to any of vertices, so it is called a leaf (terminal) vertex. In the inner vertex, there is a condition that allows deciding whether the object is to be sent to the left or to the right branch of the tree. So to classify a new case, you have to go through the tree to the leaf and get an answer.

To solve the second question—the choice of the error functional (responsible for the degree of fitting our model for real data), the researcher has the following tools:

X	space of objects,
Y	space of answers,
$x = (x^1, \ldots, x^d)$	space of features,
$X = (x_i, y_i)_{i=1}^n$	fitting sample,
$a(x)$	algorithm selected from algorithms,
$Q(a, x)$	error functional of the algorithm a on sample X.

It is logical that the purpose of the chosen algorithm, which is to minimize the functional, can be expressed this way:

$$a(x) = \arg\min_{a \in A} Q(a, X), \tag{1}$$

where A—algorithms.

The root-mean-squared error is to estimate the quality of the algorithm, since it is a smooth function and, therefore, it is differentiable:

$$Q(a, X) = \frac{1}{n}\sum_{i=1}^{n}(a(x_i) - y_i)^2. \quad (2)$$

At this stage, there is a problem to estimate functional parameters—the threshold of the third question (choosing the method of instruction). The traditional, analytical way of finding parameters is well known, and in the space of d features, it requires the matrix $d \times d$ to be reversed, which at a large value of d can be a very laborious process. To solve this problem-obtaining parameter estimates, the so-called gradient descent is applied in machine learning (which is quite logical if we recall that the gradient is a vector of partial derivatives indicating the direction of the steepest growth of the function), which is a generally accepted method for determining the optimal values of functional parameters.

At the initial stage, a certain random point with weights w_0 is taken as a starting point of the motion to a minimum. After selecting initial values of weights (they are also unknown functional parameters), a cycle is started in which new weights are calculated based on the calculation of the gradient (∇), which heuristically determines the step size η, directed to the opposite side from the gradient (since the minimum function is being searched):

$$w^t = w^{t-1} - \eta_t \nabla Q(w^{t-1,} X). \quad (3)$$

As a result, when $\left\|w^t - w^{t-1}\right\| < \varepsilon$, this cycle leads the algorithm to the minimum point. At this stage, it is considered that the algorithm has learned.

In order to simplify the calculation of weights, in addition to the usual gradient descent, which requires finding the full gradient, the so-called stochastic gradient descent is used, when calculations are performed on one object from the entire sample (a random object x_i from X is chosen for this purpose):

$$w^t = w^{t-1} - \eta_t \nabla Q\left(w^{t-1}, \{x_i\}\right). \quad (4)$$

The stochastic approach allows fitting the algorithm on large samples and gives you a number of advantages: faster execution of the step and no need to store a larger amount of computed information in the computer's memory.

Since we are developing a binary classification model (the analyzed objects are included in cost-effective and inefficient classes), the response space is transformed into a set of two labels that represent membership in two opposite classes: $Y = \{-1, +1\}$. In this case, the linear classifier will have the following form:

$$a(x) = \text{sign}\sum_{j=1}^{d+1} w_j x^j = \text{sign}\langle w, x\rangle \quad (5)$$

The quality of the algorithm for machine learning is an important factor on which it is trained. In this regard, traditionally the entire analyzed population is

divided into at least two parts—the one takes part in this fitting, and the test one is used to verify the quality of fitting. In order to make maximum use of available data, they often resort to cross-validation methods. The essence of the method is that the entire initial sample is divided into k parts, after that the model is trained using $k-1$ frequent data, and the rest of the data is used for testing. The procedure is repeated k times, as a result of which each of the k pieces of data is used for testing. In addition, other methods are used, for example, bootstrap + aggregation, when basic algorithms are learned independently from each other in random bootstrapped samples, after that their overall learning result is either averaged or determined by voting. To build the ensemble classifier, the authors use the following method.

It is logical that the interpretation of any model implies an estimation of its quality. To do this, the "quality metrics" are calculated, and they are quantitative characteristics of successful results obtained when testing developed algorithms for machine learning. So, in the case of a binary classification, the population is divided into four groups, which can be represented in the following form (Table 1):

Based on the information contained in this matrix (called the "confusion matrix"), the following quality metrics of the constructed classifier model are calculated:

Accuracy, ACC—proportion of correct results from the total number of all results:

$$\mathrm{ACC} = \frac{\mathrm{TP} + \mathrm{TN}}{\mathrm{TP} + \mathrm{TN} + \mathrm{FP} + \mathrm{FN}}. \tag{6}$$

Precision, PRE—proportion of objects that really belong to this class, in the total number of objects classified by the classifier for this class:

$$\mathrm{PRE} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FP}}. \tag{7}$$

Recall, RE—percentage of objects found by the classifier and that belong to the class, relative to all objects of this class:

$$\mathrm{TPR} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FN}}. \tag{8}$$

Table 1 Matrix of inconsistencies in distribution of the population by classes

		Actual class	
		1	0
Predicted class	1	True positive (TP)	False positive (FP)
	0	False negative (FN)	True negative (TN)

Source Compiled by the authors based on the work by Raschka (2015)

In other words, this is the proportion of positive results from all identified results (i.e., the proportion of objects correctly identified by the classifier and that belong to the class "1" in the structure of all objects that really belong to the class "1").

3 Results

The conducted study, the purpose of which was to estimate the efficiency of information technologies as a factor of economic production, made it possible to obtain a number of important results and make nontrivial conclusions.

At the preliminary stage of the analysis, the internal implicit structure of the factor subsystem of indicators was discovered as a result of using the principal component method. This allowed identifying priority individual groups of indicators in this subsystem in terms of their influence on the overall variation of values of factor characteristics. Further, it was possible to establish the composition of the most important indicators in each of these groups, which allowed them to be used as input data for classification models.

By means of methods that allow reducing dimensionality of data and detecting their hidden structure, three main components from the original feature space were identified. These components explain three-quarters of the joint variation in exponents of the factor subgroup. The results of factor analysis allowed determining these components. The factor subsystem is clearly divided into typological groups that characterize the infrastructure, software application, and cost aspects of the generated factor subsystem. The contribution to the overall variation of these groups was as follows. The largest share is costs associated with information technologies—this component explained about half (49.3%) of the total variance. The second in importance (18.7% of the explained variance) is a group of factor indicators, reflecting the use of specialized software. Infrastructure characteristics (6.1%) have the least impact.

When choosing an indicator of economic efficiency based on the cluster analysis method, the authors took into account the fact that the separation of the same population through various methods leads to a set of unique results. As a result, the conducted cluster analysis made it possible to give priority to the results obtained by the agglomeration method of hierarchical cluster analysis, before the results of clustering by the *k*-means method. Based on the results of the analysis, Ward's method and percent disagreement were recognized as the most optimal clustering parameters (the method of combining objects and the metric of measuring distances between them).

The main stage of the analysis of the impact of information technologies on the level of economic efficiency of economic entities gave the following results, allowing making statements about the successful achievement of the goal—building a model of the classifier on the basis of machine learning methods.

First of all, private algorithms for machine learning were implemented: the method of *k*-nearest neighbors, logistic regression, and decision tree. These

algorithms showed a sufficiently high quality of classification—the values of the basic quality metric for accuracy indicator of these algorithms, respectively, were 93.8 and 86%.

Further, based on the results obtained for particular basic algorithms, a transition was made to the development of their composition, which made it possible to create a composite classifier that has distinct advantages over individual partial algorithms. This classifier, which determines if this unit belongs to one of classes, is based on the principle of majority voting (the decision on membership is taken by the majority of votes by algorithms for a certain class). As a result, the received composite classifier showed a greater (in comparison with private algorithms) accuracy level—96%. This is clearly shown on the graph of ROC curves (receiver-operating characteristic). The area under curve characterizes the predictive quality of the obtained model (Fig. 1).

The composition of the analyzed set included enterprises and organizations for all types of economic activity in the context of regions of the Russian Federation. Classification of this set, according to the goals set, was carried out in several variants (based on the initial set of most significant factor characteristics, finally, based on results of the principal component method). And since the classification is carried out in a multidimensional space (n-dimensional, as a rule, $n > 3$), the visual reproduction of these results is impossible for obvious reasons, then classification results were transferred to two-dimensional space for the best visualization. The obtained variants (Fig. 2) allow stating that although their results practically coincide, fewer class boundaries are clearly different.

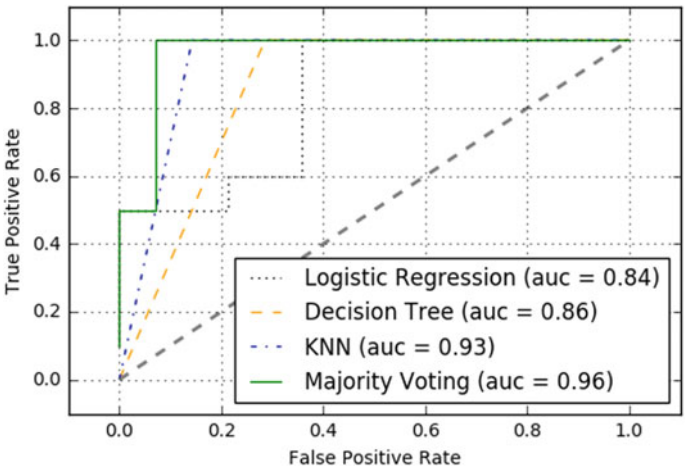

Fig. 1 Graph of the ROC-curve of learning outcomes of particular algorithms and the compositional algorithm for the classifier of economic efficiency on applying information technologies. *Source* authors' calculations on the basis of Rosstat data, https://drive.google.com/open?id=1OlXQ3dSae2yzfgu4tIK8fwO2ak7EW6uH. Accessed 2 Feb 2018

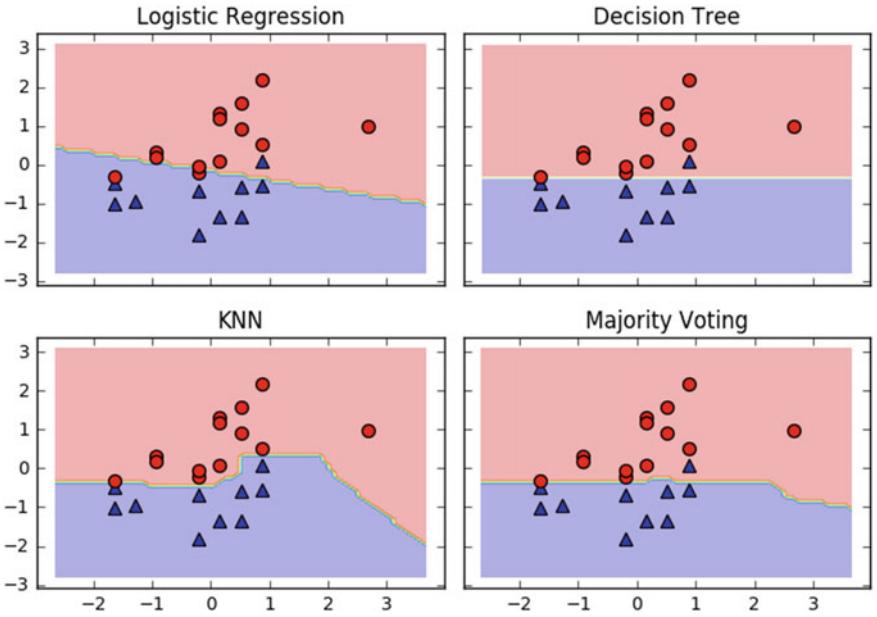

Fig. 2 Graphs of the divided and analyzed set of units into classes by using a number of particular classification algorithms, as well as the composite algorithm constructed on their basis. *Source* authors' calculations on the basis of Rosstat data, https://drive.google.com/open?id=1qsewYN38eASPY6VriYIzpeHG1Q93S_ht. Accessed 2 Feb 2018

Thus, the most precise boundary was obtained by means of the decision tree algorithm, and the most nonlinear one was obtained by the *k*-nearest neighbors method. This gives grounds to state that in the first case the algorithm is under-fitting, and in the second case, it is obviously over-fitting. The solution of this problem, known in the theory of machine learning as finding a compromise "bias-variance" was successfully achieved applying the composite approach. Accordingly, the analysis of graphs confirms the conclusion that the most practical is the composite algorithm, built on the basis of majority voting with the help of particular algorithms for machine learning.

In general, based on the analysis, it was possible to develop a methodology for constructing a classifier for the economic efficiency of economic entities in the context of information technologies they use. The results are objective and can be reproduced in the appropriate software environment (we used the Scikit-learn machine learning library of the Python programming language using other libraries of the scientific stack of this language: scipy, numpy, pandas, matplotlib).

4 Discussion

The mathematical-statistical approach to solve problems in the humanitarian sphere, as a rule, leads to a shift in the attention of the study toward the calculation of various quantitative characteristics. As a result, insufficient attention is often paid to the content side of the problem under consideration. Proceeding from this, it is quite clear that the results obtained depend to a large extent on external factors: the volume and specificity of the data, the methodology for calculating statistical indicators, and the author's approach to the choice of algorithms for constructing models.

In this context, it should be understood that the development of such a methodology to classify economic entities should not be limited by the methods considered. In the future, it is possible to build such an algorithm on the basis of a whole set of decision trees, which can be implemented in the form of the algorithm for the so-called random forest, usually comprising up to 500 trees or more.

The development of the methodology is shown in the application of other equally powerful methods of machine learning, for example, boosting, as well as methods of deep learning, implying the construction of artificial neural networks. Simultaneously, it is necessary to accumulate the amount of statistics collected and expand the set of indicators that characterize the use of information technology in economic relations. Such an approach will enable the development of classifiers with an even higher quality of predictions. However, the main condition for a high level of correct forecasts is still the presence of logic in the ongoing study.

5 Conclusions

The economic efficiency of economic entities largely depends on the level of their achievements in the field of information and communication technologies. Quantitatively, the impact of information technologies on the level of economic efficiency is possible using the appropriate analytical model or a number of models. The belonging of the analyzed object to a certain efficiency class (in the binary case —economically efficient/ineffective) is fairly successfully determined by constructing an appropriate classifier based on algorithms for machine learning. The variety of existing methods makes it possible to obtain a whole set of such classifiers and build a generalizing classifier with a higher predictive quality. The statistical methods applied to the results of machine learning provide valuable information on the influence of each of the factors included in the final classification. The convergence of the statistical approach and the approach to machine learning is capable to give a serious cumulative effect. Undoubtedly, such a compositional classifier can be applied in practical activities. In real economic conditions, its use is possible, for example, to assess the degree of innovation activity of an economic entity, one of the signs of which is a widespread use of information technologies.

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Logistics 4.0

T. E. Evtodieva, D. V. Chernova, N. V. Ivanova and N. S. Kisteneva

Abstract The modern economy is a dynamically developing system, which is characterized by the ubiquitous application of information technologies that stimulate global change. These changes are associated with the active use of robotics, additive production, cloud technologies, virtual testing, the Internet of Things, and other technological innovations, which change the principles of creating material goods, economic consciousness, the concept of organization of business processes, relations in producer–consumer coordinates and other aspects of society and business. As a result, a new economy is being formed, known as the digital economy, or Industry 4.0. Due to the fact that logistics is a sphere of economic activity and an integral functional of business structures, it becomes urgent to study changes and determine the direction of its development in the digital economy. The objective of this contribution is to develop the theory and methodology of logistic transformation in modern conditions, which will allow defining scientific and methodological approaches to the formation of strategic initiatives in the field of managing flow processes at the level of the business entity and determine priorities for their further development. The main results of the study include the allocation of characteristic features of the business activity in the interaction environment in Industry 4.0 and the analysis of their influence on logistics, determining directions of its transformation and development. As a result of the research, the following main conclusions were obtained: The main areas of logistic digitization were systematized, and the main elements characterizing the identified areas were identified.

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1 Introduction

The urgency of the studied issue is caused by significant changes in the economy which stimulated rethinking of approaches to logistic activities. In search of the best way to organize it in order to improve the profitability of assets and retain the market share, business entities are actively developing innovative approaches to build relationships with market counterparties in the process of implementing logistic functions and manifesting logistic activities in the new economic system—digital economy or Industry 4.0. As a result, development of the theory and methodology in order to transform logistics in modern conditions is an objective necessity, which will allow defining scientific and methodological approaches to the process of adaptation of logistic technologies to realities of economic life. In this regard, the research is to form a theoretical basis for making managerial decisions when implementing logistic activities in Industry 4.0 and eliminating bottlenecks in the theory of logistics in modern conditions.

2 Materials and Methods

The conceptual foundations of new conditions for conducting economic activity were considered in the works of both foreign scientists (Castels 2010; Porat 1997; Tapscott 2003; Webster 2004) and domestic scientific representatives (Avdokushin 2009; Lazarev 2005, 2015; Meliukhin 1997; Parinov 2018). The main emphasis in the presented works is made on the determination of driving forces and directions for the development of the postindustrial society and the description of technologies and methods of their application in the economy of a new type. The vectors of the logistic development are reflected in the studies of Bauersox (2001), Grigoryev (2016), Johnson (2015), Kuzins (2010), and Waters (2013), in which the main factors influencing the concept of logistics in connection with the transition of the economy to the innovative beginning, the information technologies, and the paradigm of knowledge are highlighted.

Nevertheless, it should be noted the lack of systematic consideration of logistic activities in Industry 4.0, which means that there is no unitary approaches to methodological provisions reflecting logistic transformation. In this regard, in order to eliminate methodological gaps in the theoretical interpretation of changes specific to logistics and the definition of directions for its development in the digital economy, the authors consider it relevant and timely to conduct a study of the problem concerning logistic activities in Industry 4.0.

The main research methods of logistic activities in the Industry 4.0 are general scientific methods of cognition, allowing studying conceptual provisions of logistics in the digital economy objectively and comprehensively, as well as private

experimental methods, innovative developments, including: systemic and complex approaches to study the features of logistics, dialectical method of scientific knowledge, comparative analytical, situational analysis.

3 Results

The source of long-term economic growth in modern conditions is digitalization of the economy, which has an innovative basis and essence, and is based on active automation and robotics, real-time information exchange, additive production and technologies that provide cyber-security and augmented reality. In the digital economy (or as it is called Industry 4.0), the intellectual and information potential of the society is being intensively used as the main renewable resource ensuring sustainable progressive development that allows increasing efficiency in comparison with the material production of the industrial society and, as a result, this resource has a significant influence on the dynamics of economic relation development between market actors. The prospects of the new economy are evidenced by forecasts of the leading analytical agencies of the world. According to estimates of the Global Institute McKinsey, by 2025, GDP growth will increase dramatically due to digitalization in a number of leading economies of the world. For example, in China, such an increase could reach 22%, in the USA—about 1.6–2.2 trillion US dollars, in Russia, from 19 to 34% of the total expected GDP growth (Aptekman et al. 2017).

What can digitalization bring in the economic structure? The Industry 4.0 illustrates new forms and properties of postindustrial policy that are being built on the basis of extensive informatization of the society and the practical introduction of information and telecommunications mechanisms for self-organization and harmonization of the economic system (Brown 1981; Webster 2004). Speed is becoming a key factor in the company's development under the influence of increasing accessibility of information, and it includes the speed of changes in the nature of business, the speediness of managing business processes, the dynamics of changes in the lifestyle of consumers and their requests. The duration of R&D and the timing of implementation of its results accelerated significantly, and for this reason, the life cycle of products and services is shrinking. There are shifts in innovation-active spheres of activity, characterized by a short life cycle of products. There are substitutions of material values with information, and due to this, an intensive growth of the intellectual component of produced products is ensured. In the production of high-intellectual products, the share of the information–intellectual component can reach 90% or more. According to forecasted estimates, due to the intensive development of informatics tools and the widespread introduction of new information technologies, almost 90% of the population of countries, that entered the new economy, will be engaged in the information technology sector and only 10% will be engaged in the material sphere and agriculture) (Lazarev 2015, p. 48). The studies conducted in countries with developed market relations show

that with the growth of informatization, the polarization between highly skilled labor and other categories of workers grows (Lazarev 2015, p. 48). In addition, due to the automation of work processes (by 2036 it is expected that 50% of the world's work processes will be automated), most of the mid-level staff will be released and there will be a serious gap in pay levels (Aptekman et al. 2017).

The development of the digital economy leads to a radical revision of the relationship between market participants, implementing various functions and activities in the business space, including logistics. The basis of the logistic genesis is the evolutionary theory, the postulates of which are expediency, adaptation, and self-organization. In accordance with this theory, the currently existing options for organizing logistics must perform certain activities in order to ensure legal capacity and long-term sustainability, as well as strategic development processes which include:

- Constant reorganization from within, aimed at optimizing the organizational structure of this entity;
- Company's activities have to be concentrated on the design and redesign of key business processes;
- Creation and development of special analytical services engaged in forecasting changes in the market conditions and simulating appropriate modifications of functions and activities (Avdokushin and Sukhova 2009);
- Maintenance of information transparency of mutual relations between market subjects;
- Stimulating cognitive motivation and creating a climate conducive to self-learning and developing the creative potential of specialists in the field of logistics.

It is known that any economic phenomenon and the subject of the market are in constant dynamics and evolve in accordance with specified development parameters. The subjects of logistic activities are not the exception; they have to search for qualitatively new forms of building relationships in order to adapt to modern market realities and increase the impact of joint efforts, accelerate the company's response to competition, market conditions, and consumer demands for the quality of both goods and the level of service. The subject composition in the context of this research work will be considered as a separate organization involved in bringing economic flows from the place of their generation to takeover.

While building relationships between all participants implementing logistic functions in Industry 4.0, it is necessary to take into account the following characteristic features of the genesis of the business activity in the interaction environment:

(1) The active use of new electronic means of communication leads to the formation of multi-level diverse relationships between all participants in productive and economic activities.

(2) The value of participation in Industry 4.0 increases exponentially to the number of participants in joint economic activities, which contribute to the active involvement of more and more participants in the economy.
(3) The relationship between participants in the activity should be formed taking into account the law of increasing returns, which is dominant in the digital economy. Here, the increase in the return from the results of the work performed is provided by all participants, and the effects are distributed between them. This means that increasing returns are created today by all participants through networking; they also share profits.
(4) The digital economy is characterized by a multiplicity of close ties between participants in the economic activity, which makes it behave like a biosystem. The duration of the individual organization functioning depends on the degree of the environment complementarity. A diverse, interactive, and highly flexible Industry 4.0 objectively creates the prerequisites for a permanent modification of the system (like biosystems) in order not to be in the position of "the best in the field of dying technology." The biological nature of the digital economy means that it will be absolutely common when one market participant disappears rapidly and a new one appears.
(5) The physical nature of the interaction is replaced by a virtual one. Business transactions take the form of information flows in the global information network, which increases the speed of information transfer, and business process participants receive information in a timely manner. Such a system of relationships encourages maneuverability, innovation, company, and quick response.

All designated specific aspects of Industry 4.0 are reflected in the process of organizing interaction within the framework of logistic activities. Without affecting technical and technological innovations that have had a serious impact on logistic technologies, including the methods and means used to achieve the goals and objectives of logistics, we will dwell on the changes in the system of relationships that must be taken into account when establishing and managing the relationships between logistic entities.

Logistics in Industry 4.0 should be based on the use of knowledge and skills, as well as the experience of companies in accordance with the needs of the client, which is considered as part of the value creation process, and not as a passive consumer of goods and services. As a result, the company has an opportunity to analyze key activities in terms of competitiveness and decide on the effectiveness of the transfer to the side of supporting processes. This scheme of transfer of functions is called partnership, strategic alliance, third-party logistics, and contract logistics (Johnson 2015). Each of these terms carries a semantic load, but the main thing is that absolutely independent of each other in the economic, legal, and financial terms companies enter the relationship in all schemes of transfer of logistic functions. Therefore, it can be concluded that digital economy conditions create prerequisites for the organization of a system of relationships between participants in logistic activities, combining the logic of hierarchical control and market-based, competition-based logic.

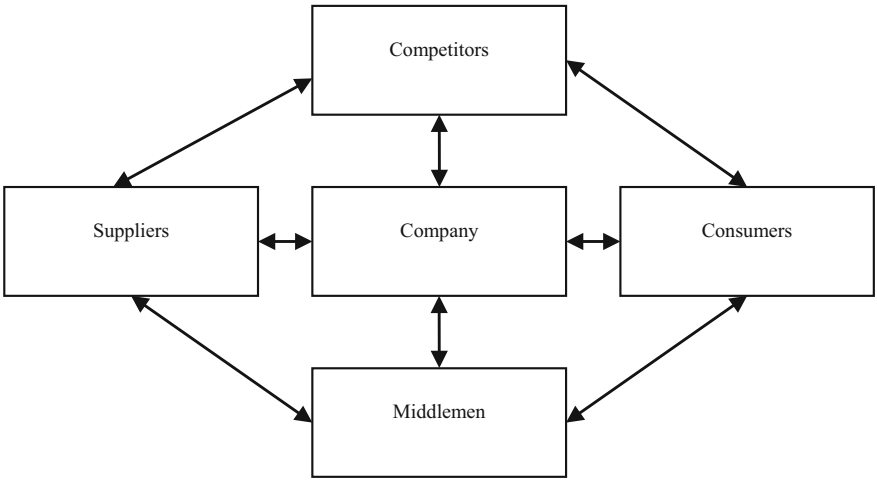

Fig. 1 Electronic digital value network. *Source* compiled by the authors based on Tapscott (2003, p. 108)

The priority role of information flows shifts the emphasis from logistic management to the information component, which provides an access to management information of all participants of logistic activities. The result is the transformation of the value chain into a value network linking suppliers, consumers, all types of intermediary structures, which is reflected in the figure (Fig. 1):

This leads to the fact that the system of relations between organizations also changes, which leads to "the emergence of new organizational structures that can not only complement existing values, but also generate new ones. Creating new values is not a linearly organized process, a new one appears in an ever-changing open network" (Tapscott 2003).

Industry 4.0 contributes to the development of a new type of organization, in which logistic activities should also be manifested. For companies of a new type, it is possible to work in real time and constantly adapt to the dynamism of the market space due to short-term information.

There are three types of organizations that have emerged in the digital economy: shell, network, and virtual organizations (Peter 1993).

Shell or hollow organizations, using the latest means of communication, create networks of third-party contractors, leaving behind management functions related to their core competencies. Network organizations realize the idea of free interconnections of their members, whose activities are aimed at performing clearly defined tasks. The activity of virtual organizations is based on the intensive use of possibilities of telecommunication technologies connecting independent contractors to solve a particular problem.

The advantages of organizations of a new type are, first of all, a low level of costs for fixed and circulating assets, as well as the ability to respond flexibly to any

changes in the external environment and technology. Consequently, the digital economy leads to an increased interest of participants in joint activities in the use of "open systems," shifting the center of interest from maximizing their own internal profits to maximizing the effectiveness of the infrastructure as a whole. The consequence is the intensive development of common standards of activities and the interest of participants in compliance with these standards (Lazarev 2005). This is explained by the fact that logistic entities are clearly aware of the need to ensure integration unity, with a highly developed information component and the idea of the conceptual partnership.

Therefore, integration in the digital economy is the basis that forms relationships between logistic entities. Integration in logistics is seen as a way to achieve competitive advantages by reaching a consensus between different market actors and, accordingly, efficient management of total costs. According to some authors, logistic integration is an essential system approach and includes the following organizational principles:

- Use the network information system;
- Control by means of exceptions;
- Design the way from the supplier to the buyer;
- Review all works in terms of customer service;
- Transfer authority, alignment of hierarchical structures;
- Change management structures;
- Plan changes.

Logistic integration allows considering the possibility to rationalize relationships of economic entities, as a result of which both the supplier and consumers simultaneously have an economic effect, both the overall efficiency of economic systems functioning and an increase in the efficiency of each participant's functioning, as well as the possibility of creating some effect for the consumer by means of price reduction.

Integration unity is presented when everyone should follow the same goal, that is, work for a common result related to the satisfaction of the identified need, and to achieve this goal it is necessary to mobilize their efforts and direct them toward coordinating activities. In logistics in the digital economy, coordination is already reduced not to a system of rigid procedures, which is characteristic of hierarchical entities, but to activities by specific participants. These activities are possible only if there are direct communication channels between relatively equal participants in integration.

The basic logistic strategy in Industry 4.0 should be a strategy of active growth, which is the only possible one for a qualitatively new approach to the business in the new environment. Its key characteristics are: increase in market shares and profits, search for new market niches, continuous improvement of labor quality and high productivity, low resource costs, flexible grouping of modular, adaptable computer-controlled equipment, accelerated response to changing market and technology needs, the minimal amount of reserves and losses, and the minimum

number of management levels. The implementation of the active growth strategy relies on diversifying companies' activities into the field of in-house logistics and is mediated by the outsourcing mechanism, which can be represented by the following groups in modern conditions:

- Production outsourcing;
- Outsourcing of business processes;
- Outsourcing of information technologies;
- Outsourcing of R&D.

The peculiarity of logistics in the digital economy is the use of system outsourcing, which allows transferring both key functions and corresponding resources to independent companies that are able to perform these functions more efficiently and productively and use the transferred resources in the interests of the customer. Inside the company, the main strategic knowledge, processes, and resources must be concentrated, and the remaining, less important processes and components are transferred to the external environment to suppliers, contractors, and other partners. System outsourcing allows putting together and using permanently and objectively limited resources of any individual company outside the system more efficiently, which helps to concentrate efforts on key competencies and ensures a rapid growth of the company's efficiency with small capital outlays and a simplified management structure.

As a result, outsourcing relationships make it possible to form global, national, and regional networked logistic entities with a variable custom structure consisting of autonomous modules that grow according to the volume of company's functions and the complexity of the tasks to be solved.

If the connection of modules takes place in a strictly specified territory, more often regional, involving the intellectual component (creators of technology, know-how) and market institutions, with the participation of the consumer and the administrative resource initiating or supporting the given education, then such organization of logistic activities has a cluster form.

The cluster form represents a highly integrated education with a powerful innovative start, the goal of which is not to increase the competitiveness of a single company but the aggregate of companies united by a technological process. The cluster makes it possible to use the competitive advantage of a region or a separate territory through the joint use of interrelated spheres of activities of common resources for them.

In the cluster form, the number of hierarchical levels is reduced, which is compensated by the structural complexity and heterogeneity of reintegrated organizational units, by the wide variety of intra-system and inter-system coordination (horizontal) links, which leads to the establishment of a higher level of cooperation and allows obtaining a synergistic interaction effect (Evtodieva et al. 2017). Therefore, it can be noted that logistics in the digital economy can be realized with a system, network, cluster form of its organization.

The application of the concept of logistics with shared responsibility is an important condition for the effective implementation of logistics in Industry 4.0, which implies achieving the maximum ratio between the benefits of the company and the costs of organizing logistics by taking into account not only the characteristics of the economic environment, but also other components of the activity, including environmental.

The pressure on logistics, associated with environmental problems, comes from both the external and internal environments. The external environment is manifested in requirements of state structures, financial institutions, public organizations at all levels of the market hierarchy—global, international, national and local, offering many rules, regulations, instructions, laws regulating the system of relationships in coordinates "business structure-society-ecology". The internal environment (staff organizational structures) has a direct impact through the development of strategic initiatives to achieve a competitive advantage and increase efficiency, not only by reducing costs, but also by reducing biophysical impacts (soil, water, and air pollution).

In this regard, business entities, developing logistic activities, focus on correct behavior in relation to the environment through the use of resource-saving technologies and environmental assessment of the impact of resource processing activities on the environment. This is also due to the fact that logistics is responsible for moving material flows through the market chain by performing transport, storage, consolidation operations and thus has close contact with the environment (McKinnon et al. 2010). The ecological component contributes to the improvement of the ecological climate and to the reduction of the anthropogenic impact of logistic activities in ecological processes. The integration basis ensuring the consolidation unity in the interaction of these components in logistics is resource-saving technologies aimed at saving all kinds of resources in case if the high quality of products remains and if these technologies allow reducing the anthropogenic impact on the environment, which contributes to increasing company's reputation assets and the efficiency of consumption and distribution of all types resources. According to experts, in the near future the use of these technologies in logistics will become as much a necessity as a quality management system" (Gromov 2014).

Eco-technologies, focused on resource-saving in relation to logistics, can be implemented through the following activities:

- Design warehouse and other buildings from environmentally friendly materials based on energy-saving technologies;
- Minimize thermal energy costs while ensuring quality preservation and loading/unloading of goods;
- Apply multi-turn packaging;
- Increase carrying capacity of vehicles;
- Provide utilization processes in the form of reverse supply chains (collection and sorting of waste, its delivery to distribution warehouses, delivery of finished products received from waste to the trading network, etc.) (Kapustina 2017).

In order to reduce the anthropogenic impact on the environment, it is advisable to rely on such productive basic technologies as reducing the distance in the transportation of goods at all stages in the chain of goods movement; increase in consumption of local resources (reduction of fuel costs and harmful emissions into the atmosphere); active use of modern environmentally friendly energy-saving vehicles.

Environmental aspects of the logistic development in Industry 4.0 when performing a separate logistic function by its participants is the automation and robotization of individual operations and processes which main goals are time-loss reduction and real-time management (EDI communications, application of drones, cloud technologies, IoT technologies, unloading, sensory logistics, etc.), which positively affect sustainability and efficiency of the business.

It should be noted that the implementation of logistic functions, taking into account eco-orientation, is based on a clear regulatory and legal regulation of their implementation, the introduction of internal corporate environmental standards by each participant in the logistic system of commodity circulation, the formation of a system of environmental performance indicators, and the conduct of an independent environmental audit of activities. The latest trend is the development of immutable standards of suppliers, affecting environmental aspects of activities.

Consequently, taking environmental standards into account requires a change in traditional approaches to the management of logistic activities, reorienting companies to the application of environmentally sound logistic technologies, giving way to green logistics. With regard to environmental issues, this means relationships between supply chain management and production activities. As a result, relationships between participants in logistic activities are regulated by the so-called life cycle contract, which implies full support of the transaction: procurement—logistic service—operation during the service life—repair—disposal of delivered goods. The advantage of such contract is the lack of gaps between design, production, and maintenance, which guarantees increased responsibility of the product manufacturer and reduces costs in the supply chain. With regard to the Russian reality, the experience of concluding such contracts is available to Russian Railways, which signed a contract with Siemens for the delivery of eight high-speed Sapsan trains and a contract for their maintenance for 30 years and the Moscow Metro Subway, purchasing 768 new wagons.

Thus, taking into consideration the general tendencies of Industry 4.0 and logistic activities of business entities, it is possible to systematize the main areas of logistic digitization and to identify the main elements that characterize this area. As scientific knowledge grows in the field of the digital economy and theoretical understanding of conceptual provisions of logistics in Industry 4.0, it is possible to update or exclude both areas and their filling. To date, the author's view on the studied definition is as follows (Table 1):

Table 1 Characteristics of the main areas forming logistics in Industry 4.0

Areas of logistic digitization	Key units
The dominant concept of logistics	– The concept of integrated logistics – The concept of shared responsibility
Factors of logistic competitiveness	Time, quality, flexibility, costs, integration, innovation, speed of reaction, forms of logistic activities
Information	– Management of large quantities of data – Full transparency of information assets – Clear structuring of data – Availability of data – Effective management of data quality
Technological innovation	– Self-driven vehicles – Complete reality – "Cloud" services – Smart transport systems – Smart warehouses – Automation and robotics – Smart sensors
Business structures where logistic activities are presented	The smart company, which includes extreme principles of resource-saving or minimalist production, combining the method of "total quality management," the timeliness ("on time") strategy and the methodology of combined product development (virtual, network, shell)
Competence of logistic entities	Key competences for each logistic entity, defined tangible and intangible assets (own technologies, reputation assets, intellectual assets)
Key strategies	– Innovative growth strategy – Strategy of a comprehensive offer of goods and services that create added value during the entire life of the service
Models of relationships between subjects of logistic activities	– Vertical – Horizontal – Conglomerate
Regulation of relationships between subjects of logistic activities	A life cycle contract that provides for the purchase of goods or works, subsequent maintenance, operation during the service life, repair, disposal of delivered goods, or the object created as a result of the work

Source Authors

4 Discussion

Many researchers have studied the evolution of logistics. However, there is no comprehensive consideration of logistic development vectors at the moment in the context of transformation of economic relations. In the works of both foreign and domestic scientists, there were factors influencing logistics as a tool for optimizing business processes. However, the researchers did not pay attention to

transformation of scientific and methodological approaches to strategic initiatives in the field of managing flow processes at the level of a business entity in the context of factors characteristic of Industry 4.0. In this regard, there are no clear priorities for the further development of logistics. The mentioned moments served as the basis for this scientific research and determined its subject, relevance, and target orientation. The presented research results do not pretend to exhaustive consideration of the problem. Its main task is to systematize the main areas of logistic digitization and identify the key elements that characterize selected areas, which will allow improving the quality of logistic management at the subject level in modern conditions in a qualitative way.

5 Conclusions

Logistic activities within the framework of Industry 4.0 require a serious rethinking and search for new approaches, methods, and technologies for their implementation. To do this, it is necessary to form a holistic view of basic conceptual provisions of logistics and the genesis of its development, taking into account the current realities of business organization. In this regard, the essential features of Industry 4.0 considered and the reflection of their influence on logistics as a scientific and practical area of activity will make it possible to approach objectively the formation of strategic initiatives in the field of flow process management at the level of a business entity and determine priorities for their further development.

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Transformation of Household Consumption in the Conditions of Transition to the Information Economy

Yu. A. Tokarev, O. V. Bakanach, N. P. Persteneva and N. V. Proskurina

Abstract Transformation of consumption caused by the information economy leads to changes in the list of durable goods purchased by households. In the first place are science-intensive and intellectual household goods. The objective of this research is to analyze statistical consumption of durable goods in the Russian Federation in the transition to the information economy. The main methods applied to the study of this problem are cluster analysis, time series analysis, the "Pattern" method, rank correlation, and descriptive statistical analysis. The largest cities in Russia (Moscow and St. Petersburg) were leaders in household consumption of durable goods. In general, the level of consumption in the country is rapidly increasing (including cars in personal use), but in the near future the country will not be able to reach the level of advanced countries in this indicator. The performed research is of practical importance and can be used by relevant government bodies when developing and adjusting the programs for socioeconomic development of the subjects of the Federation, as well as for quantifying the standard of living of the population of the territory.

1 Introduction

The development of the national economy always implies raising the level and quality of life and consumption of various goods. One of the main indicators of the quality of life in the country can be called the structure and dynamics of con-

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sumption of consumer durables, namely consumer goods with estimated life (use) for 3 years or more. The allocation of durable goods as an independent object of analysis and forecasting is associated with peculiarities of consumption and the formation of demand for them, as well as the intensive development of demand for this group of goods.

Over the past few years, there has been a significant accumulation of durable goods (cars, refrigerators, televisions, furniture, computers, etc.) in Russian households, that is, there has been a significant renovation of all home funds, and the so-called consumer pillow has been formed. The Russian Federation shows one of the highest shares of expenditures (15%) on durable goods, which certainly affects the possible scope of fluctuations in purchases in the face of economic downturns or difficulties. There is the need for socioeconomic monitoring of consumption of this category of goods, based on statistical tools, which confirms the relevance of the chosen research topic.

In addition, the relevance is justified by the fact that a qualitatively new information economy determines structural shifts in consumption and requires a qualitatively new production structure corresponding to them that is adequate to the needs of the innovative development.

The goal of the work is a statistical analysis of the population's consumption of durable goods in the subjects of the Russian Federation in the transition to the information (digital) economy.

The object of the research is the population's consumption of durable goods in the subjects of the Russian Federation.

The subject of the research is the quantitative characteristics and patterns of consumption of durable goods.

Taking into account the objective of this research, it is necessary to solve the following tasks:

- Form a system of statistical indicators characterizing the population's consumption of durable goods;
- Identify groups of regions which are homogeneous in terms of factor indicators of consumer consumption of durable goods;
- Carry out the ranking of federal districts on the population's consumption of durable goods;
- Analyze the dynamics of the number of cars per population;
- Provide a predictive estimate of the number of cars per population;

Household consumption as a whole is a long-standing subject of research by scientists from different countries. The main emphasis was on factors that produce a certain level of consumption. However, most often the structure of household consumption or consumption of food was analyzed. Consumption of durable goods (including home appliances) was restricted to a limited number of scientists.

Macroeconomic aspects and factors of household consumption in the information economy are conceptually considered in the works of I. Manakhov (Manakhov 2012, 2014). The author reveals the concept of consumption transformation as a

process of profound systemic changes manifested in transformation of consumption items, complication of consumer goods, expansion of consumer choice, diversification of consumer demand, structural shifts in consumer spending and changes in consumption patterns. The development of the information economy promotes active dissemination of the credit consumption model. This is directly related to social risks that change consumer behavior (Vasilenko et al. 2016). At the same time, the credit model can both act as a consumption driver and as its limiting factor (Dynan 2012; Nivorozhkina 2016).

The information economy transforms not only the consumption model, but also stimulates households to acquire more science-intensive and intellectual home appliances, trend that emerged more than 25 years ago (Goldsmith and Hofacker 1991; Olanrewaju et al. 2017). Accordingly, the role of younger age-groups in the selection, purchase, and maintenance of household appliances is growing—this is what R. Collins called "refocusing sustainability of households" (Collins 2015).

Many works consider the relationship between consumption and income (based on the Engel curves) and the region's competitiveness (Krasilnikova 2014; Chistik 2015; Lianyou et al. 2015; Bakanach et al. 2015), with the impact of macroeconomic shocks and effects (Abakonova et al. 2014; Muravyov et al. 2017).

Some of the research is devoted to consumption of durable goods on a particular territory. And there are few studies of this subject in Russia. Larin A. estimated the Euler equation for various utility functions, and divided current consumption into two groups—"food products" and "other goods and services." This estimation is based on a generalized method of moments based on microeconomic data from the panel survey of households "Russian Monitoring of the Economic Situation and Health of RLMS-HSE," which has been conducted for more than 20 years (Larin et al. 2015). A statistical estimate of household consumption in Russian has led to the conclusion that if consumption of food products roughly corresponds to the normal level of average developed countries, then consumption figures for durable goods (especially cars and telephones) are noticeably behind them (Krasilnikova 2014; Kholodko and Kulagovskaya 2015). In the regional context, studies by Shokumova R. and Maksimova T. (Shokumova 2014; Maksimova et al. 2015) can be noted.

At the level of other countries and territories, similar studies were conducted in Eastern Europe (Piekut 2013), in urban China (Da Zhao et al. 2017), in the UK (Bell et al. 2015; Biglia et al. 2017), in Australia using the example of Aboriginal Victoria (Bedggood et al. 2017), in Germany (Teubler et al. 2018).

A significant part of the research aims to develop a model of energy-efficient household behavior, calculating energy-saving options when replacing obsolete household appliances (Gaspar et al. 2017; Harrington et al. 2017; Mudge and Saman 2017).

Other authors are distinguished by the original, non-standard approach when determining the list of "durable goods" (Farbotko and Head 2013; Shmakov 2016).

The authors of this research believe that there is a certain lack of research on the comprehensive statistical description of household consumption of durable goods in the Russian Federation. This research is to eliminate this gap.

2 Materials and Methods

The theoretical and methodological basis of the research are the works of Russian and foreign scientists on applied statistics, econometrics, theory of market economy, social and economic theory of statistics, regional economy and statistics, computer data processing.

The information base of the research is official statistical data of the Federal State Statistics Service, as well as materials of scientific publications, periodicals, and Internet resources on the topics studied.

To process the initial information, the programs "STATISTICA 10.0" and "Microsoft Excel 7.0" were used.

The statistical tools of the study were the graphical and tabular method, absolute, relative and average values, methods of multidimensional statistical analysis, descriptive analysis.

To establish the relationship between ratings of federal districts, the authors calculated the concordance coefficient, which allowed estimating the consistency degree of ratings. This coefficient is used when it is necessary to identify the relationship between more than two of the characteristics being analyzed.

To study the dynamics and forecasting, the authors used traditional methods of the time series analysis and the extrapolation method.

To conduct multidimensional grouping, the authors used the method of the cluster analysis for 78 subjects of the Russian Federation. The cluster analysis is a multidimensional statistical procedure, the main purpose of which is to break up goods under research into groups or clusters that are homogeneous in a number of ways.

The analysis was carried out using hierarchical agglomerate and iterative methods (Ward and k-means), when you can obtain different grouping results for the same data.

Agglomerative Nesting (AGNES) is a group of methods characterized by a successive integration of original elements and a corresponding decrease in the number of clusters. Cluster elements are combined on the basis of similarity or distance between points in a multidimensional feature space. Euclidean distance is to determine the distance between goods in the study.

To classify the subjects of the Russian Federation, the initial data was standardized to eliminate the difference in the units of measurement.

The results of this method implementation are presented in the dendrogram of dividing the aggregate of regions into clusters by the Ward method, the visual analysis of which makes it possible to decide how many clusters the aggregate should be divided into.

3 Results

Consumer durables are goods with a long service life, bought for final consumption. It is assumed that the lifetime of such goods exceeds the period for which national income accounts are compiled.

As you know, the first stage of statistical research is observation. The question arises—how can statistics bodies learn about how many and what durable goods are available in Russian households. There are two possible sources of this information: sample surveys and trade turnover statistics. In addition, they are also received through the current accounting for the purchase of goods and the assessment of their disposal.

On the basis of the collected data, some indicators are calculated to assess the presence and list of durable goods, to conduct interregional comparisons and, ultimately, to characterize one of the sides of the standard of living. But in order to get correct comparisons, all indicators should be brought into the appropriate form —this means that they must be calculated, for example, per capita, per 1000 inhabitants or per 100 households.

It is quite natural that a set of durable goods cannot be fixed for a long period. If ever VCRs used to be popular in our society (their availability in the house was equated with elements of prosperity), then for almost 5 years this item is practically not needed. On the contrary, in recent years mobile phones have become a mass product. Every element of household appliances is actual and modern at its historical stage. With the expansion of scientific and technological progress and the transition to the digital economy, preference is given to more science-intensive goods, which seems quite logical.

One of the main factors affecting consumption of durable goods is per capita monetary incomes of the population. Also, consumption can be influenced by psychological factors: as a rule, they are the Keynesian "motives of consumption" (pleasure, short-sightedness, generosity, miscalculation, extravagance).

Each household has to constantly decide what part of its income to spend (to consume) today, what to put off for the future—in case of an unforeseen situation, disease, inflation, in order to save money for an expensive thing. One part is spent for current consumption, the other one is in savings.

In the Russian Federation, the list of durable goods has changed over the years as follows (Table 1).

The main factors in changing the list of goods were: technical progress, changing living conditions, increasing welfare, etc. In this list are collected goods' representatives of the level and lifestyle of the Russian family. The consumer's choice of certain long-term goods is connected with the standard scheme of human behavior as a consumer, and the scheme allows him to navigate the market of goods and services.

The authors calculated descriptive statistics for the level of consumption of durable goods by 80 subjects of the Russian Federation (Table 2).

Table 1 Comparison of the list of durable goods in the Russian Federation

2001	2005	2011	2016
TVs	TVs	TVs	TVs
Videorecorders, camcorders	Videorecorders, camcorders	Videorecorders, camcorders	Videorecorders, camcorders
Personal computers	Personal computers	Personal computers	Personal computers
Musical centers	Musical centers	Musical centers	Musical centers
Refrigerators, freezers	Refrigerators, freezers	Refrigerators, freezers	Refrigerators, freezers
Washing machines	Washing machines	Washing machines	Washing machines
Electric vacuum cleaners	Electric vacuum cleaners	Electric vacuum cleaners	Electric vacuum cleaners
Cars	Cars	Cars	Cars
Tape recorders, players	Tape recorders, players	Tape recorders, players	–
Sewing, knitting machines	Sewing, knitting machines	Sewing, knitting machines	–
–	–	Microwave ovens	Microwave ovens
–	–	Mobile phones	Mobile phones
–	–	–	Dishwashers
–	–	–	Conditioners

Source Authors, compiled according to Russian State Statistics Agency—Rosstat methodology

Table 2 Descriptive statistics on the level of consumption of durable goods by regions of the Russian Federation (units per 1000 inhabitants)

Units	Average	Median	Fashion	Min.	Max.	The coefficient of variation (%)
Cars	283.35	290.70	317.80	100.20	486.90	20.87
TVs	190.04	186.50	179.00	109.00	298.00	16.30
Camcorders	14.53	13.00	12.00	1.00	47.00	52.45
Personal computers	118.39	116.00	101.00	28.00	193.00	22.80
Mobile phones	257.20	250.00	246.00	213.00	370.00	10.61
Music centers	30.68	30.50	31.00	6.00	63.00	34.29
Refrigerators	131.09	129.00	128.00	101.00	163.00	9.95
Washing machines	100.73	100.00	99.00	74.00	118.00	5.57
Electric vacuum cleaners	95.18	96.00	95.00	68.00	108.00	6.63
Microwave ovens	76.79	79.00	84.00	5.00	95.00	16.59
Dishwashers	5.64	4.00	2.00	1.00	36.00	105.01
Conditioners	14.33	5.00	1.00	1.00	101.00	147.79

Source Authors. compiled according to Russian State Statistics Agency—Rosstat methodology

In terms of consumption, "cars" are in the first place—283 units per 1000 inhabitants. On the second place of consumption, there are "mobile phones"; their average level is 257 units. On the third place—"TVs," their average level of consumption is 190 units. The lowest consumption in our country—dishwashers, their average consumption is 6 units per 1000 population. The coefficient of variation has mainly small values, which indicates a slight variation in consumption by regions. The biggest fluctuation was noted in the group of "air conditioners." This is the item of household appliances, which is closely related to a hot climate, and in Russia a limited territory has this climate conditions.

In order to get a general idea about integrated consumption of durable goods, the authors conducted their multidimensional grouping. The analysis of interregional differences in indicators of the level of consumption of durable goods using the Pattern method revealed that the largest group was the group with "average level of consumption" of durable goods, covering 78% of the studied set of regions, including the Samara Region. The group, characterized by "high consumption," included cities of federal significance, such as Moscow and St. Petersburg, and accounted for 3% of the total. The third group with "low level of consumption" of durable goods accounted for 19% of the total number of the subjects, such as the Kursk Region, Kaliningrad Region, Voronezh Region, Kostroma Region, Astrakhan Region, Bryansk Region, Altai Republic, Mari El Republic, Chechen Republic, Tambov Region, Republic of Buryatia, Republic of Tuva, Republic of Dagestan, Republic of Ingushetia, Chuvash Republic.

Assigning ratings to each federal district by the level of consumption of durable goods, it was revealed that the leading position in almost all subjects is the Central Federal District. The middle place is occupied by the Volga Federal District. The last place was occupied by the North Caucasian Federal District, whose ratings were mainly occupied by last positions in such units as television sets, video cameras, and music centers (Table 3).

The first rank was assigned to the federal district with the lowest level of consumption.

To check the consistency of the results for each rating of durable goods, the authors calculated the concordance coefficient. The relationship between features under research is not confirmed with a 95% probability. Thus, there is no explicit statistical relationship between the ratings of the number of certain types of household appliances.

When analyzing consumption of durable goods, it is necessary to consider the number of cars per population. This commodity is defined as one of the most important one, characterizing the level of well-being.

TOP-3 by the number of own cars (per 1000 population) by federal districts in 2016: Urals—327.9, Northwestern—315, Far East—314. The outsider is the North Caucasian Federal District—219.4. On average, the country provided 283 cars per 1000 inhabitants. For comparison: in the USA, for example, there are 900 cars per thousand inhabitants, in Europe, on the average—600 cars, in China—50 cars.

For the analyzed period of time 2001–2016, there was a positive dynamics of this indicator both for the whole of the Russian Federation and for all federal

Table 3 Ratings of federal districts by the level of consumption of durable goods in 2016

Federal districts	Durable goods						
	TVs	Camcorders	Personal computers	Music centers	Refrigerators	Washing machines	Electric vacuum cleaners
Central Federal District	8	8	6	8	2	4	4
Northwestern Federal District	7	7	8	4	1	3	3
Southern Federal District	2	3	2	7	2	5	5
North Caucasian Federal District	1	1	1	1	2	1	1
Volga Federal District	4	2	3	5	5	2	2
Urals Federal District	5	4	5	5	6	7	7
Siberian Federal District	2	4	4	2	8	8	8
Far Eastern Federal District	6	6	7	3	6	5	5

Source Authors. compiled according to Russian State Statistics Agency—Rosstat methodology

Table 4 Modeling time series of the number of cars in the Russian Federation and federal districts

Territory	Trend model		R^2
Russian Federation	Linear	$y = 11.515x + 117.56$	0.991
	Parabolic	$y = 0.1647x^2 + 8.8797x + 125.02$	0.994
Central Federal District	Linear	$y = 11.431x + 136.44$	0.992
	Parabolic	$y = 0.0109x^2 + 11.605x + 135.95$	0.992
Northwestern Federal District	Linear	$y = 12.386x + 130.37$	0.988
	Parabolic	$y = -0.0462x^2 + 13.125x + 128.28$	0.989
Southern Federal District	Linear	$y = 17.383x + 37.002$	0.912
	Parabolic	$y = 0.8898x^2 + 3.1451x + 77.342$	0.947
North Caucasian Federal District	Linear	$y = 15.494x - 14.165$	0.824
	Parabolic	$y = 0.5618x^2 + 6.5053x + 11.303$	0.834
Volga Federal District	Linear	$y = 12.263x + 95.513$	0.978
	Parabolic	$y = 0.4226x^2 + 5.5001x$ 114.67	0.996
Urals Federal District	Linear	$y = 14.229x + 111.09$	0.994
	Parabolic	$y = 0.1326x^2 + 12.108x + 117.1$	0.995
Siberian Federal District	Linear	$y = 12.168x + 97.504$	0.989
	Parabolic	$y = 0.2236x^2 + 8.5898x + 107.64$	0.995
Far Eastern Federal District	Linear	$y = 11.825x + 125.5$	0.931
	Parabolic	$y = 0.7238x^2 + 0.2446x + 158.31$	0.982

Source Authors, compiled according to Russian State Statistics Agency—Rosstat methodology

districts. The number of cars per population increased by 110.5% for the Russian Federation as a whole. The greatest increase in the period under review was observed in the Southern Federal District 230.1%; the smallest increase was 96.3% in the Far Eastern Federal District.

To study the features of dynamic changes in the number of cars (per 1000 population) and the forecasting of this indicator, the authors constructed a trend model for the period under research using the analytical equalization. The choice of functions is made empirically: by comparing constructed functions with respect to the value of approximation certainty. The preference was given to functions with the largest value of the determination coefficient R^2. The results of the analytical equalization are presented in Table 4.

Since the values of determination coefficients of linear and parabolic models differ insignificantly, the linear trend model was used in the study. Considering the Russian Federation as a whole, it can be concluded that with the probability of 95%, the forecast values of the number of cars in 2018 will increase to 306–343 cars per 1000 people. In the Volga Federal District in 2018, the number of cars will be in the range from 285 to 347 cars. The results obtained are shown in Table 5.

The authors conducted a study of the fleet of cars in Russia as of January 1, 2017, which covered cities with a population of more than 1 million inhabitants. This study allowed determining the number of cars per population in major cities of

Table 5 Forecast of the number of cars per 1000 people

Territory	Point forecast, units	Interval forecast, units
Russian Federation	324.8	[306.3–343.4]
Central Federal District	342.2	[324.3–360.1]
Northwestern Federal District	353.3	[330.5–376.0]
Southern Federal District	349.9	[258.3–441.5]
North Caucasian Federal District	264.7	[143.2–386.3]
Volga Federal District	316.2	[285.3–347.1]
Urals Federal District	367.2	[347.8–386.6]
Siberian Federal District	316.5	[295.3–337.8]
Far Eastern Federal District	338.4	[283.6–393.1]

Source Authors, compiled according to Russian State Statistics Agency—Rosstat methodology

the country. On average, the country provided 283 cars per thousand inhabitants (Table 6).

The absolute leader was Samara; the number of cars was 334 units per 1000 people. That means that every third inhabitant of the city has his own car. However, the total number of cars is not so great—391 thousand units, but the population is not the largest one: 1 million 171 thousand people. On the second line was

Table 6 Number of cars per thousand inhabitants in cities of Russia with a population of more than 1 million people (as of January 1, 2017)

City	Car fleet, thousand units	Population, thousand people	Number of cars per 1000 people, units
Samara	3909	11.710	334
St. Petersburg	16.653	52.257	319
Voronezh	3184	10.324	308
Moscow	37.828	123.301	307
Kazan	3685	12.170	303
Yekaterinburg	4465	14.777	302
Krasnoyarsk	3125	10.679	293
Rostov-on-Don	3192	11.199	285
Ufa	3116	11.214	278
Nizhny Novgorod	3520	12.755	276
Novosibirsk	4331	15.841	273
Omsk	3213	11.781	273
Chelyabinsk	3204	11.920	269
Volgograd	2563	10.161	252
Perm	2465	10.419	237

Source Authors, compiled according to Russian State Statistics Agency—Rosstat methodology

St. Petersburg with 319 cars per 1000 inhabitants. Moscow is the leader in the number of registered cars—3 million 783 thousand cars, and also by the number of inhabitants—12 million 330 people. But as for the number of cars per 1000 people, this city did not hit even the top three. With an indicator of 307 units per 1000 inhabitants, Moscow took only the fourth place. At the third line of the rating was Voronezh with an indicator of 308 cars per 1000 inhabitants. Kazan had 303 cars and Yekaterinburg—302 cars, respectively. The lowest level was in Perm. There were only 237 cars per 1000 inhabitants.

The results of the multidimensional grouping of regions on factor characteristics of the number of cars per population using the cluster analysis have shown that differences in the number of consumption of cars are formed as a result of the complex interaction of economic, social, and other factors.

The cluster 1 with the best indicators affecting the number of cars per population included 14 subjects, among which the highest consumption of cars belonged to Kamchatka Territory (487 cars per 1000 population). Regions of this cluster are characterized by high values of demographic indicators and the highest level of the subsistence level. The low level of consumption of cars was in nine regions, mainly in North Caucasian Federal District (two clusters). The lowest relative number of cars was registered in the Republic of Tuva (135 cars per 1000 population). Regions of this cluster have the highest unemployment rate and the lowest monetary incomes of the population. The cluster 3 had 55 regions, including all regions of the Volga Federal District.

4 Discussion

The statistical analysis methods used in the research work allowed assessing territorial differences in consumption of durable goods. The obtained results and formulated conclusions can be useful when developing regional programs for the social and economic development of the Russian Federation.

This study can be continued both in a temporary aspect that involves comparing the countries of the European Union by years (in 2016, 2017 and subsequent years), and in a spatial one, involving the expansion of the geography of territories being compared. This analysis can help compare both the countries and some territories within them (e.g., in the cities of the Russian Federation). This will allow describing consumption of durable goods statistically in conjunction with informatization of the economy.

The analysis of dynamics can be complicated by permanent changes in the list of durable household items, so it can be carried out on a comparable range of items. The presence of cars in this analysis is also at issue. The authors consider this item to be the most significant element that directly characterizes the standard of living of the population and has a direct bearing on changing the paradigm of the economy, since it is not only an investment, but also an intellectual product (especially considering the forthcoming popularity of self-driving cars).

5 Conclusions

The tasks, set at the beginning of this research work, were successfully solved in the course of the research, namely:

(1) The process of consumption of durable goods as an object of the statistical study is considered.
(2) The analysis of interregional differences in indicators of the population's consumption of durable goods using the Pattern method revealed that the largest group was the group with "average level of consumption" of durable goods, covering 78% of the surveyed set of regions, including the Samara Region. The group, characterized by "high consumption," included cities of federal significance, such as Moscow and St. Petersburg, and accounted for 3% of the total. The third group with "low level of consumption" of durable goods accounted for 19% of the total.
(3) By assigning ratings to each federal district on the level of consumption of durable goods, the authors found out that the leading position had the Central Federal District. The middle place was occupied by the Volga Federal District. The last place was taken by the North Caucasian Federal District.
(4) In the study period of 2001–2016, there was an increasing dynamics of the number of cars per 1000 people both in the whole of the Russian Federation and in all federal districts. The number of cars per population increased by 110.5%, it is—152 cars. According to this indicator, Russia is in the middle of the world rating. On average, the country provided 283 cars per 1000 inhabitants. This is far enough both from leading countries (the USA—900 cars) and from countries-outsiders (from the developed countries there is China—50 cars). The top three cities in Russia are Samara—334 cars, St. Petersburg—319 cars, Voronezh—308 cars.
(5) Considering the Russian Federation as a whole, it can be concluded that, with a 95% probability, the forecast values of the number of cars per population in 2018 will be 306–343 cars per 1000 people. In the Volga Federal District in 2018, the number of cars will be in the range from 285 to 347 cars.
(6) The results of the multidimensional grouping of regions based on factor characteristics of the number of cars per population using cluster analysis methods have shown that the cluster 3 with the best indicators affecting the number of cars per population included 55 subjects, among which almost all regions of the Central Federal District, as well all subjects of the Volga Federal District, all subjects of the Northwestern Federal District, almost all subjects of the Siberian and Southern Federal District. The cluster 1 included 14 regions. The cluster 2 with the worst conditions for improvement the number of cars per population had the smallest number of regions—9 regions.

Thus, the analysis methods used in the work allowed taking into account territorial differences in the development of population needs and features of durable goods as an object of statistical research.

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Using Artificial Intelligence in Analyzing and Predicting the Development of Stock Prices of a Subject Company

V. Machová and M. Vochozka

Abstract Stock prices are developing very dynamically and nonlinearly. The stock price is affected by a number of factors. Stocks are therefore characterized by asymmetric volatility, non-stationarity, and sensitivity. Given these facts and the unpredictability of a global crisis, it is logical that the process of stock price prediction is a complex task. Traditional methods for price prediction are no longer enough; new applications and techniques, such as artificial neural networks, are coming to the forefront. The aim of this contribution is to analyze and predict the evolution of the stock price of Unipetrol, a.s. on the Prague Stock Exchange using artificial neural networks. Stock price data is available between January 2006 and April 2018. The data file is first analyzed. Subsequently, a total of 10,000 multilayer perceptron networks (MLPs) and a basic radial function network (RBF) are generated. A total of five neuron structures with the best characteristics are preserved. Using statistical interpretation, it is found that in practice, the MLP 1-17-1 network is applicable in one business day prediction.

1 Introduction

According to Kliestik and Birtus (2012), stocks can simply be characterized as tradable securities whose owner owns a certain share of the company's assets. Zahedi and Rounaghi (2015) state that their trading occurs on the stock market, a public market where, among other things, the stock price is also approved. The stock price issue is a relatively complex issue, since it develops very dynamically and nonlinearly. In addition, the stock price is affected by a variety of factors, such as global price indices, exchange rates, aggregate economic activity, or interest

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rates. Hašková (2017) ranks asymmetric volatility, non-stationarity, and sensitivity among the basic characteristics of the stock price.

Given the above-mentioned facts and the unpredictability of the global crisis, it is quite logical that the process of stock price prediction is a rather complex task (Zhuge et al. 2017). However, on the other hand, a successful prediction of future stock price developments can be a significant asset. Preliminary stock price is therefore one of the most important issues of stock market research, since accurate stock price prediction is the basis for deciding on financial investment and is probably the biggest challenge in capital investment. Dvořáková (2017) also notes that at present time the stock price prediction is a very important issue in the field of finance and in the future a huge potential for the whole market economy as well as the investors themselves, which will help to improve the return on equity. Koutroumanidis et al. (2011) state that the prediction of price development is a key task for investors to maximize their profits. Of course, investors want to predict the movement of stock prices, even though it is a stochastic process. Groda and Vrbka (2017) add that the stock price prediction attracts the interest of researchers and investors who make subjective investment judgments on the basis of objective technical indicators.

According to Li et al. (2016), an effective market hypothesis suggests that stock prices reflect all the information currently available and that price changes that are not based on newly discovered information are themselves unpredictable. However, some people disagree with this claim, and so a number of technologies and methods are being linked to this term to obtain information on future stock price developments.

According to Vochozka (2012), for the application of stock price forecasting, traditional methods are not enough today because they cannot be predicted and analyzed well because there are some difficulties such as slow training speed and inaccuracy of forecasting. Thus, new applications, techniques, or methods such as artificial neural networks are now at the forefront of interest. Vochozka et al. (2016) state that neural networks are very effective methods for collecting data, their analysis, and forecasting, which can solve difficult situations. Given the ability to uncover the investor's complex relationship and price fluctuation, artificial neural networks are being used to predict the company's stock prices. Artificial neural networks have the advantage that they can be used in many areas, and because of the growing amount of information and data, they are becoming more popular. In their capabilities, they are able to analyze complex patterns very quickly and with very high precision (Santin 2008).

According to Hassan et al. (2007), a great deal of research has been developed over the past few years, and studies have been developed to predict the development of stock prices, which contain many artificial neural network approaches. One such study was made by Lertyingyod and Benjamas (2016), in which they presented the predictive model of the stock price prediction through the data mining method. To the investor, this research will allow easier decision making in buying and selling the stock at the most appropriate time. The prediction concept predicts

the learning of price models that are historical, as well as behavioral indicators, and then predicts what the stock price will be in each period. Based on the results, the prediction model for the weekly (5–10 days) stock price prediction is improved due to the use of artificial intelligence or artificial neural network, where the maximum accuracy of the model is 93.89% on the 10-day forecast.

Further studies were done by Shi and Liu (2014), when they worked out the prediction method using the Eltman neural network model. The results of this method show a faster network speed, short training time, and higher accuracy. Based on Chang (2011) study on artificial neural networks, it has been found that when compared to other methods, neural networks represent a much more robust technique for forecasting stock price developments. Also worth mentioning are Yamashita et al. (2005), who demonstrated higher generalization abilities and representation in a multifunctional neural network than in a common neural network. Through the stock price in time series and other information, these networks are able to learn the price prediction of the next day.

The aim of this contribution is to analyze and predict the development of the stock price of Unipetrol, a.s. on the Prague Stock Exchange using artificial neural networks.

2 Materials and Methods

Unipetrol company is one of the most important business entities within the Czech Republic. Its business, structure, vision, and activities are described as follows (Unipetrol 2018): "Unipetrol is the most important refinery and petrochemical group in the Czech Republic and also one of the major players in Central Europe in this sector. It is the major oil refinery in the Czech Republic and also one of the most important plastic manufacturers as well as an owner of the widest network of Benzina service/petrol stations. In 2016, its sales were 87.8 bn. CZK. The Unipetrol group has been a part of the largest refinery and petrochemical Polish group PKN Orlen since 2005.

The group is divided into two segments: downstream (combining refinery and petrochemical activities) and a retail distribution of fuels. Within the downstream segment, the company runs refineries in Litvínov and Kralupy nad Vltavou.

The group is number one in the Czech wholesale fuel market. In Litvínov, the group operates an ethylene manufacturing unit with a subsequent polymers production. The Benzina petrol stations network with its 363 filling stations (on December 31, 2016) and estimated market share in the retail fuel market of 17.6% was a Czech leading company (estimation based on the data of the Czech Statistical Office in October 2016).

Within the subsidiaries PETROTRANS, s.r.o. and Unipetrol DOPRAVA, s.r.o., the group operates a wide range of transport and transportation services. Unipetrol Centre of Research and Education, a.s. and a spin-off enterprise Polymer Institute Brno are performing research and development activities in the

Table 1 Statistics of input data of data set

Statistic	Share price (output)
Minimum (training)	105.5
Maximum (training)	385
Average (training)	198.86
Standard deviation (training)	64.58
Minimum (testing)	107.5
Maximum (testing)	380
Average (testing)	195.96
Standard deviation (testing)	62.86
Minimum (validation)	106
Maximum (validation)	381
Average (validation)	199.49
Standard deviation (validation)	59.57
Minimum (overall)	105.5
Maximum (overall)	385
Average (overall)	198.51
Standard deviation (overall)	64.49

Source Authors

petrochemical field. On December 31, 2016, the group was had over 4500 employees of various professions.

The parent company of the group is Unipetrol, a.s.

Data on share prices between January 2, 2006 and April 30, 2018 are available, i.e., 3076 entries in total. The data were obtained from the Prague Stock Exchange database. They are final prices at the end of each day on which the company shares were traded in the given period. The data statistics are given in Table 1.

For data processing, DELL´s Statistica software, version 12, will be used. A tool of neural network data mining will be applied, specifically time series (by means of regression).

Multilayer perceptron networks (MLP) and radial basis function (RBF) network will be generated. Time will be independent variable, while company shares prices will be dependent variable. The time series will be divided into three sets—Training, Testing, and Validation. The first set will contain 70% of all input data. Based on the Training data set, neural structures will be generated. The two remaining data sets will contain 15% of the input data each. Both data sets are intended for the verification of reliability of the generated structure, or the model identified/found. The delay in the time series will be 1. 10,000 neural networks will

be generated, out of which 5 with the best characteristics.[1] The hidden layer will contain at least 2 but no more than 20 neurons. In the case of radial basis function, the hidden layer will contain at least 21 but not more than 30 neurons. For multilayer perceptron network, the following activation functions in the hidden and output layers will be considered:

- Linear,
- Logistic,
- Atanh,
- Exponential,
- Sinus.

Other settings will remain default (according to the ANS/ANN—automated neural networks tool). If the outputs are not adequate, the results can be corrected by adjusting weights of the individual neurons in the structure using the VNS/ONN (own neural networks) tool.

As soon as the neural networks are generated, their validity will be evaluated expertly, not only according to statistical characteristics. Due to the neural networks deficiencies (black box, possible overtraining of neural networks and some others), it can happen that the neural networks will show excellent statistical parameters, but it will not be possible to use them for real prediction. The predictions of the retained networks will be confronted. The development of share prices will be predicted for other 62 days on which the shares will be traded. However, it is necessary to realize that the prediction of the price development will probably not be accurate. Higher degree of accuracy is expected when predicting the price for the day following the input of the data.

3 Results and Discussion

Table 2 shows 5 neural networks with the best characteristics retained out of 10,000 generated structures.

The first neural network is different from the remaining ones. It is a radial basis function neural network. As Training algorithm, RBFT was used. As in the case of other retained neural networks, error function was determined using the sum of the least squares. For the activation of the neurons in the hidden layer, Gaussian function is used, while identity is used for activating the neurons in the output layer. The remaining retained neural networks are multilayer perceptron (MLP) networks. All of them were generated using the Quasi-Newton algorithm (different version for

[1]We will follow the least squares method. Networks generation will be finished when there is no improvement, i.e., there is no decrease in the sum of the squares. We will retain the neural structures whose sum of the squares residuals to the actual gold price development will be the lowest (zero in ideal case).

Table 2 Retained neural networks

	Network	Training performance	Testing performance	Validation performance	Training error	Testing error	Validation error	Training algorithm	Error function	Activation of hidden layer	Output act. function
1	RBF 1-25-1	0.987764	0.986103	0.989493	50.66039	54.57406	45.63646	RBFT	Sum of squares	Gaussian function	Identity
2	MLP 1-20-1	0.989723	0.987887	0.990214	42.60973	47.6501	42.41196	BFGS (Quasi-Newton) 733	Sum of squares	Tanh	Logistic
3	MLP 1-20-1	0.988754	0.987263	0.989342	46.7116	49.95894	45.79425	BFGS (Quasi-Newton) 584	Sum of squares	Logistic	Logistic
4	MLP 1-20-1	0.990416	0.988148	0.991166	40.30469	46.76308	38.14231	BFGS (Quasi-Newton) 1206	Sum of squares	Tanh	Logistic
5	MLP 1-17-1	0.989041	0.986828	0.989956	45.40605	51.71415	43.3042	BFGS (Quasi-Newton) 523	Sum of squares	Logistic	Logistic

Source Authors

Table 3 Performance of retained neural networks

Neural network	Share price Training data set	Share price Testing data set	Share price Validation data set
RBF 1-25-1	0.987764	0.986103	0.989493
MLP 1-20-1	0.989723	0.987887	0.990214
MLP 1-20-1	0.988754	0.987263	0.989342
MLP 1-20-1	0.990416	0.988148	0.991166
MLP 1-17-1	0.989041	0.986828	0.989956

Source Authors

each case). For the activation of the neurons in the hidden layer, two functions are used, specifically hyperbolic tangent and logistic function. For activating the neurons of the output layer, only logistic function is used.

The performance of the neural network is expressed by means of the correlation coefficient value. Correlation coefficients of all retained neural networks and all data sets are shown in Table 3.

We are looking for a specific neural network whose correlation coefficient is as close to 1 as possible. The performance of all three data sets should be similar in ideal case. This means that the structure generated by means of the Training data set is valid and verified on the other two data sets. Furthermore, the neural network should have a minimum error in all three data sets. Correlation coefficient value of all neural structures and data sets is always higher than 0.986. The differences between the individual neural networks are minimal. Therefore, the analysis of prediction statistics will be important (for further information, see Table 4).

Following the prediction statistics of the individual neural networks, it is concluded that the differences between the networks are minimum for all statistics.

The correct result can be indicated also by graphic illustration of prices and predictions development. Figure 1 shows graphical comparing of the development of actual Unipetrol shares prices and predictions calculated using all neural networks.

It follows from Fig. 1 that all neural networks were more or less precisely able to copy the actual prices development using the older data. However, at particular moments, e.g., on the 100th trading day, there was a decrease in the share prices. Those fluctuations in both directions occurred several times. The issue is thus to what extent these fluctuations are result of a turbulent environment that neither of the retained neural networks was able to illustrate. Nevertheless, despite of this fact, it can be assumed that all retained neural networks are applicable in practice.

After network training, prediction of development for the following 62 trading days was made. Figure 2 provides a detailed look at these 62 trading days.

It follows from the graph that the networks always (or almost always) predict steady development of Unipetrol share prices in a monitored period. The only network not predicting a steady development of share prices in the monitored period is network No. 5, that is, MLP 1-17-1. However, the differences in prices on

Table 4 Statistics of predictions of individual neural networks

Statistics	1.RBF 1-25-1	2.MLP 1-20-1	3.MLP 1-20-1	4.MLP 1-20-1	5.MLP 1-17-1
Minimum prediction (training)	120.1925	123.5535	119.5583	120.9355	119.4795
Maximum prediction (training)	387.5554	374.8945	384.771	385	381.3817
Minimum prediction (testing)	120.1919	123.5555	119.5586	120.9518	119.5251
Maximum prediction (testing)	387.5525	374.8302	384.6541	385	380.9729
Minimum prediction (validation)	120.2007	123.5533	119.5627	120.9459	119.4791
Maximum prediction (validation)	387.5476	374.894	384.7621	385	381.347
Minimum residues (training)	−54.031	−45.0864	−49.1901	−39.3348	−45.535
Maximum residues (training)	37.6793	49.0984	40.8764	38.1443	39.5881
Minimum residues (testing)	−56.01	−39.976	−43.0483	−38.7561	−43.9389
Maximum residua (testing)	30.1897	33.3395	38.5448	31.2415	37.5442
Minimum residues (validation)	−34.6119	−42.2136	−32.397	−35.0735	−32.8213
Maximum residues (Validation)	36.4955	48.7342	45.0962	33.3061	44.0382
Minimum standard residua (train.)	−7.5912	−6.907	−7.1972	−6.1958	−6.7575
Maximum standard residues (train.)	5.2938	7.5216	5.9808	6.0083	5.875
Minimum standard residues (test.)	−7.5818	−5.7912	−6.0904	−5.6675	−6.1101
Maximum standard residues (test.)	4.0866	4.8298	5.4533	4.5686	5.2208
Minimum standard residues (valid.)	−5.1235	−6.482	−4.7874	−5.679	−4.9876
Maximum standard residues (valid.)	5.4024	7.4832	6.664	5.3929	6.6921

Source Authors

individual days are in the order of thousandths CZK. There are rather significant differences between the individual networks predictions. At first glance, even in view of the existing price development, constant price in the monitored period of 62 trading days seems to be unlikely.

Table 5 provides a detailed look at selected cases of prediction. Specifically, it is every tenth case.

The Table shows that the second and third neural networks have exactly the same course of predictions. Specifically, it is always the minimum prediction in the given period of time. Other predictions show higher values. The Table also shows the overview of the minimum and maximum predictions of the given case. Moreover, it calculates the difference between the minimum and maximum prediction. Subsequently, this difference is compared with the maximum prediction and expressed as a percentage of difference per maximum prediction. It is thus found out that the difference between the minimum and maximum prediction is

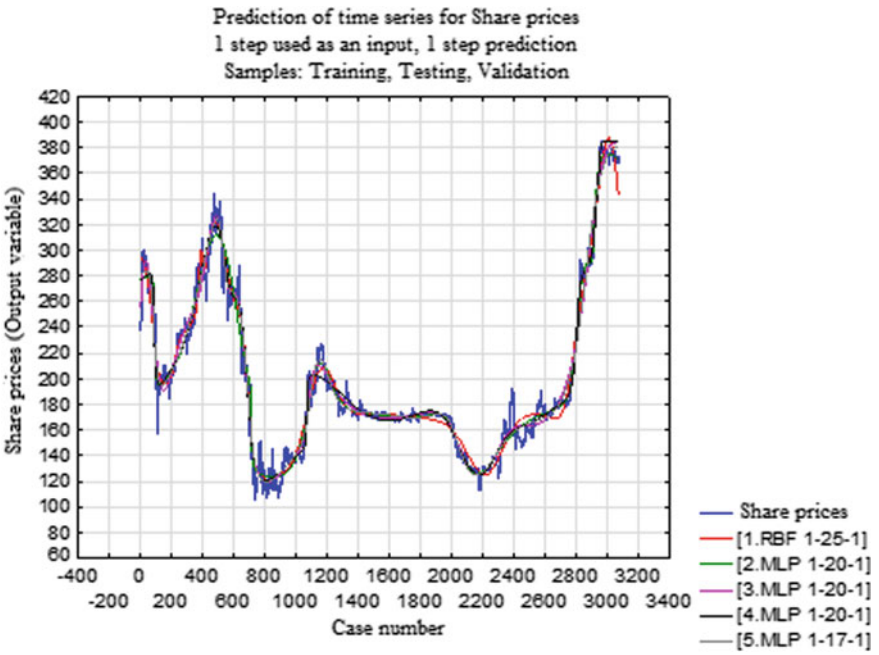

Fig. 1 Time series with a prediction for the 62 trading days *Source* Authors

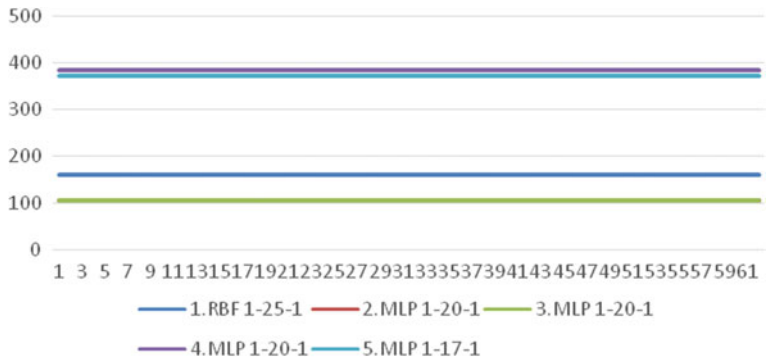

Fig. 2 Prediction for the following 62 trading days *Source* Authors

about 72.6%. It appears that the interval between the minimum and maximum prediction is too large for the purpose of future prediction. This means that the actual price can be in this range, but the value of the prediction for an investor is zero. However, if the prediction for one following day is evaluated expertly, the best one seems to be the network No. 5, i.e., MLP 1-17-1. The second best one would be network No. 4, MLP 1-20-1.

Table 5 Values of selected predictions by individual neural networks

Case	1.RBF 1-25-1	2. MLP 1-20-1	3. MLP 1-20-1	4. MLP 1-20-1	5.MLP 1-17-1	Max	Min	Difference max–min	% of the max. price (%)
10	160.364	105.5	105.5	385	371.766	385	105.5	279.5	72.60
20	160.364	105.5	105.5	385	371.7664	385	105.5	279.5	72.60
30	160.364	105.5	105.5	385	371.7667	385	105.5	279.5	72.60
40	160.364	105.5	105.5	385	371.767	385	105.5	279.5	72.60
50	160.364	105.5	105.5	385	371.7673	385	105.5	279.5	72.60
60	160.364	105.5	105.5	385	371.7676	385	105.5	279.5	72.60

Source Authors

4 Conclusions

The objective of the contribution was to predict the future development of Unipetrol share prices on the Prague Stock Exchange using neural networks.

Firstly, the data set was analyzed. Subsequently, neural networks were generated, out of which five with the best characteristics were retained. By means of statistical interpretation of the results, it was found out that for a prediction for one trading day, MLP 1-17-1 network can be applied. Although the statistical characteristics of other networks are comparable with the network No. 5, predictions made seem to be unlikely. They cannot be considered even for setting a specific interval in which the prices will range. The difference between the maximum and minimum predictions is 72.6% in relation to the maximum prediction. The difference is thus huge. The author therefore recommends testing the future results of the tool in the form of the artificial neural structure No. 5. Furthermore, the author recommends adding the prediction of the share prices for the following day into the data set and subsequently to apply the methods used again and generate new networks for further prediction. The results shall be examined with the aim to respond the question whether it is possible to predict a long-term share prices development by making a prediction only for the one following day (to sum up, for the long-term prediction, a different neural structure will be used every day). The proposed solution is complicated but possible to be implemented. Furthermore, it will be interesting to see how the results of two data sets, one of them containing 3076 and the other 3097, will differ.

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Part IV
Specific Features of the Modern Labor Market Development

Analysis of European Approaches to Improving the Life of the Population Through the Implementation of a Mechanism of Independent Assessment of Qualifications

E. P. Pecherskaya, V. V. Klimuk and T. M. Tarasova

Abstract At this moment, the staff is the most important intellectual and professional resource that ensures the socioeconomic development of the country, region, and enterprise. Every year the Russian Federation approaches the global standards of qualification assessment. Presidential Decree № 249 of April 16, 2014 established the National Council for professional qualifications under the President of the Russian Federation, which coordinates the work aimed at improving the quality of vocational education, as well as the formation of a system of independent assessment of professional qualifications. The expediency of an objective independent confirmation of a person's qualifications necessary to perform certain work or solve specific tasks is due to the dynamically changing labor market. The basis of certification is professional standards. Independent assessment of qualifications allows the employee to confirm their qualifications, skills, and competencies, thereby contributing to a higher position, improving their well-being and quality of life. This contribution deals with the European experience of joint activities of business and education in the organization and evaluation of professional competencies of employees, allowing to create optimal conditions for their inclusion in the system of continuing education. All this strengthens the role of professional communities in the development of professional qualifications, procedures for confirming compliance of the applicant's qualification with the provisions of the professional standard. The developed framework of professional qualifications is based on the results of training, and this approach allows you to structure and compare professional

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qualifications. In addition, based on the results of training, it is possible to formulate educational standards and programs of additional professional education that meet the needs of the labor market and the citizens themselves in order to improve the quality of life of the population.

1 Introduction

The strategy of socioeconomic development of the Russian Federation until 2020 sets the task of transferring the country's economy to an innovative path of development, bringing it to the path of rapid and sustainable growth on the advanced technological basis. Currently, high-quality and modern education directly contribute to the construction of a society with a highly developed digital economy. Human resources are the most important intellectual and professional resource that provides social and economic development of the country, region, and enterprise. For the success of organisations' activity there is constant need of highly qualified specialists, such as: heads of state and business structures, top managers of financial and credit organizations, managers of innovative and venture projects, experts in public procurement, IT professionals, managers of small- and medium-sized businesses, experts in the field of crisis management and many others, whose training is conducted in the system of professional education.

Presidential Decree No. 249 of April 16, 2014 established the National Council for professional qualifications under the President of the Russian Federation, which coordinates the work aimed at improving the quality of professional education, as well as bringing the Federal state standards for professional education in line with professional standards; for professional and public accreditation of professional education programs; and for the formation of a system of independent assessment of professional qualifications. In view with the adoption of the Federal law 238-ФЗ "On independent assessment of qualifications" (IAQ) on January 1, 2017, in the shortest possible period, business and education need to start working together to assess the professional competencies of workers in the sphere of economy and education, to create conditions for their inclusion in the system of continuing education, to strengthen the role of professional communities in the development of professional qualifications, to develop procedures for confirming the applicant's qualification to the provisions of the professional standard.

This should lead to an increase in the quality of vocational education and competitiveness in the labor market of persons who have passed an independent assessment of qualifications (State program of the Russian Federation "development of education" for 2013–2020, 2014).

1.1 Problem Statement

EU countries have already accumulated a positive experience of the relationship between business and education through the introduction of national systems of professional qualifications, which allowed European universities not only to significantly develop their human resources, but also to respond quickly to the ever-changing requirements of the business community in the new conditions of the digital economy (Allais 2010). The research of the experience of leading European universities will allow using the accumulated potential to promote national systems of professional qualifications, to transform it taking into account national characteristics and priorities, to fulfill the tasks in the shortest possible time, to increase the sustainable readiness of business, social environment, and universities to system interaction.

1.2 Research Questions

All qualifications frameworks are based on learning outcomes, and this approach will allow to structure and compare professional qualifications. In addition, based on the results of training, it is possible to formulate educational standards and programs that meet the needs of the labor market and citizens (Benveniste and Montoya 2016).

In all countries involved in the development of NQF, the framework is considered as part of the national qualifications framework and aims at comparability with the European qualifications framework (EQF) (Coles 2017).

The EU has adopted a European qualifications framework, which is a meta-constructor that compares and compares different national qualifications. The European qualifications framework makes it possible to correlate national labor markets with a single system of qualifications and contributes to the development of innovations in national education and training systems focused on the European educational space (Cedefop reference series; No 106. 2016, Cedefop: Defining, writing, and applying learning outcomes: a European handbook. Luxembourg: Publications Office 2017).

EQF integrates Vocational Education and Training (VET) and Higher Education (HE). Almost all European countries are reviewing their existing qualifications frameworks and updating them to ensure that they are in line with the European qualifications framework (Keevy and Chakroun 2015).

At the sixth meeting of ASEM Ministers of education in Seoul on November 20, 2017, experts from the European Training Foundation (ETF) presented a study entitled “Global inventory of regional and national qualifications frameworks”.

The two-volume publication provides an update on the national qualifications framework (NQF) worldwide. It contains information on national and regional developments as well as selected topics. This is the result of joint work between

large international research companies. This publication is the third version (the first was published in 2013 and the second in 2015) (UNESCO 2016). The next update is scheduled for 2019.

The publication summarizes, systematizes, and analyzes NQF in 100 countries on five continents. It also covers seven global/regional frameworks, including the European qualifications framework (EQF) (SAQA 2014).

The main goals, objectives, mechanisms of their implementation and assumptions, risks and preconditions of the project are presented in the logical-structural matrix.

1.3 Purpose of the Study

1. Study of the experience of leading European universities in the implementation of national systems of professional qualification.
2. Using the accumulated potential to promote national systems of professional qualification, its transformation, taking into account national characteristics and priorities.
3. Increase of sustainable readiness of business, social environment and universities for system interaction.
4. Development of methodological documentation on the interface of professional education programs and standards of professional education.
5. Creation of centers for professional development to implement the model of training or retraining of the expert community for accreditation of professional educational programs and independent qualification assessment.

2 Materials and Methods

The basic idea of independent qualification assessment is that quality (qualification—quality concept) is very difficult to measure, and it is an integral concept (Oleynikova and Muraveva 2011). However, it can be decomposed into simpler elements and build a kind of property structure. The system of such assessment (normative, sample) is based on the principle of comparison with the standard of implementation of actions.

Basic principles and methods of research:

– The measurability and active mode properties qualifications;
– The principle of comparability of the quality of competing versions of different versions of the object of the same type;
– The quality of the whole object is determined by the quality of its components;

- The principle of modularity of evaluation, which determines the feasibility of evaluation of individual properties of qualification, since each small segment of the study is characterized by more accurate results;
- The principle of expediency, ensuring the achievement of the goals of measurement and analysis of the implementation (achievement, formation, availability) of essential properties of qualification from the position of their priority need for the production process;
- The principle of comparability of the estimated qualification property and the quality of a single standard of the description of the demonstration of this property or a set of all properties;
- The principle of manufacturability, providing the possibility of evaluation procedures for a specific algorithm;
- The choice of the model of the integrated indicator, the definition of the weight coefficients of indicators, etc.

3 Results

1. The number of NQF has stabilized by about 150, but they are more developed, especially in Europe, South Africa, the Pacific, and some Asian countries.
2. Between 2015 and 2017, countries are strengthening cooperation through linkages with regional structures. In Europe, 33 of the 39 countries that participate in the EQF and are now linked to each other by these structures. In Asia introduced reference structure of ASEAN.

   By December 2017, 34 countries connected (by links) their national qualifications levels to the EQF: Austria, Belgium (Flanders and Wallonia), Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Kosovo, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, the UK (England, Scotland, and Wales). Finland will present its referral report at the December meeting of the EQF Advisory group. The rest of the countries are also expected to link their national qualification levels with the EQF in 2017–2018, which means that the first phase of EQF engagement is almost complete.

   EQF has become a source of inspiration for the development of national and regional qualification systems worldwide. An increasing number of countries and regions are seeking closer links between their qualifications framework and the EQF.

   In addition to European countries we should mention a few countries that are connected to EQF qualifications framework. For example, the EQF is now linked to the Australian qualifications framework (AQF), the New Zealand qualifications card (NZQF) and the Hong Kong qualifications framework (HKQF).

3. The NQF needs to support the qualifications framework and its four main components are common to almost all:

   – Proportional legislation;
   – Sustained engagement of stakeholders;
   – Institutional sustainability;
   – The national strategy for quality assurance.

The modern era is usually characterized by the terms «globalization» or «digital economy» . The peculiarities of this era have a serious impact on the formation of the educational system as an integral part of the common economic space (Pecherskaya and Tarasova 2018).

First, we must now focus on the formation of a fundamentally new paradigm of lifelong learning that takes into account the growing dynamism of needs, individualization of demand and opportunities to meet it.

Secondly, there must inevitably be a change in the financial model of education. The growth of personal expenses in the formation of the educational strategy of a person is increasing.

Thirdly, there is an increase in individual trajectories in education. Individual preferences are manifested not only in the choice of educational institution, but also in the individualization of the programs of the institution.

Fourthly, globalization makes competition in the international educational market inevitable for a serious educational institution. This involves the formation of international educational alliances and joint programs with different educational institutions, including foreign ones (Pecherskaya et al. 2018).

Fifth, the importance of practical orientation of education related to obtaining a set of competencies is growing. This is especially important at the present time, when there is an active promotion of national qualification systems. The introduction of the professional standarts in the field of Economics has even more serious aims of the educational program influence on the formation of new professional competencies that will enhance the competitiveness of the potential employers (Kapterev et al. 2015). Therefore, the lifelong learning of students, including even those of the “silver age”, becomes an integral feature of the modern era.

4 Conclusions

At present, Samara State University of Economics and the Financial University under the government of the Russian Federation together with the universities of the Czech Republic, Ireland and Belarus are involved in the development of the project «Global promotion of national systems of professional qualifications in education and business in the context of the positive experience of the EU» .

1. This project will achieve strategically important goals that will make it possible to make an essential step forward in the integration of international cooperation and the development of interaction between the business community and universities. Among them are:
2. Study of the positive experience of the leading EU countries in the development of national systems of professional qualifications. Analysis of the state of development of professional standards in the field of Economics and management in the EU, Russia, and Belarus.
3. Monitoring of the labor market, the emergence of new professions, changes in the names and lists of professions in the field of economy and management of the EU, Russia, and Belarus.
4. Development, application, and updating of the industry qualifications framework and qualification requirements for Russian financial market specialists in the context of the EU experience. Transfer of positive tested European practices for business and education.
5. Development of a roadmap for universities in the EU, Russia and Belarus for the modernization of curricula in the context of approved professional standards and best practices of the EU.
6. Study of the best practices of the European Union for the professional and public accreditation of educational programs and their compliance with the approved professional standards.
7. Development of the competence potential of the teaching staff of Russian universities in the framework of sustainable readiness for the implementation and modernization of curricula in accordance with professional standards.
8. Internationalization and modernization of educational programs in Russian universities based on the best practices of EU universities and optimization of interaction between universities and economic and social partners.
9. Formation of new professional competences of experts in conducting IQA, as well as in the development, validation of evaluation tools and professional examinations in the center of qualification assessment.
10. Study of the experience of universities of the advanced EU countries on system interaction with the business community and the development of regulatory and organizational documents of the IQA system of financial market specialists, as well as methodological and technological conditions of the IQA procedure.
11. Training of experts in the development, validation and application of assessment tools for independent assessment of the skills of specialists in the field of economics and management to empower them to conduct an independent assessment of skills (Salakhov 2011).

Network interaction between universities and the business community is one of the powerful resources of innovation in the market of educational services. It is the network interaction of all participants that should ensure the availability of quality education for all citizens of the country, the possibility of choice and openness of educational organizations.

Currently, Samara State University of Economics is perceived by the authorities, corporations, joint ventures, and financial and industrial groups as a reliable partner in the development of corporate knowledge, offering high-level educational services for business owners, top managers of large companies, small- and medium-sized businesses. SSEU aims to give students a full vision of the prospects of business development, to acquaint with the best international and Russian management practices, conducts advanced and problem-oriented training across the line of business education programs, including MBA level programs. The implementation of such programs is ensured by the coordinated work of the management team and teaching staff, the presence in the structure of the University of Specialized Business Schools and centers, coaches, consultants, practitioners, providing an interdisciplinary approach to learning.

Integrated networking will be possible through the creation of information portals at partner universities, designed for integrated exchange of information between authorities, businesses, citizens, and students on the basis of standardized processes of information exchange, providing a full range of services in the field of IQA for all consumers.

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Differentiation of Regional Labor Markets: New Risks and Opportunities for Smoothing

M. V. Simonova, F. I. Mirzabalaeva and L. V. Sankova

Abstract Spatial differentiation of regional labor markets in the modern economy is a reflection of its opportunities to develop and respond to local and global challenges and shocks, which determines the relevance of the study of the most significant causes based on the evaluation of various indicators. One of the most difficult problems is the regional development inequality and fundamental differences that are associated with the ability of different regions to economic growth. Sharp differentiation of regions implies the implementation of a more flexible and differentiated regional employment policy. The aim of the work is to identify issues and assess the dynamics of differentiation of regional labor markets in Russia in terms of traditional indicators. The methodological basis of the research includes a systematic approach and clustering of regional labor markets in Russia on the basis of self-organizing maps on the analytical platform Deductor. This contribution analyzes spatial differentiation of Russian labor markets. Here it is necessary to read that the authors, on the basis of the conducted research, identified from 5 to 7 groups of regional labor markets, which differ in the degree of depression and characterize the shifts between them. It is shown that labor markets of 6–7 clusters throughout 2010–2016 are relatively stable, which makes it possible to diagnose depression in regional labor markets of these clusters and the poor efficiency of employment policies. The development of regional labor markets and the alleviation of differentiation are predetermined by the regional economic system development, primarily through modernization and development of the system of jobs in traditional and innovative economic sectors (including those associated with digitalization trends).

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1 Introduction

The urgency of the issues of spatial differentiation of regional labor markets is associated with the special role of regional labor markets as system-forming parameters of the spatial economic development, reflecting its opportunities to develop and respond to local and global challenges and shocks. In recent years, the measurement of inequalities and tensions of regional labor markets have attracted increasing attention of scientists (Freedman 2015). Regional labor markets differ in the nature, productivity and efficiency of regulation, contributing to the deepening of regional inequalities in employment, unemployment, jobs and incomes. In studies of the inequality of regional markets, several blocks of sources can be identified: a study of the inequality of labor markets in regions and migration; disparities in the development of regional labor markets, wages and productivity; estimation of the inequality; problems of the inequality of individual groups, etc.

The regional inequality in the formation, functioning and development of labor markets is part of a more global problem—inequalities in the development of regions as a whole. It is connected with fundamental differences in the ability of different regions to economic growth. They, in turn, are determined by the uneven geographical distribution of fixed assets and technologies and by the characteristics of the population, labor and capital in the region (Simonova 2014). In many countries, disparities of labor markets in the regional context are higher when considering small territorial units (e.g., in Australia, the UK and the USA), whereas in other countries (particularly in Germany and Italy) differences are most evident at the level of wide formations, within which there is a relative homogeneity (Black et al. 2009). These different models of differentiation of labor markets, respectively, can give rise to various consequences from the point of view of implemented measures of state employment policy (Martin and Tarschys 2005). The emphasis should be placed on measures of structural and macroeconomic policies coordinated at the national level, where the main regional divisions are domestically, while the existence of "hotbeds of unemployment" in regions can require more specific attention to integrated programs combining local initiatives with external ones (OECD Employment Outlook 2016). The decomposition of regional variations in unemployment and employment growth indicates the existence of factors of differentiation of regional labor markets associated with competitive advantages of regions. They can cover a number of material and non-material characteristics of regions that are immeasurable parameters of labor supply, the nature and availability of innovative activity and the efficiency of institutions.

In the foreign literature, the problems of forming equilibrium in local labor markets are considered in the framework of the model of local labor markets: (Moretti 2011, 2012). In models, the distribution of labor, wages and rents are collectively determined endogenously, taking into account incentives for movement, balance in local labor markets and local real estate markets. The World Bank report 2009 (World development report 2009) shows that spatial inequalities in the modern world are formed by the following basic factors: spatial concentration of

population and agglomeration effect; economic distances and institutional barriers in the broad sense of the word, including barriers to borders that prevent the penetration of goods, services, innovations.

The problem of young people in depressed labor markets is discussed in "Youth in the labor market: past, present, future" (Furlong et al. 2017). This category of the population has great difficulties in finding a job and is a risk group in labor markets with high unemployment.

Using the example of Germany, the results of vector autoregression modeling (PVAR) show that slow adjustment processes after a region-specific demand shock for labor are a possible explanation for persistent differences in regional unemployment. Labor mobility is defined as the main mechanism for adjusting after the regional demand shock for labor. Evidence of convergence is found for regional general and highly skilled groups of employees (Werner 2013).

There is a different elasticity of employment in European countries and regions. Labor market institutions and characteristics of regional labor markets affect the speed of adjustment of regional labor markets and the elasticity of employment (Herwartz and Niebuhr 2017).

The presence of regions with high and low unemployment in the same country testifies to a low efficiency of the labor market and the irrational use of resources. Chronically low productivity in some regions limits the success rate of national employment targets (Estevão 2003).

The analysis of geographically homogeneous wages across regions with different productivity shows that the growth of employment in the public sector creates the effect of crowding out. At the same time, when the government pays wages according to local productivity, the displacement effect disappears (Caponi 2017).

The Russian labor market is characterized by a combination of serious structural problems (such as a low mobility of employees and a significant size of the shadow sector), but at the same time, by a constantly low level of unemployment in recent years (Gurvich and Vakulenko 2017) Mosaic picture of the space of the Russian labor market in the regional context is always mentioned as a characteristic feature of the national labor market.

Russian researchers consider the problems of the labor market inequality in a broader context—regional inequalities in general. In particular, Zubarevich and Safonov (2013) use the Gini index and the coefficient of variations weighted by the population of the region or the city as indicators of the socioeconomic inequality of Russian regions, which can be seen more as a consequence of the labor market efficiency in the regions.

One of approaches to the study of differentiation of regional labor markets is clustering of regions in a number of indicators. Russian sociologists A.V. Maltseva, O.V. Makhnitkina and N.E. Shilkina effectively use in their practice mathematical methods when studying the segmentation of the labor market. Their work describes in detail the methodology of the labor market clustering based on the use of self-organizing maps (Maltseva et al. 2016). The evaluation of Russian regions by the level of depressiveness of regional labor markets is given in studies by other specialists (Mirzabalaeva et al. 2016).

Despite a significant number of works, the problem of evaluation and dynamics of differentiation of regional labor markets still has poorly researched segments. It should be noted that the problem of possibilities and limitations of intergroup labor market movements with a tense situation, the efficiency of anti-crisis measures in these markets, depending on the nature of imbalances in labor supply and demand, is insufficiently developed, which significantly limits the choice of new vectors in employment policies in different groups of regional labor markets, taking into account modern trends in employment development.

2 Materials and Methods

Estimates of differentiation of regional labor markets in this study are based on self-organizing maps on the analytical platform Deductor, which allow identifying non-obvious patterns, determining relationships within and between clusters. The main problem is the definition of indicators on the basis of which differentiation and depressiveness in the labor market are determined. The array of data characterizing regions contains 4004 variables, grouped together from the above indicators. The data source is an information portal of the Federal State Statistics Service (Federal State Statistics Service 2017). Self-organizing maps allow effectively visualizing the information received, because they consist of segments of a rectangular or hexagonal shape, called cells, and use different colors according to the characteristics being analyzed, so that for each analyzed variable it is necessary to build a separate map. By the intensity of color, one can judge the situation in a particular region in the context of analyzed indicators. The study using self-organizing maps also makes it possible to identify the relationships between clusters. Thus, using self-organizing maps, it is possible to determine the relationship between clusters by a general criterion that allows us to see the grounds for maximum similarity or differences in the characteristics of the analyzed objects or processes.

The productive experience of multidimensional classification models is noted for the analysis of socio-structural specifics of Russian regions (Maltseva et al. 2015).

3 Results

The methodology used allowed determining up to 7 clusters of regional labor markets by years for the period of 2010–2016 (see Table 1). The regional codes of the Russian Federation are presented in Appendix 1. **The first cluster** was formed under the influence of such significant indicators as the average monthly total wages and employment rate taken as the main indicators in the calculation.

In the second cluster, the indicators of the average duration of job search and the proportion of unemployed people looking for work for 12 months or more were determining factors (100% significance). To defining indicators of importance,

other indicators are also close, except for the coefficient of tension and the average monthly total wage.

In the third cluster, the rating indicator of the socioeconomic regional development (99.3%) is the determining factor. The significance of the wage indicator (7.6%) is insignificant, and the indicator of the level of employment (36.5%) is of little importance. The significance of other indicators varies approximately within close limits.

In the fourth cluster, two indicators are determining (wage and socioeconomic rating).

In the fifth cluster, employment indicators are significant (99.6%), overall unemployment (99.1%) and the regional rating (93.0%), the importance of the proportion of unemployed who are looking for a job for 12 months or more is low—19.4%.

In the sixth cluster, the indicators of the employment rate, the proportion of unemployed people looking for work for 12 months or more, the average duration of job search on the labor market of the Russian Federation subjects, the socioeconomic ranking have a value equal to 100%, while the coefficient of tension on the labor market is 4.5%.

In the seventh cluster, the coefficient of tension in the labor market, the level of total unemployment (100%) and the proportion of unemployed looking for work for 12 months or more turned out to be significant, forming a cluster, the average duration of job search (99.9%), the level of employment (99.6%).

The analysis of the figure (Fig. 1) shows that the greatest dynamics of displacements is typical for regional labor markets of the second, third and fourth clusters.

The number of regions in the fifth cluster is almost the same. For the period of 2010–2015, the number of regions in the third cluster increased sharply (from 10 in 2010 to 30 in 2015), which indicates the reaction of the labor market to the social and economic crisis, the reduction of employed in the economy and the intensification of differentiation in the country's labor market. During the period under

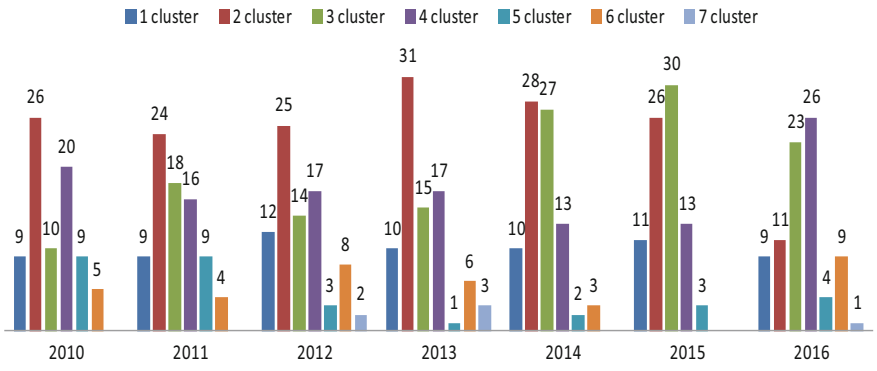

Fig. 1 Differentiation by the number of regions in clusters (*Source* Authors)

study, regions with the second, third and fourth clusters occupy the largest share. Within each cluster, it is possible to identify regions that make up the core that did not move into others (Table 1). For example, labor markets in Moscow, Magadan, Sakhalin, Khanty-Mansiysk Autonomous District-Ugra, Yamalo-Nenets Autonomous District, and Kamchatka Territory remained stable in the first cluster. St. Petersburg in 2011 and 2013, 2016 worsened its position, moving to the second group. The Republic of Sakha (Yakutia) after 2010 significantly improved its position, moving to the first group of regions-leaders. The Murmansk region moved from the first to the third cluster, which is associated with noticeable deterioration in labor market parameters.

Within the second cluster, the most sustainable positions for the period of 2010–2015 were typical for the labor markets of the following regions: the Belgorod, Irkutsk, Kaluga, Leningrad, Moscow, Nizhny Novgorod, Novosibirsk, Omsk, Rostov, Samara, Sverdlovsk, Tomsk and Chelyabinsk regions, and Krasnodar, Krasnoyarsk and Khabarovsk Territories, the Republics of Bashkortostan, Komi and Tatarstan. The situation in labor markets of the Rostov, Samara, Sverdlovsk, Tomsk, Tula and Kaluga regions, the Khabarovsk Territory, the Republic of Bashkortostan, and Tatarstan has deteriorated and they have moved to the third cluster. The Yaroslavl region in 2012, 2013 and 2014 was in the second group of regions, later moved to a less favorable third group. The Voronezh region in 2015 moved from the second cluster to the third. Perm and Primorsky Krai during the period under study moved between second and third clusters, in 2016 they finally moved to the third. It should be noted the progress in the labor market development of the Republic of Udmurt, which has significantly improved its position, having been consolidated from 2011 as part of the second cluster. The Republic of Chuvash improved its positions and moved from third to second clusters. The Omsk region moved from the second cluster to the fourth.

The third largest group of regions became the most numerous in 2015, and the fourth group in 2016, which in general characterizes the worsening of the situation in regional labor markets, despite low unemployment rates in Russia on average. The steady positions throughout 2010–2015 were in third group of labor markets of the following regions: the Altai Territory, the Amur, Astrakhan, Vladimir, Volgograd, Vologda, Voronezh, Ivanovo, Kaliningrad, Kostroma, Kurgan, Kursk, Novgorod, Orel, Penza, Saratov, Smolensk, Tver, Ulyanovsk regions, the Republics of Karelia, Mari El, Mordovia, Khakassia; the Republic of Chuvash and the Stavropol Territory. In 2015, compared to 2010, labor market positions of the Astrakhan and Vologda regions significantly improved, which moved from the fourth group to the third. The situation of the labor market of the Ryazan region deteriorated, which moved from the third group to the fourth, the Republics of Kalmykia, Buryatia, North Ossetia moved from the fourth to the sixth cluster group. At the same time, we should note the worsening of the situation in labor markets of many regions and subjects in the third group in 2015 and they moved to a less favorable fourth cluster in 2016 (in particular, the Kemerovo, Amur and Astrakhan regions, the Altai Territory, the Orel, Penza regions, the Republics of Mari El, Mordovia, Khakassia, etc.).

Table 1 Clustering of regional labor markets for 2010–2015 by the level of depressiveness using self-organizing maps

Indicators	2010	2011	2012	2013	2014	2015	2016
Number of clusters	6	6	7	7	6	5	7
Number of statistical indicators	553	560	567	581	581	581	581
Number of regions—total	79	80	81	83	83	83	83
1 cluster (Region codes: total/total weight in total number)	**9 regions (11.4%)** 77, 78, 41, 49, 51, 64, 86, 87, 89	**9 regions (11.3%)** 77, 41, 49, 51, 83, 65, 86, 87, 89	**12 regions (14.8%)** 77, 78, 41, 49, 50, 51, 83, 14, 65, 86, 87, 89	**10 regions (12.0%)** 77, 41, 49, 51, 83, 14, 65, 86, 87, 89	**10 regions (12.0%)** 77, 78, 41, 49, 83, 14, 65, 86, 87, 89	**11 regions (13.3%)** 77, 78, 41, 49, 51, 83, 14, 65, 86, 87, 89	**9 regions (10.8%)** 77, 41, 49, 83, 14, 65, 86, 87, 89
2 cluster (total/ total weight in the total number)	**26 regions (32.9%)** 31, 35, 35, 38, 40, 42, 23, 24, 47, 50, 52, 54, 55, 56, 59, 25, 02, 11, 14, 16, 61, 63, 66, 70, 27, 74	**24 regions (30.0%)** 31, 78, 38, 40, 42, 23, 24, 47, 50, 52, 54, 55, 59, 25, 02, 11, 14, 16, 61, 63, 66, 70, 27, 74	**25 regions (30.9%)** 31, 33, 34, 38, 39, 40, 42, 23, 24, 47, 52, 53, 54, 55, 02, 11, 16, 61, 63, 66, 71, 18, 27, 74, 76	**31 regions (37.3%)** 29, 31, 33, 78, 38, 39, 40, 42, 23, 24, 47, 50, 52, 54, 55, 56, 59, 25, 02, 11, 16, 61, 63, 66, 70, 71, 18, 27, 74, 76	**28 regions (33.7%)** 31, 36, 38, 40, 42, 23, 24, 47, 50, 51, 52, 54, 55, 56, 59, 25, 02, 11, 16, 61, 63, 66, 70, 71, 27, 74, 76	**26 regions (31.3%)** 29, 31, 38, 40, 43, 23, 24, 47, 50, 52, 54, 55, 59, 25, 02, 11, 16, 61, 63, 66, 70, 71, 72, 18, 27, 74	**11 regions (13.3%)** 31, 78, 43, 47, 48, 50, 52, 16, 18, 74, 21
3 cluster (total/ total weight in total number)	**10 regions (12.7%)** 22, 32, 36, 46, 48, 58, 26, 68, 69, 73	**18 regions (22.5%)** 28, 30, 33, 34, 35, 37, 39, 43, 53, 57, 58, 10, 62, 69, 71, 18, 21, 76	**14 regions (17.3%)** 22, 32, 34, 36, 46, 48, 56, 59, 25, 64, 26, 68, 70, 73	**15 regions (18.1%)** 22, 28, 32, 34, 36, 75, 46, 48, 57, 03, 13, 62, 64, 26, 68	**27 regions (32.5%)** 28, 29, 30, 33, 34, 35, 37, 39, 43, 44, 45, 46, 53, 57, 58, 10, 12, 13, 19, 62, 64, 67, 26, 69, 18, 73, 21	**30 regions (36.1%)** 22, 28, 30, 33, 34, 35, 36, 37, 39, 42, 44, 45, 46, 53, 56, 57, 58, 60, 10, 12, 13, 19, 64, 67, 26, 69, 73, 95, 21, 76	**23 regions (27.7%)** 29, 33, 35, 36, 38, 39, 40, 23, 24, 51, 54, 57, 59, 25, 02, 11, 62, 63, 66, 70, 71, 72, 27
4 cluster (total/ total weight in total number)	**20 regions (25.3%)** 28, 30, 33, 37, 39, 43, 44, 53, 57, 60, 10, 13, 19, 62, 64, 67, 71, 18, 21, 76	**16 regions (20.0%)** 22, 32, 36, 44, 45, 46, 56, 60, 04, 12, 13, 19, 64, 67, 26, 73	**17 regions (21.0%)** 28, 30, 37, 44, 45, 57, 58, 60, 03, 10, 12, 13, 15, 19, 62, 67, 69	**17 regions (20.5%)** 30, 35, 37, 43, 44, 45, 53, 58, 60, 10, 12, 15, 19, 67, 69, 73, 21	**13 regions (15.7%)** 22, 32, 79, 75, 07, 48, 60, 01, 04, 03, 08, 15, 68	**13 regions (15.7%)** 32, 79, 75, 07, 48, 01, 04, 03, 05, 08, 15, 62, 68	**26 regions (31.3%)** 22, 28, 30, 32, 35, 37, 42, 44, 46, 53, 55, 57, 58, 60, 10, 12, 13, 19, 62, 64, 67, 26, 68, 69, 73, 76

(continued)

Table 1 (continued)

Indicators	2010	2011	2012	2013	2014	2015	2016
5 cluster (total/ total weight in total number)	**9 regions (11.4%)** 79, 75, 07, 45, 01, 04, 03, 12, 15	**9 regions (11.3%)** 79, 75, 07, 48, 01, 03, 08, 15, 68	**3 regions (3.7%)** 43, 65, 21	**1 region (1.2%)** 95	**2 regions (2.4%)** 05, 95	**3 regions (3.6%)** 09, 06, 17	**4 regions (4.8%)** 01, 04, 05, 95
6 cluster (total/ total weight in total number)	**5 regions (6.3%)** 09, 05, 06, 08, 17	**4 regions (5.0%)** 0,9, 05, 06, 17	**8 regions (9.9%)** 79, 75, 07, 09, 09, 04, 08, 17	**6 regions (7.2%)** 79, 07, 09, 01, 04, 08	**3 regions (3.6%)** 0,9, 06, 17		**9 regions (10.8%)** 79, 75, 07, 09, 45, 03, 08, 15, 17
7 cluster (total/ total weight in total number)			**2 regions (2.5%)** 05, 06	**3 regions (3.6%)** 05, 06, 17			**1 region (1.2%)** 06

Source Authors on the basis of data from Federal Service of State Statistics, Regions of Russia and Social Social Economic Indicators (2017)

Throughout 2010–2016, the share of regions in the fifth cluster decreased (from 9 regions to 4 regions). At the same time, in 2015 the state of labor markets of the Republic of Karachay-Cherkess, the Republic of Ingushetia and the Republic of Tyva improved. They moved from the sixth cluster (which was in 2010–2014) to the fifth, characterized by more favorable labor market parameters. The Republic of Chechen moved to the third cluster of regions. In this cluster, there are the Republic of Adygea, the Altai Territory and the Republic of Dagestan (with four clusters) with a worsening situation. However, in 2016 the situation in most of regions included in this cluster worsened, a hundred transferred to outsiders (the Republics of Tyva and Ingushetia into the seventh cluster, the Republic of Karachay-Cherkess into the sixth cluster).

In 2016, the sixth cluster got nine regions that moved to this cluster from the more prosperous third, sixth and fifth clusters (the Jewish autonomous region, the Transbaikal region, the Republic of Kabardino-Balkaria, the Republic of Karachay-Cherkess, the Kurgan region, the Republic of Buryatia, the Republic of Kalmykia, the Republic of North Ossetia-Alania, the Republic of Tyva).

The most problematic are depressed labor markets of the seventh group. In 2012, there were only two regions in the group (the Republic of Dagestan and the Republic of Ingushetia). In 2013, there were already 3 regions (the Republic of Dagestan, the Republic of Ingushetia and the Republic of Tyva), which already in 2014 moved to the sixth group, improving their positions. However, in 2016, in the seventh cluster got the Republic of Ingushetia, which moved from the fifth cluster, which was more prosperous in terms of labor market parameters. In the sixth and seventh clusters, as a rule, the unemployment rate among Russian youth and other socially unprotected groups of the population is especially high.

The upward intergroup shifts in regional labor markets indicate an improvement in key indicators of labor market functioning, which indicates the available potential for smoothing imbalances.

The peculiarities of the regional labor market development in modern conditions are: the localization of labor markets (the territorial concentration of production in megacities and the emergence of zones of gravitation labor pendulum migration), the differentiation of labor markets, the spread of precarization. The analysis of groups of regional labor markets shows that crisis situations at the regional level are formed both under the influence of macroeconomic processes and due to peculiarities of the regional development, its resource potential, the speed of progress toward a balanced structure, the efficiency of labor market institutions, participation in the national division of labor, etc.

The analysis showed that the differentiation of regional labor markets is stable in the time range. The composition of groups with the most favorable situation in labor markets and with the depressed situation and outsiders on key labor market parameters is changing little in 2010–2016.

In 2016, the following regions are classified as territories with a tense situation in the labor market: the Republics of Karelia, Adygea, Kalmykia, Dagestan, Ingushetia, Kabardino-Balkaria, Karachay-Cherkess, Alania, Chechen, Altai, Buryatia, Tyva, Khakassia; the Kurgan, Irkutsk, Kemerovo regions and the Jewish Autonomous District; the Altai and Transbaikal Territories (Order of the Ministry of Labor and Social Protection of the Russian Federation 2017).

Anti-crisis measures are implemented in labor markets of specific territories, taking into account the specific functioning of regional economic systems and factors determining the development of regional labor markets. These measures are quite high cost due to high coverage and variety of forms), which actualizes the need to optimize costs.

The problems of the formation of employment policy in the context of global and local challenges are considered in detail by a group of authors (Mirzabalaeva et al. 2016).

The appeal to the analysis of youth labor markets in regions shows that, for example, in 2016, compared to 2008, the unemployment rate of youth aged 20–29 years increased in the following regions: the Vladimir, Ivanovo, Tver, Tula, Vologda, Novgorod, Kirov, Samara, Chelyabinsk, Magadan, Sakhalin, Murmansk, Orel, Astrakhan regions, the Krasnodar Territory, the Republic of Mordovia, etc. The improvement in the indicator of youth unemployment for the indicated period is noted in the following regions: the Penza region, the Republic of Tatarstan, the Republic of Mari El, the Republic of Mordovia, the Republic of Chuvash, the Perm Territory, the Nizhny Novgorod, the Novosibirsk region, the Kemerovo region, the Kaliningrad region, the Volgograd region, the Kamchatka Territory, the Primorsky Territory, the Khabarovsk Territory, the Arkhangelsk region, the Republic of Karelia, etc. As a positive trend, we can note the growth in the number of regions with the level of youth unemployment of 6.1—10%, the reduction of regions with youth unemployment rate of 15.1—20%. At the same time, the structure of the group of regional labor markets with high youth unemployment rates changed little.

4 Discussion

Researchers (Gimpelson and Roshchin 2017) distinguish the following clusters of regions: the "northern" regions (the Chukotka Autonomous District, the Magadan region, the Yamalo-Nenets Autonomous District, the Khanty-Mansi Autonomous District, the Murmansk region) and conditionally Central European regions (Moscow and St. Petersburg, the Moscow and Yaroslavl regions) with well-functioning labor markets) outsider regions are a group of southern republics (the Republics of Dagestan, Ingushetia, Karachay-Cherkess and Kabardino-Balkaria, and the Republics of Kalmykia, North Ossetia and Adygeya are also close to them) and regions of Southern Siberia (the Republics of Tyva, Transbaikal, Altai, Altai edge, and the Jewish Autonomous District, the Republics of Buryatia and Khakassia, the Irkutsk region are close to them in a number of indicators). The results noted generally coincide with the clusters obtained by the authors.

The case study of the country shows that the methodology of employment policy and labor market anti-crisis measures has evolved over the past decades in the search for reserves of efficiency gains, individualization, sophistication, flexibilization, differentiation, revitalization, partnerships (Card et al. 2009; Coe and Snower 1997).

In all countries with economies in transition, large and persistent regional differences develop in the labor market, and there is some evidence of polarization. Thus, the policy should have a long-term perspective on existing regional imbalances, focus on eliminating barriers to mobility, review existing institutions for implementing regional policies and aim at closely coordinating regional labor market policy instruments (Rutkowski 2006).

A major role in smoothing disproportions in the regional labor market development is played by the national employment policy, the rigidity of labor market institutions. Thus, studies show that the impact of the labor market rigidity on the labor force is determined by three important components: social security spending, public spending on active labor market programs and passive labor market measures (Parisi 2017).

The analysis of the efficiency of employment policies in the spatial context shows that differences in labor productivity and sectoral contribution to employment and output by industry categories play a key role in explaining policy responses (Epstein and Shapiro 2017). Research shows that social benefits of creating jobs are two or three times more per job in depressed local labor markets than in more rapidly developing local labor markets (Bartik 2014).

In future studies, we propose to pay attention to the following urgent problems: to investigate the general and specific features of regions in clusters; to analyze the peculiarities when implementing employment policy in regions united into single clusters; to determine the direction of increasing the efficiency of regional employment policies in order to reduce differentiation in regional labor markets; to justify the possibility of creating additional jobs in digitalization of the country's

economy as a whole; to study the influence of "disappearing" professions and jobs on the formation of popular competencies in regional labor markets; to evaluate the efficiency of measures of active employment policies, taking into account highly differentiated regional labor markets and taking into account strategic risks; to study the impact of digitalization on overcoming disproportions of regional labor markets in various market segments, etc.

Turning briefly to the "digital profile" of disproportions in regional labor markets, we note that differentiation of regions by the number of personal computers per 100 employees determines different "digital profiles" of employment. Thus, in the Central Federal District in 2016 this indicator was 39 in the Bryansk region and 77 in Moscow; in the North-West Federal District—42 in the Leningrad region and 59 in St. Petersburg. In the Volga Federal District, the maximum value of the indicator was observed in the Samara region (59), and the minimum value in Orenburg (42); in the Urals region, the maximum value was noted in the Tyumen region (50); in the Siberian Federal District, the maximum value of this indicator for the Russian Federation was observed in the Tomsk region (60), and the minimum was recorded in Kemerovo (36). In the Far Eastern Federal District, there were 47 personal computers in the Chukotka Autonomous District for 100 employees, and in the Magadan region—56 (Regions of Russia and SocioEconomic Indicators 2017). Digitalization of the economy forms new challenges and risks for regional labor markets, which must be taken into account when developing and implementing employment policies. "Digitalization" changes the way employees access knowledge and information capacity of their work activities, transforms production and consumption processes in regions in different ways.

5 Conclusions

So, the hypothesis put forward by the authors has proved its objectivity in practice and using self-organizing maps it is possible to cluster regions according to the level of differentiation, and on its basis to monitor the situation on the labor market and formulate regional employment policy. This approach avoids the influence of the subjectivism of the researcher, escapes from the mechanical ranking of regions into groups. Regional labor markets are differentiated on the basis of seven indicators, which reflect the complex nature of differentiation in the labor market development.

Thus, the stable composition of clusters of regions in the time range under study indicates the inefficiency of traditional market smoothing mechanisms, including migration, capital transfer, trade and diffusion of innovation. Territorial differences in the state of labor markets, in the opinion of researchers, are largely "programmed" and depend on inherited characteristics of regions (demographic, structural, reproductive, institutional). Market reforms have strengthened the advantages and aggravated the defects of the existing territorial inequality of labor market conditions.

The stability and complexity of interregional differences presupposes the development of non-fragmentary anti-crisis measures, but a strategic and integrated approach to smoothing differentiation through, including budget regulation instruments, effective use of human potential and innovative development of territories.

Differentiation of labor markets and their willingness to digitize the regional economy are determined by diverse factors. The most significant at the present stage are factors of economic and institutional order that determine opportunities for generating workplaces in regions, the development of new sectors, the digitization of employment, the institutionalization of new labor practices, the formation of "protected flexibility" institutions in the labor market, the development of a competent component of the workforce, the search for new formats of interaction of social partners in labor markets, linking to regional anchors of monetary standards with a more complete account of local conditions.

Appendix 1

Codes of regions of the Russian Federation

Code	Subject of the Russian Federation
01	Republic of Adygea
02, 102	Republic of Bashkortostan
03	Republic of Buryatia
04	Republic of Altai (Gorny Altai)
05	Republic of Dagestan
06	Republic of Ingushetia
07	Republic of Kabardino-Balkaria
08	Republic of Kalmykia
09	Republic of Karachay-Cherkess
10	Republic of Karelia
11	Republic of Komi
12	Republic of Mari El
13, 113	Republic of Mordovia
14	Republic of Sakha (Yakutia)
15	Republic of North Ossetia-Alania
16, 116, 716	Republic of Tatarstan
17	Republic of Tyva
18	Republic of Udmurt
19	Republic of Khakassia
21, 121	Republic of Chuvash
22	Altai Territory
23, 93, 123	Krasnodar Territory
24, 84, 88, 124	Krasnoyarsk Territory

(continued)

(continued)

Code	Subject of the Russian Federation
25, 125	Primorye Territory
26, 126	Stavropol Territory
27	Khabarovsk Territory
28	Amur region
29	Arkhangelsk region
30	Astrakhan region
31	Belgorod region
32	Bryansk region
33	Vladimir region
34, 134	Volgograd region
35	Vologda region
36, 136	Voronezh region
37	Ivanovo region
38, 85, 138	Irkutsk region
39, 91	Kaliningrad region
40	Kaluga region
41	Kamchatka Territory
42, 142	Kemerovo region
43	Kirov region
44	Kostroma region
45	Kurgan region
46	Kursk region
47, 147	Leningrad region
48	Lipetsk region
49	Magadan region
50, 90, 150, 190, 750	Moscow region
51	Murmansk region
52, 152	Nizhny Novgorod region
53	Novgorod region
54, 154	Novosibirsk region
55	Omsk region
56	Orenburg region
57	Oryol region
58	Penza region
59, 81, 159	Perm Territory
60	Pskov region
61, 161	Rostov region
62	Ryazan region
63, 163, 763	Samara region
64, 164	Saratov region

(continued)

(continued)

Code	Subject of the Russian Federation
65	Sakhalin region
66, 96, 196	Sverdlovsk region
67	Smolensk region
68	Tambov region
69	Tver region
70	Tomsk region
71	Tula region
72	Tyumen region
73, 173	Ulyanovsk region
74, 174	Chelyabinsk region
75, 80	Transbaikalian Territory
76	Yaroslavl region
77, 97, 99, 177, 197, 199, 777, 799	Moscow
78, 98, 178, 198	St. Petersburg
79	Jewish Autonomous District
82	Republic of Crimea
83	Nenets Autonomous District
86, 186	Khanty-Mansi Autonomous District—Yugra
87	Chukotka Autonomous District
89	Yamalo-Nenets Autonomous District
92	Sevastopol
94	Territories located outside the Russian Federation and serviced by the Department of Security Objects of the Ministry of the Interior of Russia
95	Republic of Chechen

Source Authors

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Sectoral Framework of Qualifications as a Tool for the Integration of Educational and Business Spheres of Russia

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Abstract This contribution substantiates the necessity of transition from the concept of "qualification" to the concept of "competence," since the competence approach to education reflects the requirements not only for the content of education, but also for the behavioral component, caused by insufficient consideration of the constantly changing demands of the labor market. The proposed sectoral qualifications framework should address the task of filling the national qualifications framework (NQF) to ensure transparency, comparability and recognition of qualifications, and training certificates. The authors define the essence and main characteristics of the sectoral qualifications framework, the purpose of the sectoral qualifications framework, the relationship between learning outcomes and descriptors of the NQF, the structure of the sectoral qualifications framework, the principles, the sequence and the general algorithm for developing the sectoral qualifications framework. Based on the studies, functional maps for the specific training profile "Management" have been developed. The choice of the training profile for the development of the sectoral qualifications framework is due to the fact that a scientific approach to management needs to be justified, because each managed system has its own properties and parameters, for the description of interrelationships which need analysis, planning, forecasting, decision making.

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1 Introduction

The growing processes of globalization, the need for labor mobility and the development of all forms of lifelong learning, changes in the way of life and training of people necessitate radical changes in the sphere of higher professional education. In the aspiration of people for vocational education, two opposite tendencies are observed: on the one hand, the desire to obtain the necessary amount of knowledge, providing a reliable foundation for lifelong learning; on the other hand, the desire to obtain as soon as possible narrow specific skills and knowledge that allow finding a job quickly after graduation (Ciuclea et al. 2018).

Now in the European, as well as in the worldwide education sphere, there is a trend of movement "from the concept of qualification to the concept of competence" (Duffy et al. 2005). This trend reflects the fact that the strengthening of cognitive and information bases in modern production is not "covered" by the traditional notion of professional qualifications. More relevant is the concept of competence. Against the backdrop of crisis phenomena in the economy, new requirements are being introduced for university graduates, among whom the demands of systematically organized intellectual, communicative, self-organizing, and moral principles that successfully organize the activities of the specialist in a broad social, economic, and cultural context, are gaining greater priority (Mitrofanova et al. 2014).

The competence approach to education (as opposed to the traditional qualification one) reflects the requirements not only for the content of education (what a graduate of a university should know, and what skills he should have in the professional field), but also to the behavioral component (the ability to apply knowledge, tasks of professional activity). So, now the interpretation of competence as the ability to apply knowledge, skills, and personal qualities for successful activity in a certain field has become widespread (Suandi et al. 2018). Competencies, in fact, determine the set of activities that a professional in a particular field should perform at a certain level, and competence is the implementation of competence by a specific subject of activity, depending on personal characteristics. In accordance with these provisions, the competence model in some professional field more accurately reveals the nature of the specialist's activity compared with the set of qualification characteristics.

It must also be remembered that the current situation in the field of the higher education development is accompanied by a number of negative trends, one of the most notable is insufficient consideration of the constantly changing labor market requirements (Pruel et al. 2017). The solution of this problem can be effective only if it is implemented through a dialog between employers and producers of educational services. At the same time, it is necessary to solve the task of filling the national qualifications framework (NQF) to ensure transparency, comparability and recognition of qualifications, training certificates (Batrova et al. 2008).

The qualifications framework in this case is a means of coordinating the demand for qualifications of workers on the part of the labor market on the basis of present and future requirements formulated in terms of such criteria as the nature of knowledge, skills, competencies, and the supply of qualifications from the education system (Simonova et al. 2016). This coordination is carried out on the basis of effective mechanisms of legal and institutional regulation of interaction between vocational education and the labor market (Kamasheva et al. 2017).

Thus, it can be said that qualifications frameworks allow, on the one hand, systematizing the goals and objectives of both vocational education and the labor market, and, on the other hand, they are an instrument for the implementation of this integrated system of goals and objectives, or at least those installations that this framework can provide to stakeholders.

The qualifications framework should encompass and contribute to the achievement of four main objectives: acquaintance with the labor market; orientation of the person in possible ways of self-realization; development of knowledge, skills, and abilities; development and maintenance of a broad, advanced knowledge base.

National qualifications frameworks are developed in accordance with priorities adopted in different countries (Sonoda et al. 2017). Like national legislation, they have varying degrees of complexity, depending on the normative practice existing in these countries: the regulatory process can be declared extremely often and may contain a detailed description of the relevant requirements. The development of national qualifications frameworks is carried out in more than 130 countries around the world ("Framework for Qualifications of the European Higher Education Area" 2005). Improving national qualifications framework is also being actively pursued in the CIS countries (Mikulec and Ermenc 2017).

The national qualifications framework has been operational in Russia since 2016, a large number of professional standards have been developed, and the Qualifications Network is developing (Martynov et al. 2017). However, the correlation of the requirements of professional standards with the education system and training profiles represents complex scientific and practical problems that have legislative and methodological limitations.

The goal of the study is to develop a methodology that favors the further development of higher education by bringing it closer to the real needs of the economy and social development. To achieve this goal, it is proposed to develop a sectoral qualifications framework (SQF) that will help to correlate the functions described in professional standards with the knowledge, skills formed during the training process.

The Sectoral Qualifications Framework: Nature and Goal

The Essence and Main Characteristics of the Construction of the Sectoral Qualifications Framework

To develop a methodology for constructing a sectoral qualifications framework, empirical and theoretical methods of economic cognition were used, which made it possible to determine the logic of the development of the SQF, the sequence, and identify the stages of its development. The analysis of the structure and content of existing professional standards, the national qualifications framework and state educational standards has allowed synthesizing the form of the SQF, in which the transition from educational to professional standards is traced and correlated. Using the method of identifying cause–effect relationships, the dependence of the formation of competencies at various stages of the educational process and subsequent work activity was determined.

To develop a methodology for constructing a sectoral qualifications framework, empirical and theoretical methods of economic cognition were used, which made it possible to determine the logic of the development of the SQF, the sequence, and identify the stages of its development. The analysis of the structure and content of existing professional standards, the national qualifications framework and state educational standards has allowed synthesizing the form of the SQF, in which the transition from educational to professional standards is traced and correlated. Using the method of identifying cause–effect relationships, the dependence of the formation of competencies at various stages of the educational process and subsequent work activity was determined.

The developed methodology for constructing the sectoral qualifications framework should define, structure, and classify the qualifications of bachelors and masters of basic education programs of specific training profiles that work in the relevant professional fields.

When developing the methodology, the authors took into account the main principles of the Bologna Process, the specific features of the sphere of labor and education in Russia, reflected in a number of documents and in the results of some projects. One of the main tools of the Bologna process (Leontyev et al. 2016) is the European Qualifications Framework (EQF), approved by the European Parliament on April 23, 2008, with the aim of "…ensuring transparency, comparability and recognition of qualifications, training diplomas and certificates in the development of academic and labor mobility of citizens on the European continent" ("The European Qualifications Framework for Lifelong Learning (EQF)" 2008; Rauhvargers 2004). With the advent of the EQF, national qualifications frameworks, including national and sectoral qualifications frameworks, have been given the opportunity to compare professional qualifications (Eremeev et al. 2016).

The analysis of the sectoral qualifications framework, the place and role of these qualifications in the national qualifications framework allowed drawing some conclusions that were taken into account when developing the sectoral qualifications framework for various training profiles:

- Some sectoral qualification frameworks, in fact, are catalogs of detailed descriptions of qualifications that allow for the assessment and certification of specialists. Qualifications are associated with the levels of the national qualifications framework and with job positions common in the industry. Such frameworks include frameworks of experts in hairdressing business;
- Other sectoral qualification frameworks, also related to the levels of the national qualifications framework and sector profiles, contain framework descriptions of the competencies of employees and, above all, are intended to use the solution of labor market tasks. Such a framework of competencies serves as reliable benchmarks that allow describing the results of training in terms of employers' expectations regarding the features of successful work in a specific context of the workplace. Such a framework provides opportunities for the flexible formation of job positions of dynamically changing sectors, for example, information technology;
- For objective consideration of the interests of employers, sectoral qualifications frameworks are usually developed outside the traditional vocational education system, which necessitates the development of another element of the national qualifications framework: a sectoral qualifications framework that is designed to maximize the demands of the labor market in the education system through learning outcomes;
- The sectoral qualifications framework for a specific training profile should allow educational institutions modify education programs in order to take into account the specific requirements of employers: *Professional requirements → Learning outcomes → Modules → Courses*;
- Each sector of training should correspond to its own sectoral qualifications framework, developed on the basis of the unified methodology, with modifications that depend on the specific field of activity (for example, Management or Informatics), the degree of development of professional standards in these fields, etc.;
- Since any sphere of professional activity is divided into a number of functional subsystems that have significant differences in terms of the content of labor functions, and, therefore, specific features of training bachelors and masters for each field of activity, differentiation of the sectoral qualifications framework in the direction of sub-frameworks focused on training profiles corresponding to these functional sub-frameworks.

The Goal of the Sectoral Qualifications Framework

The SQF is designed to ensure the simplicity and clarity of links between various qualifications in the training profile.

The SQF is designed for different groups of users (employers' associations, education management bodies, companies, educational organizations, citizens) and it allows:

- Formulating a general development strategy of the labor market and the education system in a specific training profile, including planning various training

that allows getting specific qualifications, raising the qualification level, career growth;
- Forming a large academic and labor mobility, incl. international;
- Developing education programs in line with employers, taking into account the requirements of employers;
- Describing from the unified position the requirements for qualification of employees and graduates when developing professional and educational standards, vocational education programs;
- Developing procedures for assessing the results of education and certification of qualifications, forming a certificates' network.

The SQF in accordance with the NQF can contain a specific number of hierarchically aligned qualification levels corresponding to different levels of education, for example:

Level 1—primary general education,
Level 2—basic general education,
Levels 3–4—initial vocational education,
Level 5—secondary vocational education,
Level 6—bachelor's degree program,
Level 7—master's degree program (specialty),
Level 8–9[1]—programs for training scientific and pedagogical staff in post-graduate school, residency programs, and the program of assassination-training.

If necessary, sublevels reflecting the specifics of training can be allocated within qualification levels.

The SQF forms the features (descriptors) of qualification levels and sublevels presented in the form of a table and disclosed through the basic indicators of preparation for professional activity—the learning outcome: knowledge, skills, and general competences.

These indicators are directly related and determined by descriptors of the NQF: the range of authority and responsibility, complexity and science-intensive activities (Table 1).

The indicator of "General Competences" is related to the degree of independence of the activity, its scale, social, environmental, economic, and other consequences, as well as the full implementation of the main functions in professional activity.

The indicator of "Skills" depends on a number of features of professional activity: the multiplicity (variability) of methods for solving professional problems, the need to choose or develop these methods, the degree of uncertainty in the work situation and unpredictability of its development.

The indicator of "Knowledge" is complex and determines the requirements for knowledge, depends on the following features of professional activity:

- Volume and complexity of the information used;

[1]Level 9 is provided by the National qualifications framework of the Russian Federation.

Table 1 Relationship between learning outcomes and descriptors of the NQF

Descriptors of the NQF	Description	Learning outcome
The range of authority and responsibility	Defines **the general competence** of the employee and is related to the scale of activity, the cost of a possible error, its social, environmental, economic, etc. consequences, as well as the full implementation of the main management functions in professional activity	General competences
Complexity	Defines the requirements for **skills** and depends on a number of features of professional activity: the multiplicity (variability) of methods for solving professional problems, the need to choose or develop these methods; the degree of uncertainty in the work situation and unpredictability of its development	Skills
Science-intensive activities	Defines the requirements for **knowledge** used in professional activity, depends on the volume and complexity of the information used, innovation of knowledge used and the degree of its abstractness	Knowledge

Source Authors

– Innovation of knowledge;
– Degree of its abstractness (the relationship between theoretical and practical knowledge).

The degree of its activity (transition from one skill level to another) can be associated with a change in one (any) of the component indicators, two or three.

Skills—this indicator is complex and determines the requirements for skills, depends on the following features of professional activity:

– Multiplicity (variability) of methods for solving professional problems, the need to select or develop these methods;
– Degree of uncertainty in the work situation and unpredictability of its development.
– Degree of its activity (transition from one level of qualification to another) can be associated with either a change in one (any) of the constituent indicators, or both.

Personal and professional competencies—this indicator determines the general competence of the employee and has three main degrees of activity:

– Activity under the leadership;
– Independent activity;
– Guidance of others.

The Structure of the Sectoral Qualifications Framework
The authors proposed the structure of the SQF, consisting of the following elements:

(1) Name of the training profile;
(2) Name of the area and types of professional activity;
(3) Qualification levels and sublevels;
(4) SQF descriptors for a particular qualification level.

- Main indicators of professional activity, corresponding to each qualification level/sublevel of the SQF—the learning outcome (knowledge, skills, general competencies);
- Additional indicators of professional activity;
- Ways to achieve the qualification of the appropriate level/sublevel;—the information is provided on ways to achieve qualification, specifying ways to achieve the qualification of the appropriate level;
- Main types of work activity—a list of types of work activity is provided in accordance with the allocated qualification sublevels of the SQF;
- Recommended job positions for the types of work activities.

2 Materials and Methods

Methodology for the Development of the Sectoral Qualifications Framework

Principles for the Development of the Sectoral Qualifications Framework
The SQF should be developed on the basis of the national qualifications framework and professional standards (Draft of Professional Standards of the Russian Federation in Information Technology 2018), taking into account the following principles:

- Reflection of priorities of the training profile taking into account strategic development goals and business interests of companies;
- Ongoing development of qualification levels from the lowest to the highest in accordance with the levels of education;
- Transparency of the description of qualification levels for all users;
- Hierarchy of qualification levels corresponds to the structure of the European and national education systems and the division of labor;
- Description of qualification levels of the SQF through professional performance indicators and learning outcomes.

Principles for the Development of the Sectoral Qualifications Framework

The Sequence of the Development of the Sectoral Qualifications Framework
The development of the qualifications framework is carried out in the following sequence:

– Structural design and pre-filling of the qualifications framework;
– Updating the scope of qualifications and clarifying their content.

General Algorithm for the Development of the Sectoral Qualifications Framework

The main stages in the development of the SQF are shown in Fig. 1.

Let us consider in more detail the content of each stage of the SQF development.

At the first stage, the following steps are taken to prepare for the SQF development:

– Description of the subject area;
– Allocation of the industry—the field of professional activity;
– Identification of types of professional activity—professions;
– Inclusion of all types of professional activity in the training profile, with the allocation of appropriate subunits in the SQF.

At the second stage, based on professional standards and employers' polls, a functional map is developed for a specific training profile, which includes a description of labor functions that constitute a separate finished element of labor activity, which requires its own methods, materials, equipment, and processes integrated into groups of labor functions.

The result of the first stage is the formation of the functional map for the training profile in the tabular form of the correspondence of labor functions to a certain group.

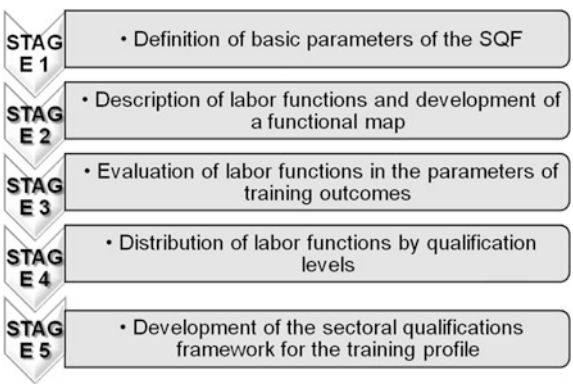

Fig. 1 Stages of the SQF development. *Source* Authors

In the context of the SQF updating, a survey of labor market experts–employers is being conducted at this stage. As a basis for the methodology of this survey, it is possible to take the proposals described in the Methodological Recommendations for the Development of Professional Standards (On Approval of Methodological Recommendations for the Development of a Professional Standard 2018).

Also, the functional map for each function contains a list of knowledge and skills necessary for their qualitative implementation, which the respondents are asked to clarify or supplement.

If new functions are added to the functional map, respondents should also offer a description of knowledge and skills necessary to perform these functions.

At the third stage, on the basis of professional and educational standards, the description of labor functions in the parameters of learning outcomes is provided.

In determining learning outcomes, it must be assumed that they must have the following characteristics:

- Learning outcomes are integrative and structured; they include knowledge, skills, and general competencies.
- Learning outcomes reflect the social educational order. The orderly nature of learning outcomes determines the mechanism for their definition and formulation—by coordinating the interests and opportunities of representatives of the professional sphere, on the one hand, and representatives of the education sector, on the other.
- Learning outcomes are diagnostic, i.e., the fact and degree of their formation can be objective, on the basis of certain attributes–descriptors.

The list of learning outcomes should be formed by applying the following economic methods:

1. Analysis of the labor market and approved professional standards in the relevant areas of activity (if any);
2. Analysis of requirements of learning outcomes for bachelor's and master's degree basic programs prescribed by the approved state educational standards;
3. Analysis of existing international professional standards in relevant fields of activity;
4. Studying and adapting the experience of forming lists of learning outcomes in the European educational space;
5. Expert evaluation by representatives of the academic environment in the formed list of learning outcomes;
6. Drawing up a final list of learning outcomes.

The result of the second stage is the formation of the correspondence matrix of learning outcomes and labor functions (Table 2).

Within the framework of the SQF updating, a survey of experts from the academic environment—managers, teachers, university students—is conducted at several stages, using the survey methodology described at the previous stage.

Table 2 Correspondence matrix of learning outcomes and labor functions

Groups of labor functions	Labor functions	Learning outcomes		
		Knowledge	Skills	General competences

Source Authors

At the fourth stage, based on the content of actions (complexity, nonstandard tasks, level of independence), knowledge and skills, labor functions are distributed according to skill levels.

When assigning labor functions to the qualification level, it is advisable to use the NQF as a guideline (Table 3).

The result of the third stage is the formation of the matrix of distribution of labor functions by qualification levels (qualification matrix) (Table 4).

At the fifth stage, based on the functional map and the qualification matrix, the sectoral qualifications framework for a specific training profile is developed by enlarging and generalizing the labor functions in the SQF descriptors and integrating them into a hierarchical structure within the specific qualification level and the SQF as a whole.

For each qualification level, as an additional indicator of professional activity, clarification of the ways to achieve a particular qualification can be made, which show typical prospects for the development of a person's qualifications throughout his life. Ways to achieve the appropriate qualification level can be changed and

Table 3 Criteria for determining the qualification level of the SQF

SQF levels	Context of complexity	Degree of independence	Typical tasks	Behavior
9	Unpredictable, unstructured	Sustainable leadership and independence	Management of the organization and its development	Convinces, transforms, implements innovations
				
1	Predictable, structured	Limited independence in a stable context	Operational management	Applies, adapts

Source Authors

Table 4 Matrix of distribution of labor functions by qualification levels

Groups of labor functions	Labor functions	Qualification levels		
		6	7	8

Source Authors

Table 5 SQF for the training profile

Level / sublevel	Descriptors (learning outcomes)			Ways to achieve the appropriate qualification level	Recommended job positions
	Knowledge	Skills	General competences		

Source Authors

supplemented with the development of organizational forms of education and training, as well as mechanisms for recognizing their results in the system of vocational education and training.

Also, for each qualification level, recommended job positions may be allocated as an additional indicator of professional activity (Table 5).

3 Results

The Practice of Developing the Sectoral Qualifications Framework for the Training Profile "Management"

As an approbation of the proposed methodology for the development of the sectoral qualifications, the authors fulfilled all the proposed stages of the SQF for the training profile "Management," since Management as scientific discipline studies management problems, relies on management practice, and Management as a discipline includes skills and knowledge required for effective management (Motyshina 2011).

Stage 1—Determination of the basic parameters of the SQF

Management is the effective and rational achievement of the organization's goals by planning, coordinating organizational resources and controlling their use in all sectors of the economy and in any organization, regardless of its structure and size (Tebekin 2016; Sekhina 2017; Ivanova 2017). Management characterizes the process of leadership and management of the whole structure of the organization, carried out through the development and management of resources (human,

financial, material, intellectual, and intangible) (Nestulayeva and Plekhanov 2014; Eskiev 2017). Management is a complex, multifaceted science, based on a scientific approach, on experience and the art of management (Grinev and Orlova 2014; Katysheva 2013). For effective management, it is necessary to be able to achieve the set goals, using labor, intellect, and motives of people's behavior.

In commercial organizations, the main function of management is to satisfy the interests of stakeholders (Kashapova 2016). On the basis of the analysis, all types of professional activity in the training profile "Management" were included in the SQF, with the allocation of appropriate sub-patterns.

Stage 2—Description of labor functions and development of the functional map

At this stage, based on professional standards and employers' polls, the functional map for a specific training profile has been developed, which includes a description of labor functions that constitute a separate finished element of work that requires its own methods, materials, equipment, and processes that are grouped into labor function groups. For the training profile "Management," the following groups of functions are distinguished: "Analysis and activity planning," "Work organization and work control," "Management and motivation of personnel," "Changes and innovations," "Self-development".

The result of this stage was the formation of the functional map for the training profile "Management" (Table 6).

Stage 3—Assessment of labor functions in the parameters of learning outcomes

To identify the required learning outcomes, the following actions were performed:

(1) Analysis of the Russian labor market and professional standards approved in the Russian Federation: "Head of Organization," "Personnel Management;"
(2) Analysis of requirements of learning outcomes for bachelor's and master's degree basic programs prescribed by the federal state educational standards approved in the Russian Federation in the field of Management;
(3) Expert evaluation of the formed list of learning outcomes by representatives of universities;

On the basis of the results obtained, the matrix of final learning outcomes was compiled, which is represented using the example of one of the previously presented A.02 functions (Table 7).

Stage 4—Distribution of labor functions by qualification levels

The result of this stage is the formation of the matrix of distribution of labor functions by qualification levels (qualification matrix) (Table 8).

Table 6 Functional map for the training profile "Management"

Groups of labor functions	Labor functions
1	2
A. Analysis, activity planning	A.01. Development of the organization's activity policy
	A.02. Development of the activity strategy, the definition of indicators for the strategy implementation /achieving goals
	A.03. Coordination of strategic and operational plans of the parties
	A.04. Development of activity plans, identification of indicators for the strategy implementation/achieving goals P
	A.05. Promotion of strategic and operational plans
	A.06. Budgeting
	A.07. Development of strategic and operational plans
	A.08. Protection of current activities
	A.09. Consumer protection
	A.10. Work planning
B. Work organization and work control	B.01. Results implementation
	B.02. Strategy implementation
	B.03. Checking compliance of performance results
	B.04. Management of the structure
	B.05. Risk and conflict management
	B.06. Creation of business conditions
	B.07. Current activity controlling
	B.08. Controlling of material and financial resources
	B.09. Controlling of technology, processes and work safety
	B.10. Management of products movement
	B.11. Coordination of activities
	B.12. Optimization of activities
C. Management and motivation of personnel	C.01. Team building
	C.02. Management of staff motivation
	C.03. Career management
D. Self-development	D.01. Ways of self-development
	D.02. Leadership
	D.03. Self-management
	D.04. Development of professional skills
E. Changes and innovations	E.01. Assessment of changes
	E.02. Planning changes
	E.03. Creation of innovations
	E.04. Implementation of changes

Source Authors

Table 7 Matrix of final learning outcomes and labor functions

Groups of labor functions	Labor functions	Learning outcomes		
		Knowledge	Skills	General competences
A. Analysis, activity planning	A.02	International and Russian practice of social responsibility of business; Methods of organization of group work; • Basic principles of risk management, main types of risks; • Fundamentals of strategic management; Economics of production, logistics, labor and financial resources of the organization	Present one's own thoughts, both in writing and orally; Carry out the analysis and estimation of efficiency of existing risk management systems and internal control in the organization; Develop target and intermediate organization's activities, ways to achieve the target activity, assess the attainability and feasibility of the chosen strategy; Think strategically, systematically, conceptually	Participate in the strategy development. Determine quality goals

Source Authors

Stage 5—Building the sectoral qualifications framework for the training profile

At this stage, on the basis of the functional map and the qualification matrix, the sectoral qualifications framework for the specific training profile was developed by consolidating and generalizing the labor functions in the SQF descriptors and integrating them into a hierarchical structure within the specific qualification level and the SQF as a whole. In view of the large volume of the matrix obtained, the study contains a fragment of the results from the two labor functions of the upper and lower levels as an example (Table 9).

4 Discussion

The proposed methodology for developing the sectoral qualifications framework allows matching the functions described in professional standards with training profiles adopted in the Russian Federation. This brings employers closer to the educational process and learning outcomes, provides a solid foundation for lifelong learning. The sectoral qualifications framework carries out the transition from

Table 8 Qualification matrix

Groups of labor functions	Labor functions	Qualification levels		
		6	7	8
A. Analysis, activity planning	A.01			
	A.02			
	A.03			
	A.04			
	A.05			
	A.06			
	A.07			
	A.08			
	A.09			
	A.10			
B. Work organization and work control	B.01			
	B.02			
	B.03			
	B.04			
	B.05			
	B.06			
	B.07			
	B.08			
	B.09			
	B.10			
	B.11			
	B.12			
C. Management and motivation of personnel	C.01			
	C.02			
	C.03			
D. Self-development	D.01			
	D.02			
	D.03			
	D.04			
E. Changes and innovations	E.01			
	E.02			
	E.03			
	E.04			

Source Authors

Table 9 Sectoral qualification framework for the training profile "Management"

Level/ sublevel	Descriptors (learning outcomes)			Ways to achieve the appropriate qualification level	Recommended job positions
	Knowledge	Skills	General competences		
1	2	3	4	5	6
6	Practical and theoretical knowledge in the field of professional activity and management Knowledge of approaches, principles and methods of setting and solving professional problems	Skills: understand orders, analyze situations, carry out self-analysis, make decisions and create conditions for their implementation, monitor and correct activities in the context of teamwork, enhance managerial and performing professionalism Skills: plan work in accordance with existing requirements; manage the work; develop personnel in technology; carry out self-development in technology; manage technology changes, innovation	High level of responsibility for the organization and quality of work of subordinates; activities in standard situations	As a rule, bachelor' degree. In some cases, secondary vocational education is possible with or on the basis of secondary (complete) general education; At least 1 year of practical experience in the organization (division) at positions no lower than the 5th qualification level	Linear leader (basic, linear, by function): chief of shift (section), senior master, master, brigadier, senior group (project), project manager

(continued)

Table 9 (continued)

Level/ sublevel	Descriptors (learning outcomes)			Ways to achieve the appropriate qualification level	Recommended job positions
	Knowledge	Skills	General competences		
1	2	3	4	5	6
8B	Knowledge of the methodology of constructing concepts, strategies, functional models of activity and interaction, ways of setting and system solving problems. Knowledge of the basic business processes of the company, the fundamentals of personnel management, production management, psychology of management	Strategic thinking, the skills of making mutually beneficial decisions using logical methods, building and playing models of professional activity and interaction. Skills: generate ideas, predict the results of innovation; carry out large-scale changes in the professional and social sphere; manage complex production and scientific processes; develop and manage the implementation of the organization's strategy: encourage the management team of senior management; manage changes in the organization to show leadership; ensure investment attractiveness and sustainable development of the organization	High level of responsibility for the performance and subordinates; activities in nonstandard and extraordinary situations; in conditions of uncertainty, risk; complexity and variety of actions when managing; absolute level of personal responsibility and independence	Master's degree (based on the studied bachelor's program) or Specialty (based on the studied program of secondary (complete) general education), and additional professional education (MBA programs, etc.); At least 4 years of practical experience of management of the organization (division); not low than 7th qualification level	General Director, Director, Manager, Managing Director, Executive Director, Head of Organization

Source Authors

qualification requirements to competencies, which fully corresponds to goals and objectives set in the study. New requirements for university graduates can be satisfied through the formation of systematically organized intellectual, communicative, self-organizing, and moral competencies that allow a successful young specialist to realize himself in a wide social, economic, and cultural context.

In the course of the research, the task of filling the national qualifications framework (NQF) with new content is solved to ensure transparency, comparability and recognition of qualifications, training certificates. At the same time, it is necessary to recognize that the existing professional standards describe mainly the most common functions for a specific type of activity and are not focused on new, not yet professionally designed professions or specialties, which limits the training of specialists ahead of the promising needs of the economy.

Thus, it can be said that the sectoral qualifications framework allows, on the one hand, systematizing goals and objectives of both vocational education and the labor market, and, on the other hand, serve as an instrument for the implementation of this integrated system of goals and objectives, or at least, those installations that the given system can provide to stakeholders. At the same time, when introducing the sectoral qualifications framework into the education system, it is necessary to take into account the deferred nature of knowledge and skills that have been generated due to the length of the training process, the need for changes in the methodology and normative acts of the educational process.

The developed methodology allows forming a model of the sectoral qualifications framework for any training profile adopted in the Russian Federation. The developed algorithm is fully supported by the completed sectoral qualifications framework for the training profile "Management," which allowed moving from qualification levels to knowledge, skills, and general competences, describing ways to achieve the appropriate level and proposing possible job positions. The conducted research contributes to the further development of higher education by its approach to the real needs of the economy and social development.

5 Conclusions

As a result of the study, the need has been formulated to develop a new element of the National Qualifications Framework—the sectoral qualifications framework in order to take into account the requirements of employers when training specialists in the education system. The SQF allows defining, structuring, and classifying qualifications of graduates of the basic education programs, provides simplicity and clarity of connections between different qualifications within the training profile. It is determined that the SQF can contain a specific number of hierarchically aligned qualification levels corresponding to different levels of education.

The development took into account the main principles of the Bologna Process, the special features of the sphere of labor and education in Russia, which enabled us to cover various aspects of the educational process. It was determined that each

sector of training should have its own sectoral qualifications framework. In addition, differentiation of the sectoral qualifications framework in the direction of sub-frameworks is required due to the division of generalized labor functions into functions and labor actions.

The conclusions drawn from the analysis of the sectoral qualifications framework contain the main limitations and directions for research: professional standards are a detailed description of qualifications or a framework description of competencies, but do not take into account the results of training. In the SQF, a logical connection was made between professional requirements for learning outcomes through modules and courses. The relationship between learning outcomes and descriptors of the NQF, such as the range of authority and responsibility, the complexity and intensity of activity, has been developed.

The structure of the sectoral qualifications framework is formed, which consists of the name of the training profile, the name of the region and the types of professional activity, qualification levels and sublevels, the SQF descriptors for a particular qualification level.

The methodology for the development of the sectoral qualifications framework, including the principles for the development of the sectoral qualifications framework and the development of the national qualifications framework and professional standards, has been defined. The sequence of the development of the sectoral qualifications framework is determined, the main stages of which are structural design and pre-filling of the qualifications framework and actualization of the qualifications framework with clarification of their content. The general algorithm for developing the sectoral qualifications framework includes five steps. The result of the stages are: a functional map for the training profile, a matrix of the correspondence of learning outcomes and labor functions, distribution of knowledge and skills in labor functions according to skill levels, criteria for determining the qualification level, a matrix for distribution of labor functions at qualification levels. To fill the functional map, the structure of the questionnaire for conducting surveys of enterprises has been developed.

As a practical application of the SQF, the sectoral qualifications framework for the training profile “Management” was developed, which describes labor functions and the functional map for the training profile. The matrix of the correspondence between learning outcomes and labor functions and the sectoral qualifications framework for the training profile “Management” has been developed.

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Part V
Sectoral Aspects of Sustainable Economic Development

Analysis of the Precious Metals Market in Russia as a Component of the Global Financial Market in Modern Conditions

M. E. Konovalova, O. Y. Kuzmina, E. S. Nedorezova, S. Y. Salomatina and A. M. Mikhaylov

Abstract The world precious metals market is an integral part of the global financial market, which determines its stability. It is mainly connected with historical development features of the financial market, where formation was related to circulation of precious metals. The world market still has high potential for growth that is especially relevant to Russia, which has high natural potential, advanced technologies for extraction and production of metals. It creates competitive advantage in the world market. The key players of this financial segment are commercial banks, which use resources of the precious metals market for diversification of its risks. It provides stability and sustainability of a bank segment. The purpose of the contribution is to study the process of formation of the precious metals market in Russia as a component of the global financial market and to identify problems, hindering its further development. The precious metals market in Russia is not completely formed and developed as there are some restrictions, which retard its development. The authors carried out the comparative analysis of gold and paper money as forms of cash equivalent of different historical eras. It allowed establishing the role of the precious metals market as a part of the financial market, which laid the basis for financial architectonics and provided financial market stability. The price fluctuations in the world precious metals market during 2000–2015 were analyzed, and the dependence of prices of various metals was defined. Based on these facts, the authors made a conclusion on the derivative character of asset prices of the precious metals

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market from gold prices. The key problems, hampering development of the precious metals market in Russia, were shown. The institutional imperfection of this financial segment is the most important.

1 Introduction

The study of the precious metals market is relevant as it allows identifying features and regularities of this segment to expand the opportunities of resource exploitation in economic activity of financial agents.

The development of the precious metals market is traditionally connected with performance of monetary functions. A set of theories and concepts appeared when developing monetary relations. Scientists and economists considered the essence and functions of money in the form of precious metals. The first one among such concepts is the theory of mercantilism. Its representatives believed that a source of wealth was accumulation of precious metals and their export was forbidden. The special role of gold and silver was considered within the monetary system, where metals performed functions of the value and means of hoarding.

The mercantilist theory served as the basis for other economic theories. In "Discourses upon Trade," North (1691) criticized early mercantilists and considered wealth not as accumulation of precious metals, but as their ability to make profit. According to his opinion, introduction of protectionist measures limits the country's development.

Unlike predecessors, the classical political economy considered not the sphere of circulation, but the sphere of production. Classical political economists did not study precious metals as a source of wealth. They believed that metals play a minor role.

Hume (1738) studied the problem of monetary circulation in the country and the cost of money and explained the value of precious metals in exchange. He claimed that the price of goods or the cost of money is not determined by absolute quantity of money, which is in the country. It is rather based on amount of gold and silver, which is in fact in circulation. However, in the long term all gold and silver, which is in the country, should be absorbed in the form of coins in the sphere of circulation. It is obvious that if gold and silver have value absolutely irrespective of all other circulation laws, only the certain amount of gold and silver can circulate being an equivalent of this cumulative cost of goods. Thus, without reference to the total cost of goods, if all gold and silver participate as means of circulation in exchange of goods, then these metals do not have intrinsic value and in fact are not real commodities. However, mentioning the cost of goods and gold, the author speaks only about their equivalent quantity.

Locke (1690) claimed that metals have ostensible or conditional value. The core of this statement is that gold and silver become money as a result of the exchange function, which is carried out by them. Thus, it is necessary to understand that their value and, therefore, the cost value are caused by their social function. As a result,

gold and silver get fictitious value in the course of commodity circulation. This process turns them not into money, but into the cost, which is determined by the share of their own volume to the volume of goods.

Smith in «An Inquiry into the Nature and Causes of the Wealth of Nations» (1776) studied the essence of money and its origin. He defined that division of labor formed the basis of exchange, and that was a prerequisite for emergence of money. Following the labor theory of value, A. Smith denoted the actual commodity cost in the form of labor input. Money only reflects their nominal value. Studying the problem of gold monetary circulation, A. Smith did not allow such situation in which emission of credit currency would exceed the stock of precious metals as it would result in decrease in value of money in relation to the value of gold and silver. Smith believed that only gold could be considered as full-bodied money and credit currency was its substitutes, only symbols of value.

Ricardo (1817) determined the cost of gold and silver, as well as the cost of all other goods, by the quantity of working hours materialized in them. The value of other commodities is measured regarding the value of precious metals, which are goods with determined cost. Ricardo (1817) represented money as a cost, which denotes a certain amount of gold.

Thus, the hypotheses of Ricardo (1817) about measurement of commodity cost through the cost of precious metals resulted in introduction of the gold standard system, which was established in England in the end of eighteenth century—the beginning of the nineteenth century. This system meant that a certain quantity of gold, established by the state, is assigned to currency.

However, in the middle of the twentieth century many countries gradually began to refuse from the gold standard. Precious metals ceased to make direct impact on money supply. Their indirect link is only shown in the fact that a part of gold and foreign exchange reserves of the country is presented in the form of monetary gold. This part also has a constant tendency to reduction (Oktay 2016). This is constantly exaggerated in the economic literature. Such leading economists like Keynes (1936), Polanyi (1968), Schumpeter (1915), Fisher (1920), Hicks (1939), Patinkin (1956), Hayek (1929), Friedman (1960) assigned only a part of securitized asset to precious metals, involving conventional and conditional nature of modern money.

Despite rather rigorous research of the precious metals market, there are some unresolved problems. The role of precious metals as bank asset, as well as specific features of bank operations with precious metals in various regional markets are not studied, that demands additional research in this area.

The purpose of the contribution is to study the precious metals market, to identify the problems, hindering further development of this market in Russia, and to find the ways of their solution. In order to achieve the purpose of the contribution, the following tasks were set: to analyze the structure of the precious metals market, to define the role of precious metals in the monetary system, to identify the tendencies of prices in the world precious metals market, to determine their conjuncture interaction and to prove the trends of further growth of the precious metals market in Russia.

2 Materials and Methods

The study was conducted in several stages. The first stage was to identify the problem and analysis of its theoretical and methodological aspects in the scientific literature. At the second stage, the price fluctuations in the world precious metals market during 2000–2015 were analyzed, and the econometric model of interdependence between prices of various precious metals was created. The final stage is connected with determination of development features of the precious metals market in Russia and practical recommendations on improvement of its institutional structure.

Theoretical (systematic, structural–functional, reproduction and dialectic–materialistic) methods, tools of mathematical statistics and graphical recording were used in the course of the research. Data of official statistics of the precious metals market was the information basis of the contribution.

3 Results

3.1 Functional and Institutional Components of the Precious Metals Market

In the past, precious metals significantly influenced opening-out of new lands and development of industrial branches, creation and change of the currency system, formation and subsequent development of money and credit relations. Over time, the functions and role of precious metals changed, but they occupy one of the leading places both in national economy and in international relations.

The precious metals market includes a set of various relationships between market participants at the stages of exploration, mining, processing, etc., up to jewelry making. As the precious metals market is a system phenomenon, it can be considered from two points of view—functional and institutional.

From the functional point of view, the precious metals market represents the trade and financial center, where trade and other commercial and property transactions with these assets are concentrated. From the institutional point of view, the precious metals market involves a set of specially authorized banks, precious metals exchange.

Gold, silver and metals of the platinum group (platinum, palladium) are classified as the main precious metals. Precious metals play a double role: They are not only used for production of industrial commodities (equipment, electronics, medical equipment, prosthetics, etc.), but they are also a subject of investment (production of coins, jewelry) and are used as treasures, reserves.

The main distinctive feature of the world precious metals market throughout all its evolution was certain conservatism. Unlike stock, bond, derivatives and even currency markets, which are characterized by big volatility, the precious metals

market is less subject to dramatic upturn, due to its natural qualities. All the main fields of precious metals are known, well studied and substantially developed.

Let us consider major participants of the precious metals market using the example of the gold market. There are the following participants in the precious metals market:

(1) Gold mining companies, placers, mines, gold producer association

Gold mining companies supply the market with the most part of gold. As a result, they comprise an important category of market participants. They can be small companies, which have no sufficient opportunity and means to run business directly with broker offices, but sometimes they can be big and capable to conduct business in all sectors of the gold market. Such companies carry out operations on significant scales, which can considerably influence changes in prices. That is why other participants of the market constantly keep a close eye on their activity. Gold refining enterprises operate in the wholesale market both for ensuring their productive processes and for periodic purchases and sales of gold by order of clients.

(2) Professional dealers and intermediate sellers

Banks and specialized companies belong to this category of participants. They act both as a customer, buying gold at his own expense, and as a seller, reselling it to other participants in the market. Banks also purchase gold to increase their reserves.

Brokers and dealers, represented by firms, sell gold in the form of bullions and make a profit at the expense of difference in prices. The London Bullion Market Association (LBMA), representing the interests of participants in the wholesale market, divides them into two categories: participants, forming the market (market maker), and ordinary participants. Now, there are 14 participants, forming the market, and 48 ordinary participants.

Other participants in the precious metals market are market makers. Unlike ordinary dealers, market makers are obliged to announce publicly the purchase and selling prices on metal during the working day.

Today, there are two purely broker companies in the interbank market. They are TFS—Tradition Financial Services—London, and Premex AG, Zurich. Unlike the main participants of the market—banks of market makers— brokers do not announce their asset prices and have no right to hold open positions. Brokers receive a commission fee for their services, for example, concerning transactions "spot", the commission fee is five percents. Large financial and trade corporations, companies selling precious metals and firms, which are engaged in refining of metals, can also be other participants of the market.

(3) Central banks

Central banks act not only as investors, committing considerable volumes of gold. They also establish the rules of the game on gold and financial markets.

The central core of the market is the Bank of the USA—the US Federal Reserve System. The Central Bank of Germany—Deutsche Bundesbank—and the Bank of England (also called Old Lady of Threadneedle Street) also play a significant role.

As gold is a reserve supply of states, central banks of other countries can affect the precious metals market considerably.

In former times, about 20% of purchases of all gold, coming to the market, accounted for central banks. However, since 1971 banks became sellers with the Jamaican currency system and cancelation of the gold standard.

The Bank of England belongs to the group of central banks, which sell gold at their own expense and bring gold in the market for receiving some financial profit on their gold holdings. The Bank of England and the Bank for International Settlements can operate in the market on behalf of other central banks.

(4) Share markets

There are no separate share markets specializing in precious metals.

In the USA and other countries, transactions with gold and other metals are carried out by means of a number of various financial tools, among which are forwards, futures, swaps and options. The main goal of such operations is to decrease risks, i.e., hedging of precious metals prices.

(5) Investors

The role of investors significantly increased after 1971. People began to purchase precious metals not only for industrial consumption. They also use them as investments for further profit earning. Investors can be banks, financial enterprises and suppliers, various funds, international organizations.

A separate type of investors is *punters* that use such financial instruments as future contracts and options. They carry out purchase and sale by means of gold during a short period. They use fluctuations in prices for making profit, but not for delivery of metals and their consumption.

Unlike investors from the USA and Europe, Asian investors invest in gold bullions and use metal as means of hoarding. They use such way of investment as a method of overcoming financial crises.

(6) Industrial customers

They are jewelry firms, industrial enterprises, refineries.

Identifying key players of the precious metals market, we will consider the structure, production output and consumption in the market of certain precious metals.

3.2 Geography of the Precious Metals Market

One of the features of the gold market is that gold is used actually by all states as a security and reserve fund. On the other hand, human population also acts as a consumer of gold, showing demand in such areas as jewelry industry, production of coins, electronics engineering and dental prosthetics. The main consumer countries

are Japan, the USA, Italy and Germany, and the production countries are the Republic of South Africa (7.8%), China (13%), Australia (10%), the USA (8%).

The largest producers of silver in the world are Mexico, Peru and China. The main consumer countries of silver are China, the USA, Japan, Germany and India. Specifically, more than 29% of all consumption of silver in the electronics and electricity segment accounts for China. About 20% of demand for these purposes accounts for the USA and about 15% for Japan. Almost 45% of all manufactured goods, where this metal is used, are electronic and electric products.

The main reserves of platinoids are concentrated in Russia and the Republic of South Africa. About 92% of world production of platinum from ores and concentrated products and more than 96% of their stocks in subsoil account for these two countries. Automotive industry is a primary branch of platinum consumption. About 80% of platinum, consumed in this branch, is used for neutralizing diesel car exhaust. More than 80% of platinum consumption is concentrated in Europe, the People's Republic of China, North America and Japan (Henckens et al. 2016).

Large-scale deposits of palladium are in the Urals, Alaska, Australia, Colombia, Transvaal (Africa), Canada. The major consumer countries are China and the countries of North America. Palladium and alloys of palladium are used mainly in electronics, in chemical industry and also in jewelry for receiving "white gold" as even insignificant amount of palladium (1%) can change sharply the color of gold and make it silver-white.

3.3 Analysis of Price Fluctuations in Certain Precious Metals Markets

Up to 1970s of the twentieth century, prices on precious metals remained rather fixed. In 1968, the gold standard was abandoned, and the prices were defined by the ratio of supply and demand through currency transactions of commodity exchanges in London, New York, Chicago, Tokyo, Sydney, Hong Kong and Zurich under the terms of the free market. The exchanges of London, Zurich, New York and Tokyo are considered as the largest international centers of gold trade. Gold is sold in bullions of the 995th fineness mark. An essential part of the world gold market is controlled by LBMA, registered in 1987.

Increase and decrease in extraction and production of gold, business cycles and political situation significantly influence its cost. In 2000, there was reduction in prices on gold. It was a consequence of increase in supply of gold from countries, which did not accede to the agreement on decrease in sales volumes, concluded by some countries of Europe (such as Great Britain, Switzerland, Sweden). At the same time, demand for jewelry, especially in the countries of Southeast Asia, its use in electronic and electro-technical industry remained stable.

In 2001–2003, there was a sharp increase in prices and up to 2008 gold had the ascending trend. Factors, which played an important role in price increase, are

weakening of the American economy and political instability in the world, which heightened after terrorist attacks in the USA on September 11, 2001, and also deterioration of the geopolitical situation in the Middle East. The trend of buying up gold considerably strengthened in the financial market. It is considered as the most reliable shelter for the capital during the periods of serious international crises.

In 2005–2006, there was further, essential increase in prices in the world gold markets. Therefore, in the first quarter of 2006 quotation of gold increased by 24%, and the maximum price was recorded on May 12, 2006—725 dollars per ounce; i.e., the increase reached nearly 40% since the beginning of 2006.

In 2007, the price on gold increased by 15% and fell outside the limits of historical values, and in March 2008 it reached a record of 31.18 dollar per gram. However, since the middle of the year, the global financial crisis, which reduced activities of exchange players, had an impact on prices, and the "superheated" prices gradually began "to cool down." From the beginning of 2009, prices on gold were growing, and in 2012 they reached its peak—1684 dollars per ounce on average during the year. First of all, it was explained by great demand for metal from investors. In 2013, prices on gold decreased a little; however, they remained at a very high level. This trend was also peculiar to the subsequent period.

Thus, it is possible to conclude that gold remains one of the leading financial tools. It is especially noticeable during the periods of economic instability: Even not too deep crisis with inevitability involves increase in prices on gold (Gangopadhyay et al. 2016). Besides, if we consider the fact that volumes of the world gold mining do not keep pace with increase in demand for precious metals (both from the financial sector and from aviation, space, jewelry industry and also medicine), it is easy to make the conclusion that gold mining is still a profitable and socially important business.

Despite all its qualities and advantages, the gold market and its cost are subject to significant influence from many external factors:

- Fluctuations of prices on raw materials and sales outlets of international exchanges;
- Political conflicts;
- Legislative restrictions on purchase/sale of precious metals;
- Upswings of the foreign exchange market;
- Economic crises of various countries;
- Level of gold reserves of the central banks of the states;
- Behavior and psychology of consumers (Gokmenoglu and Fazlollahi 2015).

Many experts still believe that sharp increase in prices on gold in 2011 was caused by punters, who benefited from public panic and agiotage.

As for the prices on silver, from 2000 to 2006 the price on this basic asset remained stable and did not exceed 10 dollars per ounce. In 2006, the average annual price on silver grew to 11.55 dollars, and it was the highest value since 1980. The main factor was launch of the first ETF on silver. It resulted in increase in investments and affected prices. Up to 2008, silver showed growth in price. In the

review of the World Silver Survey of 2009, high investment demand and restoration of industrial demand for metal were specified as the main reasons for such growth. In 2008, the cost of silver sharply decreased (from 18 dollars to 9 dollars) and returned to the former price of 2000–2006. Obviously, it is connected with the global financial crisis of 2008 and speculative influence of players in the financial market. From 2009 to 2012, the price on silver showed growth and reached the peak at the beginning of 2011, and it was 45.83 dollars. The great demand of investors became the prime factor, which defined the movement of prices on silver —it is about a quarter of the cumulative demand for silver in the world.

The average level of prices in 2012 was 31.15 dollars per ounce and became the second highest level for all the time after 2011. In general, 2012 was characterized by volatility in the branch of precious metals, but at the same time investments in silver grew to 252.7 million ounces. In terms of money, it accounted for 8 billion dollars that is much higher than an average annual indicator of 1.2 billion dollars during 2001–2010. Such data is contained in "World Silver Survey of 2013," published by The Silver Institute.

As analysts of Goldman Sachs note, the investment demand for silver increased because of high inflationary pressure, loosening monetary policy by the world central banks and low base interest rates (Sverdrup et al. 2014). Besides, the weakening dollar positively influenced demand for precious metals. Now, the trend of reduction in prices on silver remains, and that is a consequence of toughed monetary policy of central banks of the leading countries in the world.

Let us turn to the study of price fluctuations in the market of platinum and palladium.

Financial recessions and crises of 2000 and 2010 affected demand and fluctuations of prices on platinum. In this period (especially in 2000), prices on platinum slumped lower than 1 thousand dollars (almost to 900) per troy ounce of precious metal. For the last ten years, the price on platinum ounce lower than 1 thousand dollars is considered as unprofitable. Therefore, it is obvious that a part of enterprises (generally South African) extracting platinum stopped their activity. On this account, there was a certain metal deficit in "demand–supply" of platinum in 2010, and its price grew again. However, slump in automobile manufacture in China in 2014–2015 caused new reduction in prices on platinum.

The average price per platinum ounce in the first half of 2015 was about 1100 dollars. However, experts predict their own platinum price. According to them, in 2017 the level of the world economy will grow, China will resume large-scale automobile production, the price per troy ounce of platinum will exceed, at least, 1300 dollars, and the other platinoids—palladium—will cost more than 850 dollars per troy ounce.

In the early 2000s, palladium prices rallied, and in 2001 they reached a historical record—900–1000 dollars per ounce. New increase in palladium prices took place in 2011, when it was equal to 825 dollars per troy ounce. In the next years, the palladium price remained at the level of 700–800 dollars per ounce.

Constant deficit is typical for the palladium market for the last five years. In 2010, according to GFMS, the overall deficit was about 550 thousand ounces in the

palladium market. To a greater extent, this deficit was connected with growth in demand for autocatalysts—30% (1.2 million ounces)—and substitution of platinum by palladium within production of diesel fuel. The platinum and palladium markets suffer from the results of decrease in prices too. So, reduction in the price influenced mining of precious metal in 2012 (according to Johnson Matthey, there was a decrease in the global supply of palladium by 11% to 204.4; it is the lowest level since 2003). In its turn, markets of platinum and palladium are competing. It affects both demand from automobile industry and demand from ETF funds. In August 2014, palladium prices reached their historical maximum. It happened because reserves in platinum ETF funds dropped by 5.6%, and assets of palladic ETF funds increased by 36%. Thus, palladic ETF funds outran both platinum and silver ETF funds.

For the last two years, futures for palladium gradually fall at the exchange. Taking into account decrease in metal extraction and its possible deficit, reduction in the price seems unexpected. Experts explain this situation by decrease in the economy of China as the main importer and also by emergence of cheaper neutralizers of car exhaust in the automobile industry. In 2015, the average world price on palladium was about 550–600 dollars per ounce, and decrease in price continued.

Nevertheless, experts in the precious metal exchange do not provide pessimistic forecasts concerning palladium. They note a possibility of increase in palladium prices in 2017 and in the next years. Firstly, there is always need for electronics, medicine, chemical and other industries. Secondly, Russia has plans to open new, uncharted fields of palladium. However, it should be noted that investment into palladium has a long-term character and will rather allow keeping money than making fast profit. Thus, having studied price fluctuations in the precious metals market, we will study conjuncture interaction of prices and will define the nature of dependence between various precious metals.

A distinctive feature of precious metals markets is a high degree of correlation. To confirm this statement, the regression analysis of prices on precious metals was carried out. The period from 2012 to 2015 was considered for simplicity of calculations.

The greatest correlation is observed between gold and silver markets. It is confirmed by the correlation coefficient, which is equal to 0.94. There is a sufficient correlation between platinum and palladium markets. This is because platinum and palladium are used in production of automobile catalysts. The correlation coefficient between them is 0.66.

The essential correlation is also observed between prices on platinum and gold, and still there is a big correlation between prices on silver and platinum (correlation coefficients, respectively, are equal to 0.87 and 0.91). These noble metals have been applied in production and have been satisfying the increasing demand from China since 2013. At the same time, gold and palladium markets almost do not correlate with each other (their correlation coefficient makes 0.47). Table 1 illustrates correlation of prices between precious metals.

Table 1 Correlation of prices between precious metals

	2012	2013	2014	2015	Average
Gold					
Silver	0.93	0.97	0.94	0.92	**0.94**
Platinum	0.79	0.95	0.83	0.92	**0.84**
Palladium	0.36	0.51	0.17	0.86	0.47
Silver					
Platinum	0.91	0.92	0.93	0.89	**0.91**
Palladium	0.53	0.49	0.26	0.90	0.54
Platinum					
Palladium	0.71	0.58	0.42	0.92	**0.66**

Source Authors, calculated on the basis of the data of the Investfunds Web site. URL: http://gold.investfunds.ru/indicators/, Accessed 23 March 2018

During 2013, correlation between gold and silver remained the strongest among other indicators in the study. It is not surprising if we take into consideration a historical link between these two metals (Fig. 1). Interrelations of gold and silver were especially strong within a year. Nevertheless, this interrelation weakened in the next years because fears that deceleration in GDP growth of China can reduce demand for nonferrous metals caused mass sales by funds. Silver lost more than 25% of cost in the second half of the year after nonferrous metals, while gold lost more than 10% for the same period. The index of dollar grew more than by 12% in 2015, but gold fell in price only by 1.8%. It presupposes that the force of dollar was not completely reflected in lower prices on gold in dollars. At the same time, it obviously contributed to decrease in prices on gold, nominated in dollars.

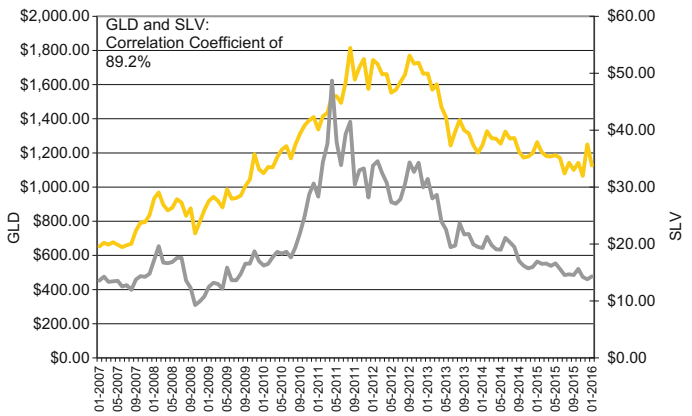

Fig. 1 Correlation dependence of gold and silver prices. Valuation prices on refined precious metals (*Source* The official site of the Central Bank of the Russian Federation. URL: http://br.ru/hd_base/?prtid=metall_base_new, Accessed 23 March 2018)

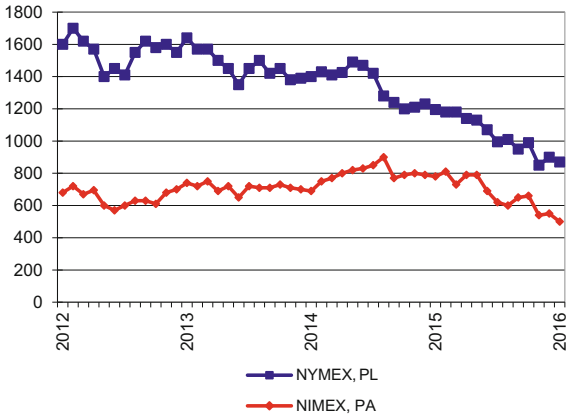

Fig. 2 Correlation of platinum and palladium prices. Valuation prices on refined precious metals (*Source* The official site of the Central Bank of the Russian Federation. URL: http://br.ru/hd_base/?prtid=metall_base_new, Accessed 23 March 2018)

The close interrelation between platinum and palladium is confirmed by their chemical characteristics (see Fig. 2). They are in one group of the periodic table and have similar industrial applications, especially in catalysts. The automobile sector dominates among consumers of platinum and palladium in autocatalysts, and its share was 41 and 69% of global gross demand for platinum and palladium in 2015. Unlike demand, supply of both metals is more various. Various events in the market within a year influenced the prices on palladium and platinum: the strike action in the Republic of South Africa, tension between Russia and the West, messages that Norilsk Nickel was about to buy a large amount of palladium from the Russian state stocks and the growing production of cars. Besides, during 2015 palladium and platinum markets remained under the influence of a sharp decline in many commodity markets—metals, energy resources, agricultural. On the other hand, while almost all these factors affected both metals equally, differences in influence of demand from automobile industry and specifics of mining of each metal weakened a little interrelation between them. Nevertheless, daily correlations remained the strongest among all ranges of the observed assets.

Platinum usually has closer correlation with gold (see Fig. 3), than palladium. It is partially caused by proportionally bigger demand for jewelry from platinum.

It dates to platinum group metals use in automobile branch, which gradually became top in consumption volume, before that jewelry (especially in Japan) was the main source of demand for platinum. In 1992–2002 (the last year before leadership of autocatalysts in the structure of demand), jewelry demand was 43% of the total demand for platinum, and that was much higher than a 35% share last year. The role of palladium in jewelry, which grew at the period 2000–2002 and at the beginning of the 2000s, significantly faded, and after six years of reduction, its share is now less than 5%. The markets almost do not perceive palladium as metal for jewelry; however, its industrial use continues to grow sharply. Besides, correlation between platinum and palladium and gold decreased in 2015. It was caused by strengthening of dollar and total outflow of capitals from commodity markets. It resulted in short-term turbulence and distortions within the sector.

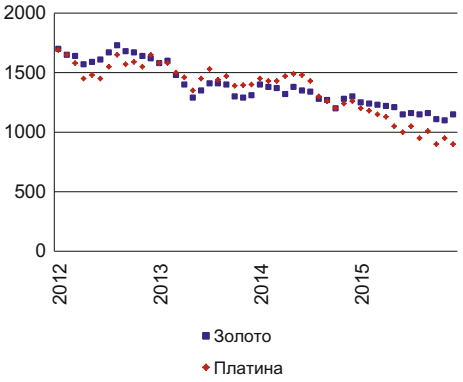

Fig. 3 Correlation of gold and platinum prices (*Source* Valuation prices on refined precious metals. The official site of the Central Bank of the Russian Federation. URL: http://br.ru/hd_base/?prtid=metall_base_new, Accessed 23 March 2018)

Thus, it was revealed that the greatest dependence of prices is observed among metals similar in chemical characteristics (platinum and palladium) and also in consumption spheres (gold and silver, gold and platinum).

4 Discussion

Russia is among countries with the richest natural resources of precious metals. It is traditionally in the first row of producers of gold and other precious metals and occupies an important place in the world market. The domestic market is export-oriented. It means that extracted precious metals are enough not only for meeting the needs, but also for bulk transferring to other countries. Nine percentage of the world mineral reserves of gold are in Russia, and the share of the world gold export is 10%. Russia has huge reserves of platinoids and takes the second place in the world in platinum extraction (26 tons). Such indicators reflect the prospect for possible development of the precious metals market in Russia. It will increase rates only by taking measures which can liberalize the market and eliminate monopolization.

The precious metals market in Russia remains one of the most archaic as there are elements of the command and administration system, laid in the USSR. In the sphere of foreign trade, it is almost impossible to negotiate a contract directly between a seller and a consumer. The government monopoly in foreign trade transactions creates mistrust from foreign consumers and investors in relation to Russian markets because of unpredictability of deliveries. The main reason is imperfection of the regulatory and legal framework, inconsistencies and disparities in various regulatory legal acts, which create contradictions while carrying out foreign trade operations. Many economists and politicians claim that movement to liberalization of the precious metals market is impossible without adoption of new regulatory and legal framework or its improvement.

It is necessary to understand that in order to fix favorable situation in the world scene, this branch should be based on firm positions of the country's economy. The Russian branch of precious metals has the prospects for growth in the world market. The following tendencies give a competitive advantage among other branches:

- Computer facet of diamonds and their distribution in the world market;
- Production of precious metals from waste using new knowledge-intensive technologies;
- Production of automotive catalysts using platinum that conform to international standards;
- Use of unique domestic technologies for processing customer-owned foreign raw materials and some other.

If we adhere to goals coordinated in 2007 and 2008 at the summits of the world's major economies, the policy of the World Trade Organization (WTO) does not constitute a danger for the market. It is necessary to consider not only the accepted terms of trade, but also other important factors, such as ecology, culture and others.

Large enterprises and corporations of the precious metals market take into account this rule: They are known both inside the national market and in foreign ones. They agree on a meeting with WTO. Besides, there are leading associations, which see their business as social force with certain interests, and they are respectively ready for mutual actions.

The association "Guild of Jewelers of Russia" is one of such organizations. Its goal is cooperation of business and society, which, as a result, will provide Russian jewelry branch with positive reputation in society, working for its stability. Jewelers are ready to join the budgetary policy and its strategic mid-range goals, which are set in the President's Budgetary Message to the Federal Assembly of the Russian Federation. Within this program, all entities of the precious metals market can be consolidated: participants of jewelry business, investment funds, banks, government institutions.

At the congress of the World Confederation of Jewelers CIBJO in 2014, jewelers confirmed their readiness for a dialogue in order to find new opportunities for the state regulation, promoting the branch and Russian society. They offered a new nationwide project at the state level, attractive to the whole country. The project was named "Power—Business—Society," and its tasks are effective development of jewelry business, increase in tax payments, creation of new jobs, support of science and education and also elimination of smuggling and illegally made jewelry, whose volumes annually grow. Experts estimated the volumes of contraband goods from 30 up to 60% of market size.

Jewelers are afraid of increase in volumes of fake jewelries, which spoil the image of Russian branch. They suggested establishing international standards in Russia and introducing association standards, which would elaborate certain criteria of compliance of Russian jewelry stores and service to customers, certification of diamonds and creation of ethical standards in the market.

Jewelers also made a number of offers concerning legal regulation, intellectual and technological support. At the present time, the business community of this branch studies these proposals and actively discusses branch standards. They stipulate that jewelry enterprises will be supplied with new high-tech equipment, they will be provided with highly professional staff, and the precious metals market will reach a new level. National traditions of jewelry production, jewelers–designers and masters are taken into account. This rich art should be developed by the younger generation.

Ambitious plans of Russian jewelers provide real prospects for becoming competitive not only in national, but also in the world market. It is shown by the performance of their development. In 1999, their consumption made 17 tons of gold, and in 2006 it was close to 50 tons with intention to increase up to 150 tons. In 1966, the legal volume of retail in the jewelry market in Russia rose beyond 3.6 billion dollars (a half is made by jewelry with diamonds) and continues to increase (unfortunately, illegal volume of retail grows too). According to association of Russian jewelers, there are already 170 thousand tons, soon there will be 200 thousand tons, and 60% accounts for small business. It means new jobs, new revenues in the state budget and also a new view on business.

Other associations in this branch are Union of Gold Producers, Russian Gold Prospectors' Union, Russian Diamond Union, Diamond Manufacturers Association, Interregional Association of Producers and Consumers of Precious Metals and other nonprofit organizations, which have both their own achievements and problems. They unite participants of commodity and services market in the branch of precious metals in their professional interests. Growth in demand and supply in all market segments of precious goods and services is now a tendency in the world market. It contributes to a long-term development of their business. That is why it is necessary to have a strong legal, regulatory and social framework.

Currently, the modern European model of corporate social responsibility (CSR) expands its activity in Russia. The basis of its work is commitment of the business initiative to three spheres—economy, employment and environment. The business is not capable to solve social problems of the population independently, but it can do it by means of harmonized activity of civil society, nonprofit organizations and public institutions. When developing Russian CSR system, not only economic factors, but also other necessary components like mentality of the population, state of the legal base, level and features of development of civil institutions are taken into consideration.

It is known that Russia has an original historical way, and, respectively, it requires nonstandard solutions. The experts of the International Labor Organization calculated that about 25% of Russians are below the poverty line, and this fact should be considered while developing consolidated offers for the government. The reason for the shadow economy in the precious metals market can be people living below the poverty line, who create an illegal supply in the market because of lack of sufficient means of living.

As a rule, there are two main spheres of consumption in the precious metals market—jewelry production and retail investment demand. The world tendency

regarding jewelry production is rather high consumption of gold by the countries with the developed jewelry industry, and that, respectively, influences metal import.

According to data of the Russian State Assaying Chamber at the Ministry of Finance of the Russian Federation, in 2016, 37.16 million units of jewelry were tested and branded. In general, assessment of pure gold makes about 58.3 tons. However, by various estimates, from 25 to 50% of the branded goods are made by "gray" import from the nearby countries, which have jewelry productions, such as Turkey, Armenia and Italy. Taking into account the specified information, it is possible to conclude that the ratio of mining and jewelry consumption of gold in Russia does not exceed 16%.

The existence of VAT in Russia forms the basis for such disproportion as turnover of gold bullions is subject to VAT. Almost in the whole world, there is no VAT on sale of bullions of precious metals. Therefore, this fact is the prime cause for high costs of raw materials for domestic jewelry production. That is why the price on raw materials is, at least, more expensive by 18% than for foreign competitors. The lack of VAT on distribution of bullions for producers of jewelry branch contributes to successful development of the precious metals market even in such countries, where there is no extraction of precious metals.

Thus, it is obvious that state measures promoting competitiveness in free trade in the world market are necessary for the precious metals market in Russia. For this purpose, it is necessary to have sufficient time, as many spheres demand changes. Today, Russian government undertook the following measures:

(1) Grant licenses for use of subsoil areas, containing precious metals and gemstones.
(2) Determine requirements to account, storage, transportation of precious metals and gemstones and report on them; determine the mechanism of transactions with precious metals and gemstones.
(3) Develop regulatory framework of companies' activity and work of individual entrepreneurs, who carry out transactions with precious metals and gemstones in the national and world markets.
(4) Comply with laws of the Russian Federation in the field of geological studying and exploration of mines of precious metals and gemstones; control their extraction, production, usage and circulation.
(5) The President of the Russian Federation established regulations on import and export of precious metals and gemstones.
(6) Define the mechanism of customs control over import on the territory of the Russian Federation and export of precious metals and gemstones.
(7) Develop the certification scheme of precious metals, worked gemstones and articles made of them.

Moreover, the central bank and other commercial banks were given the right to buy gold and silver bullions, according to the agency or commission contract from subsoil users. As the Law on the Central Bank forbids conducting transactions with investors

and industrial consumers, the Bank of Russia can purchase gold and silver bullions only from authorized banks.

In conditions of instability of world financial markets and growth of inflation expectations, many developed and developing countries encourage development of transactions with precious metals in the domestic market. They are considered as one of the tools of monetary and credit policy, which promote strengthening of macroeconomic stability in the country and increase trust of market participants to the national currency. In this regard, it is expedient to consider the role of precious metals and their application in the banking sector.

As international experience shows, banks play a leading role in transactions with precious metals in the domestic market. They are major financial intermediate sellers, who provide interrelation between producers and consumers of precious metals. At the same time, they act as major investors in the extracting branch, which create conditions for steady development of the precious metals market. In this regard, in the majority of countries the state policy in the field of the precious metals market development is based on ensuring the preferential activity to bank operations with precious metals.

Banks use precious metals in the form of bullions and prefer gold ones. Bank operations with platinum and palladium are less developed. For conducting transactions with precious metals, banks should obtain the corresponding license, which is provided by the Bank of Russia. However, if there is no license, banks can use precious metals for ensuring fulfillment of obligations of legal entities and individuals (residents and nonresidents). They can also provide services in storage and transportation of precious metals to market participants.

The least often precious metals are placed in deposits as this asset is less volatile in comparison with currency and stocks. It means that there are fewer opportunities for receiving interest return. Buying collector coins, especially made of gold and silver, becomes widespread among the population. Besides visual appeal, they are means of investment.

In conditions of economic instability, precious metals are widely used as means of hedging and saving of financial means. Negative correlation of precious metals with most economic assets allows including them in the investment portfolio during the periods of crises, thus reducing risks of losses of income (Ntim et al. 2015). As a rule, derivative financial instruments or combined transactions (e.g., contracts on immediate delivery terms, spot transactions with various dates of valuation, forward transactions and bank operations with derivatives) are used for this purpose.

Apart from banks, exchanges also carry out transactions with precious metals.

The share of operations of banks and exchanges with precious metals is rather small now—about 1–2% of the total amount of bank transactions. However, a number of banks that have licenses for transactions and dealings with precious metals are insignificant, and it makes about 14% of their total amount in the country. The following internal factors are the reasons for that: The banking sector is a rather expensive type of business, and not all banks can afford it; absence of

highly qualified staff in this sphere; underdeveloped branch network in most banks. The exceptions are: Sberbank of Russia, Alpha Bank, Rosbank, Vneshtorgbank, Bank of Moscow, Master Bank and Zenit.

Let us consider some problems in more detail. As it was already mentioned, the main problem, hindering market development, is imperfection of the regulatory and legal framework. A new version of the Law "On Currency Regulation and Currency Control" dated 10.12.2003 №. 173-FZ excludes precious metals from the category of currency values. It significantly facilitates their distribution and eliminates some problems, connected with the right for possession and disposition. Withdrawing the status of currency values from precious metals legally transfers them to commodities, which are provided with uncontrolled distribution and free movement throughout the entire territory of the Russian Federation by the Article 8 of the Constitution of the Russian Federation. If now precious metals are commodities, then, according to the Article 5 of the Law "On Banks and Banking Activity," banks are forbidden to be engaged in trade activity. Such situation confuses banks. To resolve this problem, it is necessary to give precious metals a legal status of a financial asset in bank transactions and dealings.

The main objective in the field of legal regulation of the market is development and acceptance of a new edition of the Law "On Precious Metals and Gemstones." This version should indicate only specific legal framework to regulate relations, which arise in the field of extraction, production, use and circulation of precious metals.

The precise definition of "unallocated bullion account" is practically absent in regulatory legal acts, in particular in the Civil Code of the Russian Federation. As a result, certain difficulties arise, especially concerning establishment of legal relationship between banks and owners of accounts, and it also requires solution.

The Federal Law "On Deposit Insurance in Banks of the Russian Federation" provides guarantees for owners of money, placed in the bank on the basis of the bank account contract, which include metal accounts. However, application of the law to insure metal accounts causes certain difficulties. For example, this law does not extend to metal accounts of safekeeping. But there are unallocated bullion accounts, which can be opened in two ways: by depositing money and by placing certain bullion. Being guided by the law, it turns out that accounts with financial means will have guarantees, and metal accounts will not have them. Such differentiation is illegal. It is necessary to modify the law, and it will provide a guarantee to persons, who opened a metal account by depositing a metal ingot.

Further development of the national precious metals market is slowed down by weak liquidity of gold for real investors (legal entities and individuals). It is caused by existence of the value-added tax, which is charged on sale of bank bullions and coins from precious metals. It makes this operation economically irrational.

During their activity with bullions of precious metals, banks drew the conclusion that if sales of weighted ingots are not subject to VAT, it can heighten interest of the population in investments into precious metals, in particular, in gold. And precious metals will be able to create competition to dollar and other currencies.

At the same time, precious metals became analogs of fully convertible currencies almost in all countries of the world. They are purchased and sold without additional taxation. In Russia, precious metals are double treated. On the one hand, when commercial banks sell them in the interbank market or to the central bank, they do not leave certified storages; they are considered as currency value and circulate without VAT. But if precious metals leave certified storages, they become goods and are subject to VAT. An investor gets into strange situation. If he purchases a metal ingot and wishes to take it away from a bank, he must pay more. If he wants to sell bullion, a bank will buy it without VAT. Thus, an investor loses 18% of bullion cost. No positive fluctuations of prices in the market will make this operation profitable for an investor.

Thus, it is possible to define the following main tendencies in improvement of bank transactions with precious metals:

1. Introduce amendments to the regulatory and legal framework, concerning mining, production, circulation of precious metals and transactions with them.
2. Expand the circle of financial tools with precious metals.
3. Develop the government securities market (e.g., introduction of bonds of gold federal loan) with participation of the banking sector; also, adopt highly liquid "gold" certificates of commercial banks and securities, which can be freely exchanged on gold.
4. Promote bank integration in the interbank world market by financial and industrial groups (FIGs) and other integrated structures within the precious metals market.
5. Develop information and communication technologies; in particular, develop the Internet exchanges of precious metals and a uniform international information space (Ziaei 2012).

It is necessary to begin with the regulatory and legal framework, in particular the regulation of the VAT problem. It seems advisable to make certain changes in the operating system or enhance the efficiency of the VAT system. In particular:

– Introduce the definition of "investment precious metals" to the tax legislation on VAT; it will make the system of operations with precious metals more transparent and will provide a possibility of effective control.
– Grant persons and nonbank institutions (in case if bullions of precious metals are purchased for the investment purpose) a remission of VAT payments regardless of whether bullions are withdrawn from bank storages or remain there.
– VAT payment at the standard rate (18%) when using acquired investment precious metals for industrial purposes.
– Preserve VAT rules for export–import transactions.
– Introduce special VAT rules (reverse tax charge) in certain cases by amendment of the tax liability for VAT payment from a seller to a consumer.

The offered VAT rules for operations with precious metals should stimulate investment activity of the population and organizations, implement the basic principles of VAT, result in minimum losses and risks for the state budget and grant enterprises a remission of taxation, providing production of precious metals with the corresponding raw materials and manufacturing precious metals.

The above-mentioned development measures will allow using substantial potential of the precious metals market in Russia for its dynamic development.

5 Conclusions

The precious metals markets are specific shopping centers with precious metals, where they are daily purchased and sold at market prices for industrial and domestic consumption, private hoarding, investments, risk insurance, black marketeering and acquisition of necessary currency for international payments. The precious metals market in Russia is not completely created and developed. There are some problems hindering its development.

The main conclusions of the contribution are the following:

- Precious metals represent financial assets that have special features different from other assets. Gold, silver, platinum and palladium belong to the main precious metals.
- Precious metals underwent long historical evolution, they served as money equivalent for a long time (up to the middle of the twentieth century), and then they found application not only in economic and investment, but also in other various areas.
- Comparison of gold and paper money as forms of money equivalent of different historical eras was carried out. Therefore, the main features of gold distinguishing it from banknotes are defined. They are its rarity and the nature of production and extraction. The similarity of these two concepts is one of the money functions—means of hoarding.
- Price fluctuations during 2000–2015 in the world precious metals market were analyzed; the interdependence of prices on various metals was defined. Therefore, it is established that the greatest correlation between prices is observed among metals similar in chemical characteristics (platinum and palladium) and in spheres of application (gold and silver, gold and platinum).
- The place of the precious metals market in Russia was studied. Therefore, Russia occupies the second place in the world in extraction of platinum, and the share of the world gold export of the Russian Federation makes 10%. Also, the main problems hindering development of the precious metals market in Russia were defined. Among them are imperfection of the regulatory and legal framework, VAT and others.
- The authors of the contribution suggest the following measures to improve bank transactions with precious metals:

1. Introduce amendments to the regulatory and legal framework, concerning mining, production, circulation of precious metals and transactions with them.
2. Expand the circle of financial tools with precious metals.
3. Develop the government securities market (e.g., introduce bonds of gold federal loan) with participation of the banking sector; also, adopt highly liquid "gold" certificates of commercial banks and securities, which can be freely exchanged on gold.
4. Promote bank integration in the interbank world market by formation of financial and industrial groups (FIGs) and other integrated structures within the precious metals market.
5. Develop information and communication technologies; in particular, develop the Internet exchanges of precious metals and create a uniform international information space.

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Assessing the Financial Health of Companies Engaged in Mining and Extraction Using Methods of Complex Evaluation of Enterprises

J. Vrbka and Z. Rowland

Abstract To evaluate the financial health of a company, comprehensive enterprise evaluation methods are very important. These include, in particular, creditworthiness and bankruptcy models and economic value added (EVA). Creditworthiness models effectively evaluate a company's financial health without using statistical methods, bankruptcy models indicate a threat to the financial health of the business, and are important for many decision-making processes. The aim of this contribution is to evaluate the financial health of an average mining and quarrying enterprise using comprehensive enterprise evaluation methods. Data of companies in this industry is used—specifically, the financial statements for 2012–2016. It is the average enterprise for which these bankruptcy and creditworthiness models are applied: Altman's analysis in all modifications, indices IN (IN95, IN99, IN01, and IN05), Tafler index, Grünwald index, Kralicek's quick test in original and modified version, and index of creditworthiness. EVA is further explored in two of its variants—EVA Equity and EVA Entity. Based on the results of these comprehensive enterprise evaluation methods, it can be concluded that the mining and quarrying industry is not financially sound in the Czech Republic. It is possible to correct negative phenomena that characterize the whole industry.

1 Introduction

Tools of comprehensive evaluation of company are keys to all processes throughout the whole society. Evaluation of enterprises helps to identify not only strengths and weaknesses, opportunities and threats, but also the company's successfulness in the market compared to its competitors (Linna and Jaakkola 2010). Methods for

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complex evaluation of enterprises are capable of detecting the influence of all unwanted factors affecting the whole company (Mironiuc et al. 2011).

There are various forms of complex enterprises evaluation, including the way the enterprise treats its employees, the relations with its business partners, whether the enterprise is environmentally friendly and of course the assessment of its financial health. To assess the financial health, e.g., creditworthy or bankruptcy models can be used (Gepp et al. 2010).

According to Kubenka (2016), financial creditworthy models are popular because of their simplicity and easy application. Especially, the quantitative assessment of financial health ensures objective evaluation of the enterprise. The most frequently used creditworthy models are considered to be index of creditworthiness and Kralicek's quick test. These models have been created for the purpose of assessing creditworthiness, usually without the application of the statistical methods. Horváthová et al. (2015) state that creditworthiness models are based on theoretical findings and enable to assess the overall prosperity of the enterprise and its position in the market.

Bankruptcy or prediction models are early warning systems based on analyzing selected indicators that have the ability to indicate company´s financial health threats. These models are based on the assumption that it is possible to identify symptoms of possible future problems several years before the bankruptcy (Rybárová et al. 2016). Creating reliable models for predicting bankruptcy is very important for a number of decision-making processes. Among the most commonly used models are the Altman bankruptcy model, Index IN95, and Taffler model (Mousavi et al. 2015).

Complex enterprise evaluation methods are very important for detecting financial health of an enterprise. Their advantage is that the conclusions drawn are not influenced by subjective opinions and experience of the experts, but are precise (Vochozka et al. 2017). However, their big disadvantage lies in the way and form of interpretation of partial results of analyses with the final assertion that the financial and economic condition of the enterprise is or is not ideal (Vochozka 2010).

Regarding the concrete application of the complex enterprise evaluation methods, e.g., Vochozka, Rowland, and Machová (2017) carried out an assessment of an average company engaged in electricity production in the Czech Republic between 2011 and 2015. For the purpose of complex enterprise evaluation, creditworthiness and bankruptcy models were used as well as EVA Equity and EVA Entity. On the basis of the results achieved, it is possible to state that the analysis of the branch based on the analysis of an average enterprise engaged in the specific sector of national economy comes with a very important view and recommendations for the management of all enterprises operating in this sector. It is possible to correct negative phenomena characterizing all the electricity production sectors and predict future development as well. Hašková (2017) in her contribution achieved the same results as the above mentioned authors. However, her objective was to determine the financial characteristics of an average construction company in the Czech Republic.

The above mentioned EVA is a useful and very important tool for assessing the performance of the enterprise. It combines various factors such as economics, accounting, and information on market (Issham et al. 2008). The EVA indicator is thus one of the most important indicators of value and provides several options for its calculation. The options are based either on accounting (or operational) or financial (or current values) access and particularly they apply to calculating EVA Entity and EVA Equity.

In terms of accounting access, EVA (known as EVA Entity) is described using the following equation (Bluszcz, Kijewska and Sojda 2015):

$$\text{EVA} = \text{NOPAT} - C * \text{WACC}$$

where:

NOPAT net operating profit after tax,
C capital service generating the operating profit,
WACC weighted average costs of equity.

EVA Equity is considered a structure revealing the fact that the economic value depends on the equity value €, on the return on equity (ROE) and cost of equity—r_e (Šalaga, Bartošová and Kicová 2015):

$$\text{EVA} = (\text{ROE} - r_e) * E$$

where:

ROE return on equity,
r_e cost on equity,
E equity.

2 Materials and Methods

The data for the analysis will come from the Albertina database, of which the information on mining and quarrying enterprises, i.e., section "B" (mining and quarrying) of the CZ NACE sectoral classification of economic activities. Specifically, data from subgroup 05 (mining and processing of black and brown coal), 06 (extraction of crude oil and natural gas), 07 (extraction and treatment of ores), 08 (other mining and quarrying), and 09 (mining support activities) will be used.

Additionally, a series of five consecutive business years is required for the analysis. Thus, the number of enterprises will be as follows for each year of analysis:

- year 2012: 227 enterprises,
- year 2013: 218 enterprises,

– year 2014: 212 enterprises,
– year 2015: 204 enterprises,
– year 2016: 167 enterprises.

The analysis requires the need for financial statements, namely balance sheets and profit and loss statements for all of the aforementioned enterprises in the five consecutive years. We will determine the financial characteristics of the average companies by the average of the values stated in the individual items of all the enterprises surveyed in the given year. Of course, the average value may seem inappropriate. This is because, in general, extreme values at both poles of the scale can deflect the result on one side or the other. As a result, either some of the average modifications (e.g., the harmonized average) or the modus or median are often used. In this case, however, it is not absolutely necessary. The file shows enough data to allow extreme values to exist on both sides of the scale, and their frequency will not significantly affect the result. After obtaining the financial statements of the average mining and mining company in the Czech Republic, an analysis will be carried out to assess the financial health of the enterprise.

The following methods will be used for comprehensive business evaluation:

1. Bankruptcy and creditworthiness models:
   a. Altman indices—specifically for companies tradable on financial markets, companies not tradable on financial markets, and modification suitable for Czech companies,
   b. Neumaiers'indices, i.e., IN 95, IN 99, IN 01, and IN 05,
   c. Tafler index,
   d. Grünwald index,
   e. Kralicek's quick test (both original and modified),
   f. Index of creditworthiness,
2. Economic value added (EVA Equity and EVA Entities).

3 Results

Extensive Table 1 provides the results of applied bankruptcy and creditworthiness models.

All Altman indices, in all years, predict the decline of the average enterprise. The IN95 index shows that in 2012, the enterprise is able to survive any financial turmoil, run into bankruptcy in 2013, and from 2014 to 2016 it is in the gray zone. The IN99 index, however, denoted the company as bankrupt, in all the years under review. The IN01 index shows that in 2012, the business is in the gray zone, but in the years to come it marks the enterprise as going bankrupt. The IN05 index ranked the enterprise as bankrupt in all the years under review. Tafler's index measures the average business fairly positively, claiming it is not going to bankrupt, with respect

Table 1 Bankruptcy and creditworthiness models

Indicator	2012	2013	2014	2015	2016
Altman analysis—companies tradeable in financial markets	1.281770953	0.70191452	1.083393774	1.06271487	1.072660763
Statement	Enterprise failing	Enterprise failing	Enterprise failing	Enterprise failing	Enterprise failing
Altman analysis—companies not tradeable in financial markets	1.053090383	0.537678264	0.901050792	0.902338294	0.887002215
Statement	Enterprise failing	Enterprise failing	Enterprise failing	Enterprise failing	Enterprise failing
Altman analysis—modification suitable for Czech companies	1.281770953	0.70191452	1.083393774	1.06271487	1.072660763
Statement	Enterprise failing	Enterprise failing	Enterprise failing	Enterprise failing	Enterprise failing
IN 95	2.636517351	−0.946583609	1.099439704	1.422622504	1.053462285
Statement	Enterprise is able to survive any financial distress	Enterprise is going bankrupt	Enterprise is in the gray zone	Enterprise is in the gray zone	Enterprise is in the gray zone
IN 99	0.584531697	−0.110117759	0.365304303	0.420888902	0.294844411
Statement	Enterprise is going bankrupt	Enterprise is going bankrupt	Enterprise is going bankrupt	Enterprise is going bankrupt	Enterprise is going bankrupt
IN 01	1.204750653	−0.243166486	0.599830239	0.731964097	0.579631071
Statement	Enterprise is in the gray zone	Enterprise is going bankrupt	Enterprise is going bankrupt	Enterprise is going bankrupt	Enterprise is going bankrupt
IN 05	0.535241369	0.515829897	0.556425523	0.563599864	0.524046652
Statement	Enterprise is going bankrupt	Enterprise is going bankrupt	Enterprise is going bankrupt	Enterprise is going bankrupt	Enterprise is going bankrupt
Tafler Index	0.438465472	−0.222222983	0.207714286	0.255191193	0.215615589
Statement	Enterprise is not going bankrupt	Enterprise is going bankrupt	Enterprise is not going bankrupt	Enterprise is not going bankrupt	Enterprise is not going bankrupt
Grünwald index	0	0	7.859254561	9.108959458	0

(continued)

Table 1 (continued)

Indicator	2012	2013	2014	2015	2016
Statement	–	–	Creditworthy enterprise	Creditworthy enterprise	–
Kralicek's quick test—(original) average grade	2.5	1.5	2.5	2.5	2.5
Statement	Average enterprise	Bad enterprise	Average enterprise	Average enterprise	Average enterprise
Kralicek's quick test—(modified) average grade	2.5	1.5	2.5	2.75	2.75
Statement	Bankrupting enterprise	Bankrupting enterprise	Bankrupting enterprise	Bankrupting enterprise	Bankrupting enterprise
Creditworthiness index	1.190341415	−1.072571865	0.50354771	0.219560457	0.151808496
Statement	Good credit	Very bad credit	Certain problems	Certain problems	Certain problems

Source Authors

to 2013 when it claims the opposite. The Grünwald Index is only able to rate the business in 2014 and 2015 (due to missing values), as a creditworthy business. The Kralicek's quick test in the original version ranks the company into average companies; only in 2013, it evaluates the enterprise as bad. The modified Kralicek's quick test characterizes the business as bankrupting in all the years under review. The creditworthiness index claims that in 2012 the company has good creditworthiness, but in 2013 it has a very bad credit rating. In the years to come, the company has some problems. Bankruptcies are considered primarily by IN99, IN01, IN05, and modified Kralicek's quick test.

The second area of an enterprise's comprehensive valuation is the EVA methods, namely EVA Equity and EVA Entities. Table 2 provides a calculation of the EVA Equity indicator.

The EVA Equity indicator evaluates the enterprise's benefits for its owner. It assesses the correctness of the investment made taking into account the level of risk with respect to other investment alternatives in the market. If the value is less than 0, the investor should consider his departure. This was exactly the case with the average mining and mining company in all the years under review. Table 3 includes the calculation and result of the EVA Entity indicator.

The EVA Entity indicator evaluates the attractiveness of the investment for the owner and the creditors of the business. As the same as above, the value above the level of 0 is desirable. The result for this indicator is the same as for EVA Equity. In all the years under review, it is negative, well below the value of 0. The following charts illustrate the comparison of both EVA indicators. Figure 1 shows the weighted average cost of capital.

The weighted average cost of capital (NN) is EVA Equity, with the weighted average cost of capital (CAPM) representing EVA Entities. The figure shows a positive development as the weighted average cost of capital declined (except for the moderate increase in the weighted average cost of capital of EVA Entities in 2016). Average capital costs for EVA Equity increased significantly in 2013, but declined significantly in the years to come, except in 2016 when their value rose again.

Figure 2 provides a comparison of the alternative costs of EVA Equity and EVA Entities.

In this case, the value of the EVA Equity's alternative costs (up to 2012) is higher than the EVA Entity's alternative cost of equity. This, of course, with respect to the calculation of EVA, results in the result that is the subject of Fig. 3.

Thus, EVA Equity is lower than EVA Entities between 2013 and 2016. Only in 2012 is this value higher.

4 Discussion

The EVA Equity and EVA Entity indicators, whose values were negative in all monitored years, were completely unsatisfactory.

Table 2 EVA Equity

Designation	Description	2012	2013	2014	2015	2016
r_f	Risk-free yield	3.89%	3.70%	1.92%	2.20%	0.67%
r_{LA}	Indicators that characterize the size of the enterprise	386%	3.91%	3.88%	4.03%	3.90%
$r^{business}$	Indicators characterizing production power	0.20%	10.00%	10.00%	0.79%	10.00%
	XP	0.098	0.061	0.054	0.036	0.027
ROA	EBIT/Assets	0.055	−0.105	−0.011	0.004	−0.004
$r_{FinStab}$	Indicators that characterize asset-liability relationships	0.00%	0.00%	0.00%	0.00%	0.00%
	Current ratio	2.09	2.81	2.25	2.19	2.17
	Quick ratio	1.76	2.42	1.89	1.85	1.89
WACC	**Weighted average cost of capital (NN)**	**7.95%**	**17.61%**	**15.80%**	**7.02%**	**14.57%**
ROE	Return on equity	8.49%	−13.98%	−2.09%	−0.33%	−0.82%
r_e	Alternative cost of equity (NN)	8.75%	22.61%	22.02%	12.02%	20.18%
UZ	Payable resources (equity + bank loans + issued bonds)	451,848	434,445	446,426	397,420	437,195
d	Income tax rate of legal entities	120%	220%	320%	420%	520%
EVA	**EVA Equity: (ROE-r_e) * VK**	**−1104**	**−136,205**	**−91,398**	**−41,069**	**−78,760**

Source Authors

Table 3 EVA Entity

Designation	Description	2012	2013	2014	2015	2016
EBIT	Profit before interest and tax	49,890.1	−64,578.6	3547.3	10,135	2871.4
t	Income tax rate	*19%*	*19%*	*19%*	*19%*	*19%*
C	Total capital	451,741.7	429,598.3	441,509	392,201.8	431,021.7
D	Foreign capital	30,383.2	57,290.3	62,447.6	59,730.7	55,815.9
D/C	Foreign capital/Total capital	0.07	0.13	0.14	0.15	0.13
r_d	Rate for using foreign capital	15.99%	11.12%	9.44%	6.32%	5.11%
E	Equity	421,358.5	372,307.97	379,062	332,471.1	375,205.8
E/C	Equity/Total capital	0.93	0.87	0.86	0.85	0.87
r_e	Alternative costs for equity (CAPM)	21.47%	12.03%	11.68%	11.30%	11.42%
r_f	Risk-free yield	1.92%	2.20%	0.67%	0.49%	0.53%
$\beta_{leveraged}$	Beta indebted	1.34	0.76	0.76	0.73	0.77
$\beta_{unleveraged}$	Beta debt-free	1.42	0.86	0.86	0.84	0.86
$(r_m - r_f)$	Risk premium	7.08%	6.05%	6.80%	6.87%	6.69%
WACC	**Weighted average cost of capital (CAPM)**	**20.90%**	**11.63%**	**11.11%**	**10.36%**	**10.48%**
C * WACC	Cost of capital	94,411	49,947	49,039	40,622	45,151
EVA	**EVA Entity: EBIT * (1-t)-C * WACC**	**−54,000**	**−102,256**	**−46,166**	**−32,412**	**−42,826**

Source Authors

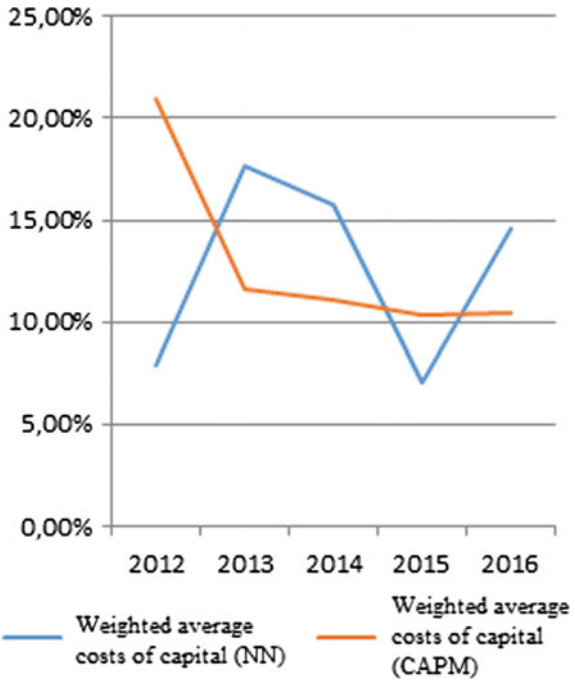

Fig. 1 Weighted average cost of capital. *Sources* Authors

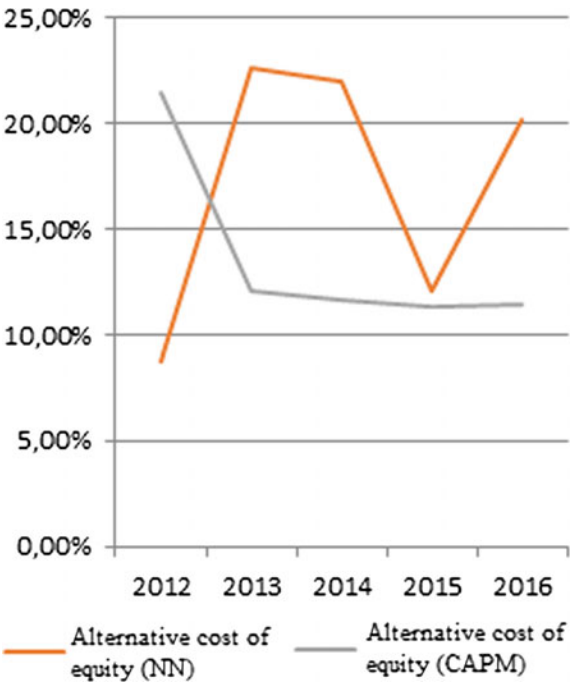

Fig. 2 Alternative cost of capital. *Sources* Authors

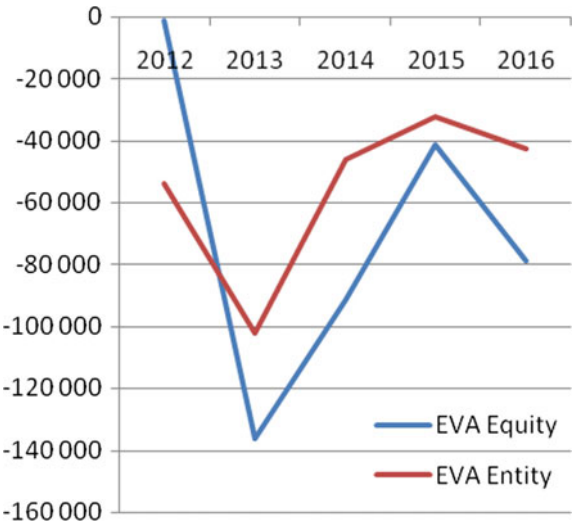

Fig. 3 Economic value added. *Sources* Authors

All Altman indices, in all years, predict the decline of the average business. The IN95 index shows that in 2012, the business is able to survive any financial turmoil, going into bankruptcy in 2013 and from 2014 to 2016 it is in the gray zone. The IN99 index, however, denoted the company as bankrupt, in all the years under review. The IN01 index shows that in 2012, the business is in the gray zone, but in the years to come it marks the enterprise that is going bankrupt. The IN05 index is ranked as bankrupt in all the years under review. Tafler's index measures the average business fairly positively, claiming it is not going to bankruptcy, i.e., with respect to 2013 when it claims the opposite. The Grünwald Index is only able to rate the business in 2014 and 2015 as a creditworthy business. The Kralicek's quick test in the original version ranks the company into average companies, only in 2013 it evaluates the business as bad. The modified version of the test characterizes the business as going into bankruptcy in all the years under review. The creditworthiness index claims that in 2012 the company has a good creditworthiness, but in 2013 it has a very bad credit rating. In the years to come, the company has some problems. Bankruptcies are considered primarily by IN99, IN01, IN05, and modified Kralicek's quick test.

5 Conclusions

The aim of the contribution was to determine the financial characteristics of the average mining and quarrying enterprise in the Czech Republic. The aim of the contribution was fulfilled. An average business was established and a complete analysis performed.

It can be said that mining and quarrying is not financially sound and promising in the Czech Republic. The results at the beginning of the reference period were generally more favorable than at the end of the reference period.

However, we must point out that we are presenting the results of the industry with an average business, that is, the sector with the eyes of one enterprise. It is therefore obvious that some facts might be presented differently from the corporate viewpoint. It is good to note, for example, that the number of enterprises surveyed has changed over time. Different partial interpretations, however, do not mean that the situation has been simplified. On the contrary, the situation has been so simplified that it is comprehensible and understandable. Based on the results obtained, it is clear that the analysis of the sector, based on the analysis of the average enterprise operating in the given sector of the national economy, provides an interesting view and recommendations for the management of all enterprises operating in the sector. It is possible to correct negative phenomena that characterize the whole industry.

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Effective Development Mechanism of Companies in the Communal Services Sector in Modern Conditions

N. V. Nikitina, V. V. Chaadaeva and A. A. Chudaeva

Abstract The communal sector of the economy is a complicated multi-sectoral complex which combines the political and socioeconomic responsibilities of the state to ensure comfortable living of citizens and the commercial interests of market participants in providing energy resources to the production sector and the service sector. The authors emphasize that insufficient attention is paid to modeling of the activities of the communal complex in order to develop a strategy for managing its effective development in the medium and long terms in the conditions of the economic instability. Understanding of the essence of the processes occurring in a sufficiently problematic communal sector of the economy, formalization and evaluation of the factors that really exert influence on them can become a basic indicator in assessing the potential investment attractiveness of the region.

1 Introduction

The communal services sector of the economy is a complex multi-sectoral complex in which political and socioeconomic responsibilities of the state to ensure comfortable living of citizens and commercial interests of market participants in providing energy resources to the production sector and the service sector are combined in a certain way.

Issues of sustainable development, including communal services in conditions of permanent modernization of the communal services market, are devoted to the work

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of many domestic scientists, such as P. G. Grabovoi, I. Ya. Blekhtsin, T. V. Kolosova, A. G. Koryakov, S. I. Kruglik, A. N. Ryakhovskaya, L. N. Chernyshev and V. Z. Chernyak.

Nevertheless, the insufficient attention is paid to the modeling of the communal complex activity, in order to develop a strategy for managing its effective development in the medium and long term in conditions of economic instability.

In addition, a systematic understanding of the essence of processes in a sufficiently problematic, communal services sector of the economy, formalization and evaluation of factors that really exert influence on them can become a basic indicator in assessing the potential investment attractiveness of the region.

By the level of development of the communal services sector, we can judge a lot:

- How active the local government is and how it builds relations with business.
- The ability of the territory to accumulate capital, and ensure guarantees of return on investment.
- What the relationship with the federal center is.
- How the region is free in certain initiatives, etc.

However, before committing to the allocation of the communal services sector with the powers of an "indicator" to assess the investment attractiveness of the region, an understandable, open and transparent information and economic mechanism should be created that allows operative monitoring objects and entities, monitoring information and financial flows in order to prevent unfair competition and counteracting corruption.

The primary task is the formation of the understandable system of goal-setting, motivation and balance of interests for all participants of market and administrative relations in the communal services sector, for which it is necessary to solve the issue of creating the appropriate mechanisms to ensure:

- Collection, accumulation and analysis of data on the actual volumes of production, consumption and losses of communal resources—as the basis for making balanced, objective and close to reality decisions in the field of effective company management, communal infrastructure systems;
- Creation of incentives for resource-supplying organizations to modernize communal infrastructure systems and improve the quality and reliability of provision of communal services;
- Improving the tariff regulation system;
- Increasing payments from consumers of communal services;
- Creation of effective methods for managing the development of communal infrastructure systems, including their sustainable planning.

Thus, in order to solve the problems of eliminating existing negative phenomena and trends in the development of the communal services sector, the effective development mechanism of companies in the communal services sector in modern conditions seems appropriate.

As of today, the most priority area of the regional economic policy is to ensure the progressive development of the communal services sector of the economy and attract investment funds in its modernization.

The special role of the communal complex that provides vital needs of the population, as well as the reliable functioning of companies in other sectors of the economy, predetermines the need to improve the management system of communal services in the direction of their sustainable development.

As a rule, the vast majority of communal services are characterized by high depreciation of fixed assets, low energy efficiency, lack of qualified personnel in the field of investment and management, the presence of risks associated with social aspects of their functioning and increasing under the impact of the economic crisis.

In addition, the situation is complicated by the multi-purpose nature and the contradictory nature of interests of various groups of consumers and companies that produce communal resources.

In these conditions, an effective solution to existing problems is possible only on the basis of the use of the integrated approach to improve and modernize the forms and methods of managing companies in the communal services sector in accordance with laws and requirements of the modern paradigm.

However, the traditional toolkit of the program-target method, created and successfully applied for more structured and less risky objects, becomes less effective in conditions of high level of uncertainty, the need to take into account and evaluate a lot of conflicting socioeconomic factors, options and constraints for the development of the communal services sector.

In these conditions, key issues of the management quality are gaining importance, which form the principles of maintaining the balance of economic interests of all market participants in the presence of a conflict of interests of the state and companies in the communal complex.

The management concept development of sustainable development of communal services in conditions of state regulation based on the target model and adherence to the principles of efficiency of its implementation will contribute to the conflict-free achievement of a balance of interests between producers and the state regulator in the formation of pricing policies, which in turn will significantly reduce risks of attracting investments.

The purpose of the study is to develop theoretical provisions, methodological and practical recommendations on the formation of the effective development mechanism of companies in the communal services sector.

Within the framework of the set goal, the following tasks are solved:

1. Research of conditions and institutional environment of production and sale of communal resources in conditions of state regulation;
2. Definition of the basic organizational–economic problems for the development of companies in the communal services sector (using the example of the Samara region);
3. Studying of foreign experience of companies' management in the communal services sector;

4. Development of organizational and economic approaches to process management for the development of companies in the communal services sector;
5. Identification of factors and indicators of sustainable development of companies in the communal services sector based on the introduction of the target management model;
6. Development of sound recommendations on the formation of a model of a sustainable development management system for companies in the communal sector.

2 Materials and Methods

The research is based on general principles of economic theory, market economy, corporate management, regional economy; on the analysis of economic, organizational, social problems of reforming the communal services sector; and on the works of Russian and foreign scientists in the field of housing and communal services sector development. In the course of the research, methods of functional, systemic and statistical analysis, methods of expert evaluations, comparisons and groupings, and graphical interpretation; deductive and inductive methods; and generalization and evaluation of research results were applied.

Information base of the research was made by the materials of the Department of Municipal Economy and Ecology of the Administration of Samara, the Federal Service of State Statistics, reference and methodological materials, programs for reforming and modernizing the communal complex of the Russian Federation and Samara, the results of collected and processed materials on the state and development of housing and communal services in Samara.

3 Results

The study showed that the experience of the Russian reform in the communal sphere at the present time cannot be considered completely satisfactory. Most of the problems in the communal services sector remained unresolved: lack of competition in the management of housing and communal services; there is practically no competition among organizations that provide products and perform works of the industrial nature in servicing of housing and home territory; the situation of underfunding of companies and organizations engaged in communal services of the population, which is aggravated every year; constant reduction in the effective demand of the population due to outstripping growth in prices and tariffs as compared to changes in official incomes; and the unreasonable system for regulating tariffs for natural monopoly products, when the tariffs of domestic monopolists are tied to the world price level, not taking into account that the average wage

level in all sectors of the Russian economy, including those that determine the value of monopoly products, is ten times lower than in countries whose economic performance indicators we are trying to use as a benchmark. Such a policy leads to a further imbalance between interests of the population and market-oriented companies, on the one hand, state and natural monopolies, on the other.

As a result of the system–evolutionary study of the stages of development and the reform of companies in the communal services sector (CSS), the organizational and economic mechanism for its effective functioning is presented in Fig. 1.

The organizational and economic mechanism for the effective development of companies in the communal services sector is a system of levers and methods, the

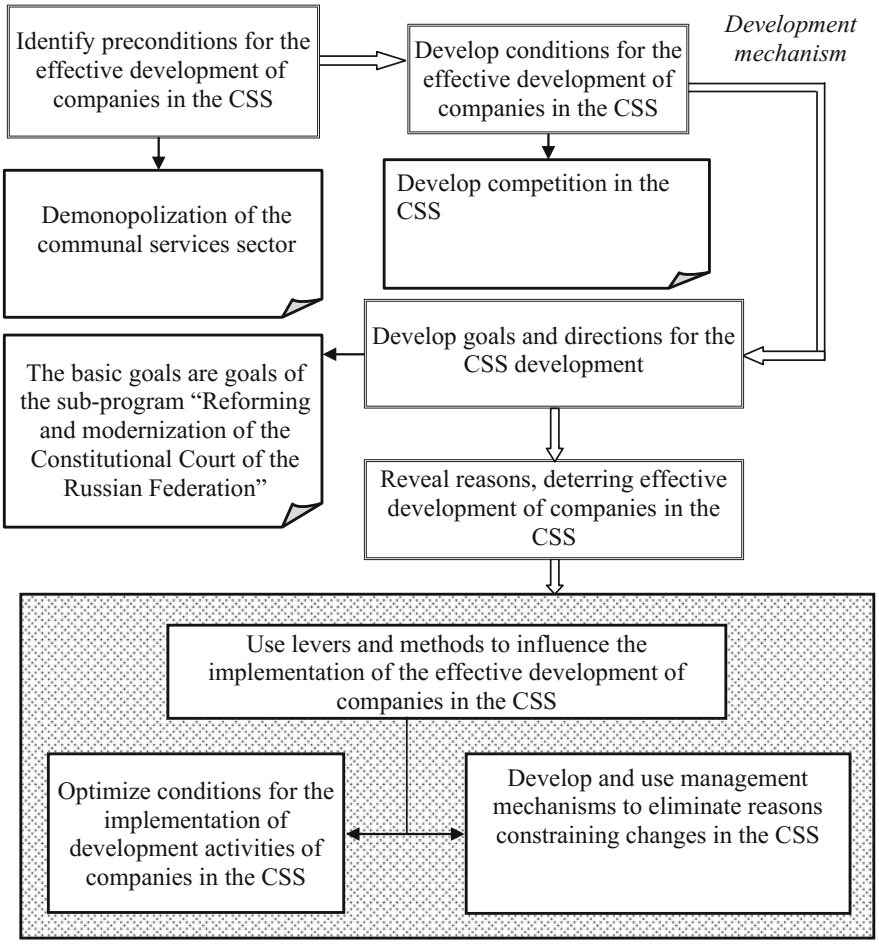

Fig. 1 Organizational and economic mechanism for the effective development of companies in the communal services sector in the context of its reform (*Source* Authors)

use of which allows the governing body (subject) to adjust (regulate) the behavior of the objects in the direction of realizing their goals.

The issues of ensuring efficient and sustainable development of communal services are especially relevant for the modern Russian economy. Modernization and progressive development of communal infrastructure systems, taking into account its current state, as a closed system are impossible.

An integrated approach to managing sustainable development of communal services is needed.

Economic stability gives an assessment of the state of the company with respect to external influences, and a stable one means a state that, with equal external and internal influences, is subject to less changes, deviations from the previous state.

The criterion for assessing the stability of the company to external influences is its own internal properties; therefore, sustainability is an external manifestation of the internal structure of the company.

Therefore, in order to increase the stability of the company to the impact of various factors, both internal and external, it is necessary, first of all, to modernize the development management system of the company.

Therefore, it seems that the activity the communal services sector will be effective and economically sustainable if it corresponds to the formed goal-setting system, motivation and balance of interests for all market participants, and possible adverse situations are neutralized by adequate government intervention, in the form of controlling impacts.

4 Discussion

There are various aspects of economic sustainability: price, financial, technological, organizational, each of which has an effect on the integral indicator in question. In this sense, there arises the need for an integrated approach to improve management of communal services, taking into account the specifics of the communal services market and the role of the regulatory role of the state.

A number of researchers[1,2,3] offered the following elements of economic stability:

- Innovative;
- Commercial;
- Organizational;
- Production and technical;
- Social;
- Financial.

[1]Anpilov (2012).

[2]Kolocheva and Titova (2010).

[3]Sisina (2012).

Table 1 Elements of economic sustainability of the company

Name of the element of economic stability	The features of the element
Innovative sustainability	Ability of the company to introduce new technologies and ways of organizing production, to expand the range of services provided, to produce new types of products
Commercial sustainability	Level of business activity, reliability of economic relations, competitive potential of the company, market share of the company
Organizational sustainability	Sustainability of the internal organizational structure, streamlining and efficiency of communications between different departments and services of the company, the effectiveness of their joint work
Production and technical sustainability	Sustainability of the production cycle of the company, stability of its resource provision
Social sustainability	Involvement of the company's staff in social processes, promotion of the welfare of society and the level of social security of its employees
Financial sustainability	State of financial resources, in which the company is able to ensure the uninterrupted process of production and sale of services, through effective use of these resources, the costs of expanding and renewing production

Source Authors

It is noted that these elements are closely interrelated and each level exerts its influence on the overall economic stability of the company.

The features of the elements of economic sustainability are presented in Table 1.

It becomes clear that economic sustainability is a complex concept that determines the place of the company as a basic element in the common system. An efficiently operating company creates a dynamic mechanism for the growth of the economic system as a whole, which ensures an increase in the capacity for its self-regulation, and thereby broadens the scope of economic stability in crisis conditions.

The analysis of the experience of companies in the communal services sector, which operate quite successfully in the rigidly state-framed framework, proves that for their sustainable development, first of all, the speed and flexibility of reactions to changes in the regulatory and legal framework, the energy efficiency of communal infrastructure systems, financial stability, widespread use of innovations are needed.[4,5,6,7,8,9,10]

[4]Elchin (2009).

[5]Basin (2005).

[6]Demidova (2010).

[7]Olenin (2013).

[8]Smirnov and Telegin (2012).

[9]Obukhova and Ogorodnikov (2013).

[10]Alferova and Tretyakova (2012).

In combination, only this allows forming a dynamically equilibrium integrated system that is able to independently determine its own sustainable development in the medium and long term, in an understandable and accessible form for implementation.

In market conditions of the functioning of regional economic systems, the issue of the need to develop a mechanism for regulating economic relations in the communal services market based primarily on improving their quality is especially urgent. In this regard, the evaluation of the Western experience in the development of this sphere is becoming especially topical. Despite the presence of specific elements in the system for providing housing and communal services and managing its development in various countries with developed market economies, which need to be introduced into domestic practice with extreme caution in view of the specifics of the Russian economy, it becomes possible to identify certain general principles, elements and mechanisms, which in time can become an integral part of the functioning and development of the domestic market of communal services. As the analysis showed, the market model of the functioning and development of the housing and communal services system in the advanced economies is quite effective and reliable and can be taken as a strategic reference point for the development of the domestic communal services sector and the communal services market.

In countries where the market for housing-related services is well developed, participation in the management of its own city home is perceived by homeowners as their advantage. Western homeowners appreciate the possibility of rational and economical spending of funds invested in the quality and comfort of living. In modern conditions, the construction of condominiums has turned into an extremely profitable business. Housing in such houses has 100% liquidity. The organization of self-management of tenants—the association of homeowners—is always represented by developers and agents for the sale of apartments as an additional benefit to buyers. They acquire the right to vote in solving internal issues, the possibility of directly participating in the affairs of the association, the independent choice of managers and operating organizations, the right to influence the quality and cost of services they provide. All provisions concerning the rights and obligations of the homeowner in the condominium are set out in the preliminary contract of sale. The USA is a well-developed rental market. But most Americans tend to buy their own homes. Ideal is to live in your own separate house or apartment, provided that it meets the highest quality requirements. Therefore, condominiums are very popular among the US population.

Unlike the USA in Western European countries, the share of the housing stock owned by the state and the municipality is much higher. A significant position in the housing sector is occupied by cooperatives. Basically, these are large organizations that own numerous dwelling houses. Cooperatives are particularly widespread in Scandinavian countries and Germany. However, in the last decade, a wave of conversion of cooperatives into condominiums has swept across Europe. Ownership of an apartment gives the tenant more advantages than simply owning a unit. Having registered the house as a condominium, the tenants become the owners of their dwelling, and their apartments acquire a new, higher cost.

There are three main procedures for selecting applicants[11]:

(1) Preliminary selection of the contractor. This method is associated with the greatest risk for the local administration, since the contractor appoints it from a certain circle of applicants and grants him the exclusive right to plan, develop a project and prepare financial estimates before the legislative confirmation of his rights to the project is given.
Advantages of this procedure are its low cost and the possibility to attract a contractor at the earliest stage of design.
(2) Selection of the contractor through negotiations. This procedure is used in the case when only one of the possible contractors expresses a desire to implement the project, because it is unprofitable for others. Negotiations are aimed at agreeing terms and payment for works.
(3) Competitive selection of the contractor. This is the most burdensome procedure for the local administration and for applicant firms. It takes a lot of time and often significant financial costs.

The procedure for competitive selection includes the following stages:

1. Preparation of the project and its public presentation;
2. Drawing up an application for information and a timetable for the dissemination of proposals;
3. Preparation and distribution of proposals;
4. Consideration of proposals;
5. Notification and public announcement of the decision;
6. Award of exclusive rights to negotiate a contract.

The main principles of competitive selection are:

1. Impartial treatment of all respondents;
2. Access of all comers to participation.

Selection criteria are: realism and adequacy of proposals for the implementation of the contract, the company's experience, its financial capabilities; experience in the field of organization and management; expected revenues from the project; business offers on prices, rents, etc.

Consider the experience of managing the development of the communal sphere of Western Europe.[12,13] One of the main elements of housing and communal Western European policy is the separation of management from ownership. Companies and organizations involved in the maintenance of communal housing are large and small companies, centralized and decentralized organizations with different forms of participation of residents. The experience of Western countries (Great Britain,

[11]British standard BS 6143: 1992 (1999).

[12]Farvacque-Vitkovic et al. (2005).

[13]Private Sector Advisory Services (2003).

Germany and Sweden) shows that large structures (e.g., more than 20,000 apartments) are less in keeping with modern requirements for operating a housing stock than for medium-sized organizations.

Owners and organizations of tenants, in turn, should have the right to choose and, if necessary, change the management of the company. Management companies have established stable relationships with contractors for housing and communal services, but several competitive firms operate in the market for a certain type of services, which determines the high degree of interest and responsibility of the contractor in the quality and efficient performance of work. Competitive bidding for the implementation of contract management companies is organized fairly rarely due to labor costs and high costs and more commonly used negotiation methods for selecting contractors (competitive methods of selection are used in the implementation of large and responsible projects for the development of housing and communal services).

In most developed European countries, much attention is paid to protection of tenants in repair matters. In Austria, for example, the landlord must carry out repairs in accordance with local standards: Both the apartments and the communal facilities are being repaired. In addition to rent, a tenant may be required to pay a tax that covers part of the cost of repairing the entire building. The lendlord carries out repair work, paid by such tax, every five years, the failure to comply with this condition entitles the tenant to demand repayment of the amount paid with accrued interest. Management companies are required to submit to the employer an annual report on the costs of repair and management of the housing stock. In Belgium, the distribution of repair works is agreed between the lessor and the tenants of the dwelling when concluding the contract. The contract provides for the responsibility of the lessor for capital repairs: A similar order exists in Denmark, Finland, France, Germany and Ireland. In this case, as a rule, it is envisaged to adjust the amount of rent in case the tenant incurs additional repair costs. The procedure for overhauling the housing stock in force in Norway, where the non-fulfill by the lessor capital repairs within the established terms, gives the authorities the right to withdraw the dwelling on their own initiative or at the request of the tenant.

Control for private firms involved in maintenance and repair of housing and communal facilities is carried out through a system of licensing, tax regulation and contract prices. The experience of the Netherlands shows that the transfer of the right to operate communal facilities to private firms in the mode of life lease with the right to transfer to the heirs can save at least 30% of the local budget.

In the UK, contracting communal services with private firms for cleaning and disposing of household waste has resulted in savings of about 25%.

In many countries, such as the UK, the USA and Sweden, city authorities have realized that the monopoly position of communal services hinders the improvement of the quality of communal services. An example of the liquidation of such a monopoly can be the sale of bus and tram lines to private transport companies on a competitive basis. As a result of competition on contracts, bus service costs were reduced by 15%.

A large experience of holding competitions for the execution of works on the improvement of territories has been accumulated by the local authorities of Great Britain. The act on local self-government, adopted in 1988, requires these authorities to create a system of competitive distribution of certain works for the construction of buildings, cleaning streets, communal services, etc. In these areas, they can resort to services of their own companies only if they have won competition with private contractors. If a private contractor can conduct a job cheaper without harming the interests of the population, the contract must be transferred to him.

In Scotland, the management and development of housing and communal services are under the jurisdiction of local authorities, but are controlled at the state level, and regulation and management measures are constantly being adjusted. The government's desire to raise standards, increase accountability and promote competition is reflected in proposals for the implementation of housing management plans, planned performance indicators and mandatory tenders for management services. Now, local authorities are required to establish management standards in cooperation with residents when creating the housing management plan. In addition, local authorities should publish the results of their activities on six key points approved by the accounting commission: the time of the application; change of residence; vacant premises and their maintenance; debts on rent; distribution of incoming grants; and sale of housing local councils. In order to establish a real and achievable level of organization standards, one must have a strategy in the field of housing, clear goals and an idea of what policies need to be carried out to implement the strategy. The role of tenants' participation is increased, for those who provided services, and for those who used them. Participation provides an opportunity for tenants to get more information and makes them listen to their point of view with regard to planning the management of housing services. Participation also means that tenants are involved in making decisions on housing services.

The financing of the housing sector also has its own peculiarities. According to the law, local authorities are required to have a separate account. It is known as the "Housing Accounts" (HAs). HAs work exclusively with the costs and revenues of the homeowners' services. Local authorities also have housing costs, such as guarantors for improving housing in the private sector and financing hostels, known as non-HAs costs. Strict financial discipline has led to a reduction in resources for investment and subsidies that stimulate income on housing accounts.

In general, the following main features of the housing and communal services sector in the USA and Western Europe, which are of economic interest for the development of the domestic industry, are:

(1) In the field of legislative and regulatory support for the regulation of the housing and communal services market:

   – The regulatory and legislative system is built on the basis of economic interests of all market participants, which allowed forming an effective system of state regulation of their relations, based on a combination of economic incentives and disincentives.

- In the field of natural monopolies, there is a clear system for monitoring the validity of tariffs for services and their increase.

(2) In the sphere of development of competitive conditions in the housing and communal services market. The development of competitive mechanisms is presented in the performance of the following works referred to the competence of municipal authorities:

- Organization and operation of the housing stock (USA, Great Britain, Belgium, the Netherlands, Sweden, Austria, Scotland);
- Consumer services: repair services, improvement of yard territories, collection, disposal and processing of domestic waste (USA, UK, France, Germany, Japan, Canada, Sweden, Austria, Scotland);
- Cleaning, landscaping (USA, UK, Austria, Germany, Belgium, Canada);
- Transport services (USA, Great Britain, Sweden, Austria, France).

Mainly in the housing and communal services market, both in the sphere of management and the contract for servicing, private business is represented; in the first case, it is a medium-sized company, and in the second it is a small business.

(3) Main methods and principles for the development of the housing and communal services sector:

- Equitable budget allocation of funds between different levels of government, ensuring uninterrupted current funding for reproduction costs of the region and the municipality, as well as the availability of a fairly decent development budget at the disposal of municipalities (typical for all countries with developed market economies);
- Significant funding in the framework of federal and regional targeted programs for the development of housing and communal services;
- Formation and equal distribution of federal and regional development funds of the territories, which are one of the main financial sources for conducting an independent municipal policy for the development of territories;
- Competitive selection of organizations (mainly private companies) for the provision of management services and housing and communal services;
- Wide development of economic stimulation methods for the development of private business in the sphere of traditional monopoly performance of works (provision of services).

Thus, in the conducted scientific research:

- The content of the concept of “economic sustainability of the company in the communal services sector” is defined.
- Factors that increase economic sustainability of communal services are identified and systemized, allowing developing and justifying the efficiency of mechanisms for the development of communal services in conditions of instability and government regulation.

– On the basis of the foreign experience studied, recommendations are proposed for integrating companies in the communal services sector into a single information and analytical mechanism for managing the regional economy.

5 Conclusions

As part of the study, the content and justification of the notion—"economic sustainability of companies in the communal services sector"—are determined, which will allow approaching more critically and reasonably systematization of endogenous and exogenous factors having a direct impact on the company's activity.

The proposed organizational and economic mechanism for the effective development will allow communal services, using the existing reserve, avoid serious mistakes, structure the ways of developing investment and production programs and contribute to the successful implementation of the goal and sustainable development goals.

Potential possibilities of using research results in solving applied problems
The organizational and economic mechanism for the effective development of communal services can be recommended for practical implementation by organizations that carry out regulated types of activities.

The results of the study can be used to substantiate the priorities for the development of the communal services sector in urban districts, municipal districts and the region as a whole; to optimize the management system of companies in the communal services sector; and to coordinate the functioning of the market for housing and communal products of an industrial nature. Separate provisions of the work can find application in the development of targeted integrated programs and strategies for the development of the communal services sector in the region in order to increase its investment attractiveness.

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Investment Development of Enterprises of Industrial Clusters

A. V. Zastupov

Abstract The relevance of the studied problem is caused by the need of using a cluster approach for innovative and investment development of industrial enterprises. Issues of investment development of industrial enterprises are studied on the basis of identification of priority industrial branches in conditions of modernization of the economy. Problems of formation of the regional investment industrial policy are considered. As a result, the advantages of the cluster approach to innovative and investment development of enterprises of industrial branches are revealed in the course of the research.

1 Introduction

In modern conditions of development, the issue of innovative and investment development of enterprises of an industrial complex, development of the corresponding scientifically based approaches and mechanisms of increase in efficiency of activity of industrial enterprises becomes the most important one.

The issues devoted to the aspects of innovative and investment development of industrial enterprises, cluster mechanisms of regional development and their improvement were considered in the works of domestic and foreign authors—Abashkina (2013), Babkina (2015), Menshikova (2014), Khasaev and Mikheev (2003), Andersson et al. (2004), Duranton (2014), Feser and Bergman (2000), Ketels (2013), Swann et al. (1996), etc.

According to the analytical review on this perspective, the issues of innovative and investment development of industrial enterprises as a part of the industrial clusters under formation are insufficiently investigated.

Accordingly, the following purposes and objectives are designated:

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- to investigate the regional industrial policy and to determine approaches to innovative and investment development of enterprises in modern conditions of economic management;
- to formulate the essence of clustering of the regional economy as forms of the territorial–sectoral industrial management;
- to justify practical implementation of the cluster mechanism as the most effective approach to innovative and investment development of the region.

2 Materials and Methods

In the course of the research, the following methods were used: theoretical (analysis, classification, specification, synthesis); diagnostic (factorial analysis, modeling, forecasting, expert evaluation method); empirical (observation, comparison, generalization); experimental (computational and analytical method); methods of mathematical statistics; and graphic representation of the results.

The experimental research base was the complex of enterprises of the petrochemical industry, mechanical engineering and aircraft industry of the Samara region.

The research was conducted in two stages:

1. Theoretical: study of the regional industrial policy and identification of approaches to innovative and investment development in modern conditions of the economy management;
2. Practical: justification of practical implementation of the cluster mechanism as the most effective approach to innovative and investment development of enterprises of the regional industrial complex.

3 Results

From the point of view of ensuring economic growth, the industrial policy has the leading role and is relevant to the state economy. A special role is played by the industrial policy in conditions of crisis and in reforming of the economy. It is necessary for restoration of controllability of the economy, change of its structure and carrying out institutional changes. To avoid overheating of the economy or its excessive falling, the elaborated and effective industrial policy is necessary. It should allow focusing attention on organizational and administrative aspect of interrelation between economic growth and investments.

In particular, risk investments into research and development require mobilization of a large volume of investment resources, especially in hi-tech inventions. Return on investments is determined with some degree of probability and cannot be

always received in the short-term period. The investments connected with innovations are always accompanied by high risks for an investor (Feser and Bergman 2000). Besides, investments into research and development demand concentration of a large volume of investment resources. As a rule, income from them cannot be received in the short-term period. Moreover, it is calculated with a high degree of probability. Usually, mobilization of resources for these purposes is impossible for a separate enterprise or a businessman. In this case, justification of an investment project is also difficult, because in conditions of high inflation, use of traditional methods of determination of efficiency of investment projects becomes a problem for financing of the research and development programs from private investors.

The basics of the industrial policy is an optimal solution of innovative and investment problems of economic growth (Andersson et al. 2004). These two aspects are closely interrelated. Introduction of inventions, new technologies and innovations requires considerable investments. In its turn, lack of investment resources creates conditions for growth of volume of innovations to various spheres of the economy—first of all, for those, which are connected with industrial branches of the economy.

The substantial party of the industrial policy is characterized by the structural and investment orientation. Economic growth and investments are connected in it (Khasaev and Mikheev 2003). Besides, ensuring high rates and quality of economic growth increases demand in the market due to the expansion of consumer and investment demand. Employment, income of the population, accumulation of enterprises and budget revenues increase owing to the economic growth. This aspect is considered as the main objective of the industrial policy and as means of achievement of the stated goal in improvement of an investment process (Babkina 2015).

The structural policy is an important component of the industrial policy. It presupposes certain institutional transformations. It is necessary for restructuring of traditional branches, which form the basis of an industrial complex, and for selective support of new perspective branches (Swann et al. 1996). The industrial policy is implemented by means of certain mechanisms and tools, which include stimulation of investments in the form of subsidies, credits, the state orders and tax benefits. Regulation of foreign investments and foreign trade policy can be also referred to tools of the industrial policy.

The industrial policy is of great importance in conditions of crisis, reforming and modernization of the economy. It allows changing its structure, mobilizing resources in the conditions of their limitedness for implementation of the chosen target characteristics. Existence of business cycles presupposes the need of management of investment and reproduction processes.

The most important tool of implementation of the industrial policy is the investment policy, which represents a set of methods and tools of impact on the certain tendencies of the industry development. Implementation of the investment policy should lead to accomplishment of investment programs and projects, achievement of goals of the industrial policy and obtaining economic, social and other positive effects (Ketels 2013). In this sense, the subordinated character

characterizes the investment policy, which should meet the purposes of the industrial policy. At the same time, the development of the investment policy has its own features.

Research of innovative and investment potential of the studied economic system is an obligatory element of the analysis of the industry development. The development priorities of an industrial complex should be chosen on the basis of the economic analysis of data for implementation of the industrial policy. It is expedient to use a number of criteria while choosing these priorities. Various options of criteria are possible; however, the major ones are the following: research intensity of output products, the role in economic development, the rating of production in foreign markets (Duranton 2014), investment attractiveness and significance for increase in competitiveness of separate technological chains. Use of these criteria on account of their hierarchy in relation to various economic systems will allow revealing priority industries.

Determination of the priority branches with their subsequent support should not be opposed to a complex of indirect measures, which can be carried out by the state for industry development. These measures include: improvement of the regulatory environment; formation of the infrastructure, necessary for industry development; development of the information environment, etc. Moreover, these measures will allow both strengthening development of the chosen priority branches and creating "growth points" which will enable to form steady positive dynamics of allied industries and productions (Békés 2015).

The stage of choice of priority branches and determination of prospects of their development is not capable to give results without creation of specific investment programs and projects. They should be a basis for the forming industrial policy, and its effectiveness will depend on success of their implementation. Investment programs and projects should be coordinated by adjacent productions. They should be also connected with domestic manufacturers.

Formation of the investment industrial policy is defined by the ability of the state to provide concentration of investment resources for the chosen programs and projects, to create overflow regulators of domestic and foreign investment resources. In order to solve this problem, the most strict measures of the state influence and measures, which are connected with the investment infrastructure, are necessary. Development of investment opportunities at the macrolevel, and at the level of separate priority enterprises, improvement of the investment legislation is obligatory. At the same time, it is necessary to control orientation of these measures—they should be focused on stimulation of inflow of real investments.

It should be noted that in recent years the technological infrastructure of production increases very slowly in the regional industry. It complicates the solution of issues, connected with transition to production of new products. All these facts lead to decrease in the technical and organizational level of enterprise production and its economic effectiveness. Frequently conducted restructuring of enterprises does not resolve organizational economic problems of improvement of material and technical resources. Besides, in a number of subindustries, there are no support programs of preservation of branch research institutions and material and technical

base of experimental enterprise productions, which have a high share of production of complex science-intensive products. Issues of coordination of legal and normative acts, which regulate and stimulate research and production activity, are also slowly resolved.

In this regard, formation and development of industrial clusters becomes the most progressive approach to innovative and investment development of the industrial economy. It helps to estimate the regional industrial policy consistently and in a complex, namely:

1. to create new competitive advantages of business on account of existing risks in activity of industrial enterprises of the industry;
2. to reveal additional opportunities for innovative and investment development;
3. to designate key tendencies for interaction between various economic market entities: the state, business community, academic institutions and public (Menshikov 2014);
4. to increase the level of employment and quality of living of the population of the region, determining positive image of the region in assessment by the external environment.

The cluster approach offers an alternative form of an institutional organization of the regional economy. Development of industrial clusters will become possible on the basis of continuous, self-replicating interaction of industrial branches, when the character and depth of relations between them become key factors of the analysis of innovative and investment development of the territory. It is important to note that clustering creates opportunities for interpenetration of various branches and education, and it results in new markets (Abashkin 2013).

It is expedient to consider a number of indicators, which characterize dynamics and the structure of investments on various features according to the data of Rosstat, for identification of possible development prospects of enterprises and organizations as a part of the forming industrial clusters of the Samara region (Table 1).

Characterizing the submitted data, it is possible to note that by the investment volume in integrated types of economic activity has considerably grown over a ten-year period: mining—by 6.7 times, manufacturing—by 3.3 times, production and distribution of the electric power, gas and water—by 6.1 times. It can be noted that the smallest growth of investments is observed in manufacturing, which are leaders in volume of output and release of innovative goods (Fig. 1).

It is expedient to analyze not only the dynamics of absolute values of investments, but also their structure. It should be noted that there were considerable shifts in the structure of investments for the analyzed 10 years (Fig. 2). The share of investments into mining (from 4.7 to 12.2%) and in production and distribution of the electric power, gas and water has considerably grown (from 5.7 to 13.6%). By industrial types of the economic activity, the share of investments reduced on many productions, which are traditionally the leading ones in the Samara region—food production, including drinks, tobacco; chemical production, machinery productions (production of vehicles and equipment—from 14.1 to 10.8%; production of cars

Table 1 Dynamics of investments by types of the economic activity (industrial cluster) in comparable prices, mln rub

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Petrochemical cluster: Mining	2452.9	6059.7	7782.9	8855.5	6760.8	8308.6	8841.8	12,578.6	11,114.5	16,421.5
Manufacturing	16,211.3	17,195.6	23,116.3	22,900.2	15,424.6	19,444.8	24,632.8	31,923.7	55,292.8	53,570.6
Production of coke and oil products	1530.1	2670.9	4191.1	3920.9	42,298,9	7572.4	8202.8	12,960.1	34,047.2	27,529.9
Chemical production	2717.2	2453.1	3002.5	3441.7	2982.8	2765.9	2359.9	2529.8	3028.4	6146.2
Mechanical-engineering cluster: Metallurgical production and production of ready-made metal products	871.6	895.1	3291.9	3234.9	840.3	564.8	1148.2	1212.7	1138.5	1543.6
Production of cars and equipment	476.7	692.6	1162.7	887.3	866.2	871.1	1223.2	1469.9	2260.7	630.3
Aircraft building cluster: Production of electrical facilities, electronic and optical equipment	372.5	557.7	938.5	973.9	341.9	270.4	289.6	390.5	653.4	501.8
Production and distribution of the electric power, gas and water	2997.7	3106.2	4716.9	6919.8	7215.5	13,464.6	12,956.2	10,941.2	10,063.1	18,333.8

Source The Territorial Body of the Federal State Statistics Service of the Samara region: official site. URL: http://www.samarastat.ru, Accessed 14 February 2018

Fig. 1 Growth dynamics of the investment volume, 2006–2015. *Source* Authors

and equipment—from 0.9 to 0.5%). The last is represented as an especially negative tendency, because the mechanical engineering took the leading positions in the economy of the Samara region (reduction in production by a factor of 2).

For the fuller analysis and in connection with great importance of investments for the subsequent development of enterprises and also for identification of reserves and tendencies of overcoming the current recession in the industry, it is expedient to consider the change tendencies of the investment activity for 2015–2016.

It is possible to note that in comparison with 2015, the investment volume in the regional economy on the full cycle of economic entities for January–March, 2016, has decreased by 24.2% (January–March, 2015—47,322.8 million rubles, January–December, 2015—29,746.4 million rubles, January–March, 2016—38,293.9 million rubles) (Fig. 3).

In its turn, the investment volume in 2015 was only 87.1% of 2014. Thus, decrease in investment activity of enterprises and organizations continues. For January–March, 2016, the ratios of investment activity remain the same as in previous years. There is almost zero share of investments into other "mechanical" types of economic activity—machine engineering and machine-tool clusters of the region. Until recently, they were the most important part of an industrial complex of the Samara region (Zastupov 2015), except for separate types of economic activity—a petrochemical cluster (production of coke and oil products, chemical production)

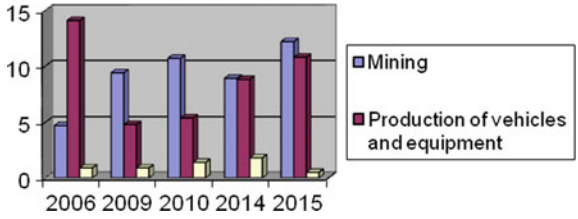

Fig. 2 Structure of investments by some types of economic activity, %. *Source* Authors

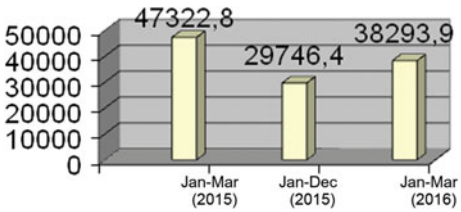

Fig. 3 Dynamics of the investment volume on the economy of the Samara region, quarterly for the period of 2015–2016, thou. rub. *Source* Authors

and an automobile cluster (production of vehicles and equipment). Types of activity of the services sector, as one of the priority industries, exceed the most part of activities by the investment volume. These activities are among manufacturing (Zastupov 2016).

High values of profitability of enterprises of a petrochemical cluster attract attention as subjects of priority industries—in mining (on account of functioning of tools of tax incentives of oil extraction), in production of coke and oil products and in chemical production (JSC Samaraneftegaz, PJSC Rosneft). If we compare it with the investment structure, we observe that the main inflow of investments is in these kinds of activity (disregarding production of enterprises in an automobile cluster, including PJSC AvtoVAZ).

Today, the petrochemical cluster of the region, which includes the most priority industries, should learn to combine implementation of large-scale investment projects with the austerity mode under the influence of sanction restrictions. Obviously, fall in the world prices for oil, weakening of the ruble and the operating sanctions regime from the West influenced on the budget income of enterprises of a petrochemical cluster (in the sphere of oil production and oil processing) of the Samara region. Nevertheless, against the economic downfall, the leading players of the oil market manage to increase production outputs and not to reduce investment programs.

Thus, the regional investment industrial policy is aimed at formation and development of industrial clusters, modernization of industrial productions and innovative development of enterprises. The formation concept of industrial clusters is implemented as an innovative development model of branches of the regional industry and as an integrated approach to innovative and investment development in general.

4 Discussion

In this research, the practical aspect of innovative and investment development of enterprises of an industrial complex is considered as a part of the forming industrial clusters. Application of theoretical and methodological provisions and practical recommendations of the research will allow making reasonable decisions in the

field of innovative and investment development of the branch industrial enterprises. It is testimony to compliance of the received results to the research hypothesis.

The practical implications consist in the fact that the main results can be used by the state and municipal authorities and by the business community, while developing the basic tendencies of increase in operating efficiency of the business environment and investment development of territories.

Further studies in this field will allow expanding the idea about opportunities of application of theoretical and methodological provisions and practical recommendations in innovative and investment development of industrial enterprises and the region in general.

5 Conclusions

The main results, conclusions and recommendations on problems of innovative and investment development of a regional industrial complex based on the forming industrial clusters are stated in this contribution.

The received research results essentially supplement the existing approach to the problem of innovative development of industrial enterprises, assigning the leading role in this process to management of mechanisms of the cluster approach of innovative and investment development of the territories.

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Monitoring the Financial Security of the Economic Subject on the Basis of Financial Risk Assessment

O. A. Naumova and I. A. Svetkina

Abstract This contribution examines the financial security system of the economic entity, the existing risks that affect financial security, suggests a methodology for financial risks assessment, and suggests measures to reduce the negative impact of financial risks. Financial security of the economic entity is the ability to influence financial risks in order to minimize them and ensure the fact that current performance is consistent with strategic performance, and to ensure an adequate level of financial control. Basic financial security risks of the economic entity can be quantified on the basis of indicators that characterize certain economic processes. Management of financial risks should be based on the risk-oriented approach. The probability of risks depends on the quantitative interval of the indicator or on the qualitative characteristics (in the case when a quantitative measurement is impossible). Monitoring the level of financial risks, conducted according to the data of companies of the Russian Federation makes it possible to conclude that there are trends in their changes and, accordingly, the possibility of planning and changing the level of risks through management decisions.

1 Introduction

Risk-oriented economic processes, initially formed and significantly strengthened in the last decade, globally determine the activities of economic entities, namely: legal organizations in the context of post-industrial transformation of the economy. The instability of the financial and economic activity (FEA) of the economic entity causes a high level of competition with a weak level of development of the national industry, the risky nature of doing business, implying higher profitability rates than the average in the economy, a high degree of uncertainty in the geopolitical sphere,

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the financial instability and even the insolvency of certain industries, states, political and economic blocks, constantly growing and highly dynamically changing consumer demand. All of the above factors lead to the fact that it is simply impossible to use conservative approaches to the planning of the FEA of the economic entity, because it will irreparably entail the most undesirable consequences for the organization, up to complete disappointment in goods produced, services provided and the work performed by end users, termination of economic activity due to loss of operation.

2 Materials and Methods

In the current situation, the average and the highest level of management of the organization, which performs the functions of planning and organizing the processes of the economic entity, faced the need to resort to fundamentally new approaches to ensure financial security. This, in turn, entails the need for timely and reliable assessment of the current level of financial security of the organization, compiling forecast values for this indicator in the framework of strategic management. A fundamentally new direction in the management of the organization is the development and implementation of a strategic financial management mechanism based on monitoring the shifts in assessing financial security of the company under the influence of existing risks in external and internal environments of the entity. The functioning of the above mechanism is impossible without an integrated strategic analysis that fully takes into account technical, technological, political, economic, and social characteristics of a particular industry, the national economy or the global economy.

When assessing risks, methods of observation, comparisons, classical and statistical methods for the occurrence of an event were used. When assessing the possible level of risks with qualitative characteristics, stochastic and simulation methods were used.

3 Results

Having considered the legislation on the economic security strategy of Russia, it is necessary to pass to the consideration of the financial security system of the economic entity (FSSEE). Its fundamental component is the system of financial indicators characterizing the subject's FEAs, which include the level of financial stability, the liquidity level of the company, the quantitative and qualitative characteristics of employees and workers, the ratio of own and borrowed capital, and others that are included in the concept of "financial security."

It is inexpedient to consider financial security of the organization, separating it from the system of financial control in the country. In addition to its own

sustainable development, companies provide an overall level of financial security in the country. Measures that support the level of financial security of the company are not only the improvement of the quality of asset management and the targeted achievement of the set rates of economic growth, but also control and audit checks, external and internal actions to ensure financial control. This should include tax inspections, counter checks of credit institutions, etc., that is, the internal and external financial controls are a prerequisite for creating a financial security system in companies. In the context of Russian business, the low level of transparency in financial transactions, a high share of shadow revenues and corruption, it seems reasonable to regulate measures to ensure financial security in companies in order to strengthen the country's financial security and implement activities to counter money laundering and terrorist financing (Naumova 2014).

Thus, it can be said that financial security can be defined as follows: financial security of the economic entity is the ability of the economic entity to influence financial risks in order to minimize them and to ensure that current performance indicators are consistent with the strategic ones, and to ensure an adequate level of financial control.

To manage existing financial risks, it is necessary to analyze their possibility, their presence in the business environment of the economic entity that is a combination of internal and external factors. So, the first component is usually attributed the following factors:

1. Macromedia.
    1. The economic environment.
    2. The political environment.
    3. The technological environment.
    4. The social environment.
2. The microenvironment.
    1. Suppliers of material resources.
    2. Consumers of products.
    3. Competitors.
    4. Intermediaries.

In the context of the internal environment, among the functional business areas, in our opinion, it should be noted:

(1) Processes of production of goods, the provision of services, and the performance of work;
(2) Process of managing human capital;
(3) Organizational structure of the company;
(4) Marketing policy;
(5) Logistic management of material and related flows;
(6) Financial accounting area.

Thus, it can be concluded that the FSSEE is influenced by external factors, for example, a number of economic factors, which include the overall economic state of the national economy and industries, as well as all factors of the internal environment of the organization. To do effective management activities aimed at countering financial security risks, it is necessary to resort to a number of indicators that help to analyze, by means of a comparison of values, the probability of certain financial risks. As for financial risks, it is accepted to understand them as the real or potential possibilities of the destructive effect of various factors on the financial development of the company, leading to a certain economic damage. As for financial security risks of the company, we can single out the following Table 1.

Financial security risks presented in the table characterize certain areas of the financial state of the organization and interaction with the external environment. It should be noted that in order to manage the risk or the possibility of a particular financial security risk, a methodology for assessing its level is needed. For this, we recommend using financial state indicators of the organization that characterize a specific risk. The advantage of using indicators is the possibility of rapid quantitative assessment, according to accounting and reporting.

Having determined the main indicators reflecting the state of the FSSEE, the economic entity needs to obtain data on the possibility of certain negative financial consequences for the organization. These possibilities can be identified with the notion of "risk level" (Table 2).

Proceeding from the fact that the organization faces risks at each stage of its life cycle, it can be concluded that it is necessary to monitor the level of various financial security risks. In our opinion, an expanded classification of the probability of risks by levels will be:

1. High risk.
2. Increased risk.
3. Average risk.
4. Reduced risk.
5. Low risk.

Moreover, with the increase in the level of risks from low to high, the possibility of corresponding financial security risks will increase, so the results of compliance with the risk category and the possibility of risks are presented in Table 3.

It is worth noting that the abovementioned indicators of the level of certain financial security risks allow the organization to position its activities with respect to threshold and critical values. A generalized table containing the most relevant risks in our opinion, the indicators, the criterion, and the level of risks are listed in Table 4.

The probability of risks was calculated on the basis of observations of activities of 12 companies in Russia in 2013–2017. The largest production companies were PJSC "Kuibyshevazot," JSC "ROSSKAT," JSC "Zhigulevskoe Beer," PJSC "TogliattiAzot," and others.

Table 1 Financial security risks of the organization

№.	Financial security risks of the organization	Contents of financial security risks
1	Loss of solvency and reduced liquidity	Loss of solvency entails deterioration of business reputation, the break of civil contracts between the organization and other subjects of legal relations of this industry, the recognition of the organization as a bankrupt
2	Loss of financial independence of the organization and increase in debts	With an increase in the share of borrowed capital, the organization may face the problem of spending a significant amount of money to cover liabilities
3	Unsustainable development of the organization as a result of non-compliance with the "golden economic rule"	The investment of a certain share of the capital of the economic entity into certain types of assets that do not directly increase the growth rates of sales and profit may lead to an unplanned increase in costs, up to a loss as the main criterion of the financial result of the activity of the organization
4	Aging of fixed assets	Use of a special depreciation fund for current financial activities leads to the inability to cover the costs of the necessary renovation of tear and wear fixed assets
5	Use of ineffective credit policy in terms of accounts receivable and payable	Due to the fact that, with the connivance of the organization in relation to stakeholders with receivables, it cannot fully and in due time make settlements on the existing accounts payable
6	Reduction in the profitability and market value of the organization	Entails an excess of capital costs for the ongoing activities of the organization over the profit
7	Critical dependence on counterparties	Opposite side of a civil law contract has a greater opportunity to impose conditions of interest to it
8	High probability of tax audit and/or blocking of settlement accounts	It is associated with significant losses (not only financial, but also temporary), as well as the inability to carry out activities until the supervisory activities are over
9	Interaction with the unreliable counterparty	Possible losses related to the quality of resources, timely payment, etc., as well as the possibility of the 8th risk

Source Authors

Table 2 Main indicators characterizing financial security risks

№.	Financial security risks of the organization	Indicator characterizing financial security risks	Formula for calculating the indicator
1	Loss of solvency and reduced liquidity (L)	Current liquidity ratio (L1)	Current assets/Current liabilities
		Adequacy of cash on accounts (L2)	Average monthly availability of funds in accounts/(Monthly salary fund with deductions)
2	Loss of the organization's financial independence and debt buildup (I)	Autonomy ratio (I1)	Equity/Balance sheet currency
		Leverage (I2)	Loan capital/Equity
3	Unstable development of the organization as a result of non-compliance with the "golden economic rule" (A)	Profit growth rate (A1)	Net profit at the end of the period/Net profit at the beginning of the period
		Profit growth rate (A2)	Net profit at the end of the period/Net profit at the beginning of the period
		Asset growth rate (A3)	Assets at the end of the period/ Assets at the beginning of the period
4	Use of ineffective credit policy in terms of accounts receivable and payable (D)	Turnover of accounts receivable (D1)	Proceeds (net)/Average annual amount of accounts receivable
		Turnover of accounts payable (D2)	Cost of sales/Average annual amount of accounts payable
5	Aging of fixed assets (O)	Depreciation rate of fixed assets (O1)	Depreciation/Original cost of operating assets
		Level of investment Depreciation (O2)	Depreciation amount/Amount invested in the purchase of fixed assets
6	Reduction in profitability and market value of the company (C)	Weighted average cost of capital (WACC)—(C1)	Cost of equity x Share of equity + Cost of borrowed capital x Proportion of borrowed capital x (1—Income tax rate)
		Economic added value (C2)	Comparison of profitability and Weighted average cost of capital
7	Critical dependence on counterparties (K)	Indicators of diversification of buyers and suppliers (K1)	Share of revenue per buyer Share in cost per supplier

(continued)

Table 2 (continued)

№.	Financial security risks of the organization	Indicator characterizing financial security risks	Formula for calculating the indicator
8	High probability of tax audit and/or blocking of settlement accounts (H)	Tax burden (H1)	
		Observance of formal signs of the Federal Tax Service and the Central Bank (H2)	
9	Interaction with the untrustworthy counterparty (S)	Presence of a system of counterparty verification and examination of contracts (S1)	
		Level of the shadow economy in the region of presence (S2)	

Source Authors

Table 3 Possibility of risks depending on the magnitude of the risk level

№.	Levels of risks	Possibility of financial security risks (%)
1	High	80–100
2	Increased	60–80
3	Average	40–60
4	Reduced	20–40
5	Low	0–20

Source Authors

To demonstrate practical application, we will conduct an example of determining the level of risks based on indicators I1 of the risk of loss of the organization's financial independence and debts buildup. (I) (Table 5).

The average weighted risk assessment (the ratio was the share of the economic entity's profit in the total sales of 12 companies) is presented in the table for 5 years. The trend of changes is defined as dynamic changes in the last three years, taking into account deviations from the average indicators for previous observation periods.

In the crisis year for the Russian economy, 2015, due to sharp fluctuations in the exchange rate and the price of hydrocarbons in late 2014, led to a sharp increase in the possibility of financial risks in this period (Table 6).

Analyzing the results of the study, we can say that in most cases, the increase in the level of risks is progressively even in the medium term (in this case 12 months), it means that when conducting continuous monitoring there is the possibility of regulating problem indicators to reduce the possibility of risks.

Table 4 Leveling of financial security risks depending on the range of values of the indicator

№.	Financial security risks	Indicator	Range of values	Level of risks
1	Risk of organization's loss of solvency	L1	L1 < 0.3	High
			0.3 < L1 < 0.5	Increased
			0.5 < L1 < 0.8	Average
			0.8 < V < 1.0	Reduced
			L1 > 1.0	Low
		L2	L2 < 0.4	High
			0.4 < L2 < 0.7	Increased
			0.7 < L2 < 0.9	Average
			0.9 < L2 < 1.1	Reduced
			L2 > 1.1	Low
2	Loss of the organization's financial independence and debt buildup (I)	I1	I1 < 0.25	High
			0.25 < I1 < 0.35	Increased
			0.35 < I1 < 0.45	Average
			0.45 < I1 < 0.55	Reduced
			0 L1 > 0.55	Low
		I2	I2 > 2.5	High
			2.2 < I2 < 2.5	Increased
			2.0 < I2 < 2.2	Average
			1.6 < I2 < 2.0	Reduced
			I2 < 1.6	Low
3	Unstable development of the organization (A)	A1, A2, A3	A1 < A2 < A3 < 100%	High
			A1 > A2 < A3 < 100%	Increased
			A1 < A2 > A3 < 100%	Average
			A1 < A2 < A3 > 100%	Reduced
			A1 > A2 > A3 > 100%	Low
4	Reduction in profitability and market value of the organization (C)	C1	C1 < 0.8 Inflation rate	High
			C1 < Inflation rate	Increased
			C1 = Inflation rate	Average
			C1 > Inflation rate	Reduced
			C1 > 1.1 Inflation rate	Low
5	Aging of fixed assets (O)	O1	O1 > 0.85	High
			0.7 < O1 < 0.85	Increased
			0.45 < O1 < 0.6	Average
			0.3 < O1 < 0.45	Reduced
			O1 < 0.3	Low
		O2	O2 > 1.2	High
			1 < O2 < 1.2	Increased
			0.7 < O2 < 1.0	Average
			0 5 < O2 < 0.7	Reduced
			O2 < 0.5	Low

(continued)

Table 4 (continued)

№.	Financial security risks	Indicator	Range of values	Level of risks
6	Ineffective credit policy in terms of accounts receivable and payable (D)	D1 D2	D2 < 1.1D1	High
			D2 < 1.1D 1	Increased
			D2 = D1	Average
			D2 > D1	Reduced
			D2 > 1.1D1	Low
7	Critical dependence on counterparties (K)	K1	K1 > 0.25	High
			0.15 < K1 < 0.25	Increased
			0.1 < K1 < 0.15	Average
			0.05 < K1 < 0.1	Reduced
			K1 < 0.05	Low

Source Authors

Table 5 Value of the coefficient of financial independence (I1)

Number of the company	Ratio	Value of financial independence coefficient (I1) by years				
		2013	2014	2015	2016	2017
1	0.21	0.58	0.35	0.31	0.31	0.44
2	0.11	0.44	0.38	0.33	0.32	0.38
3	0.08	0.35	0.29	0.28	0.29	0.35
4	0.02	0.59	0.61	0.52	0.5	0.61
5	0.01	0.8	0.8	0.4	0.41	0.7
6	0.14	0.4	0.29	0.31	0.3	0.35
7	0.16	0.39	0.27	0.22	0.24	0.7
8	0.08	0.75	0.69	0.5	0.51	0.66
9	0.07	0.55	0.5	0.5	0.44	0.51
10	0.04	0.56	0.44	0.41	0.4	0.48
11	0.02	0.53	0.33	0.35	0.31	0.31
12	0.06	0.74	0.54	0.48	0.49	0.45
Weighted average value I1		0.5123	0.3893	0.344	0.3412	0.4833
Level of the possibility of risk I		Reduced	Average	Increased	Increased	Reduced

Source Authors

Table 6 Risk assessment of the level of financial security risks of economic entities of the Russian Federation in 2013–2017

Financial security risks	Years					Trend
	2013	2014	2015	2016	2017	
L	Reduced	Increased	High	Average	Average	Stable
I	Reduced	Average	Increased	Increased	Reduced	Decrease
A	Low	Average	Increased	Average	Low	Decrease
C	Average	Average	Increased	Increased	Reduced	Decrease
O	Increased	High	High	High	Increased	Stable
D	Low	Average	Increased	Average	Low	Decrease
K	Low	Reduced	High	High	Increased	Growth
H	Increased	High	Increased	Increased	High	Growth
S	High	Low	Average	Increased	Average	Stable

Source Authors

4 Discussion

It should be noted that the use of the terms of "economic security" and "financial security" in Russia was not in the last decade. Thus, the interpretation of the concept of "economic security" at the macroeconomic level was first given in the decree of the President of the Russian Federation of 29.04.1996 No. 608 "On the State Strategy for Economic Security of the Russian Federation (Basic Provisions)," which has now lost its force. If at the level of macroeconomic entities, before the decree of the President of the Russian Federation of May 13, 2017, No. 208 "On the Strategy for Economic Security of the Russian Federation for the period until 2030," the first of them was understood as protection of civil rights of the population, raising the level and quality of life, guaranteeing social peace in the country and tranquility in society, effective solution of domestic political, economic, and social tasks, based on national interests of Russia, but this decree did not take into account the appropriate security level of economic entities in large part to the fact that among the objects recognized as "… the individual, society, state and the basic elements of the economic system, including the system of institutional relations under state regulation economic activity[1]" (p. 2117) were not institutionalized. Among the other main tasks of the state policy, the decree "On the Strategy for Economic Security of the Russian Federation for the period until 2030" can be divided into the following two, which make it possible to conclude that the policy of economic security should be considered also through activities of organizations:

[1]Decree of the President of the Russian Federation of 29.04.1996 No. 608: On the State Strategy of Economic Security of the Russian Federation (Basic Provisions). Collection of Legislation of the Russian Federation. **18**, 2117 (1996)

Table 7 Concept of "financial security"

General features	Definition of "financial security"
1. Part of economic policy	Financial security is the ability of the organization to prevent and neutralize possible risks to worsen its financial condition (Belskaya and Dronov 2013)
2. Set of measures to protect business	Financial security is the ability of organizations to independently develop and implement financial policies in accordance with the overall objectives of the corporate strategy in the context of the unknown and competitive environment (Blank 2013)
3. Protection against external and internal financial threats	Financial security is the ultimate state of financial stability, in which organizations must be located to implement their strategy. Financial security is characterized by the ability of the organization to withstand external and internal risks (Papekhin 2007)
4. Sustainable development of the organization	Financial security is part of overall economic security of the organization and represents the totality of the implemented set of measures to protect the business from internal and external negative financial risks (Parfenova 2010; Zaporozhtseva 2011)
5. Financial condition that characterizes certain indicators	Financial position and financial stability, capable of providing the organization with a normal effective development of its activities (Kirichenko and Kim 2014)

Source Authors

(1) Improving the investment climate, increasing the attractiveness of Russian jurisdiction for business;
(2) Optimization of the regulatory and tax burden on business entities, taking into account the need to ensure sustainable development of the country's economy and modernization of its production and technological base[2] (p. 2902).

It is worth noting that the concept of financial security is often interpreted by different authors ambiguously. Therefore, the authors presented some definitions used in the scientific literature (Table 7).

From the above interpretations of the original concept, we can conclude that, firstly, the resultant sign of the organization with a high level of financial security will be the compliance of the financial development strategy implemented within the framework of the overall corporate strategy. Secondly, a stable financial position allows the organization to minimize financial risks arising from the internal and external environments.

If we talk about the main approaches to the interpretation of financial risks existing within the framework of possible ways to cope with financial security risks of the organization, the authors (Hlaing and Kakinaka 2018; Nkeki 2018)

[2]Decree of the President of the Russian Federation of May 13, 2017 No. 208. On the Strategy of Economic Security of the Russian Federation for the Period to 2030: Collection of Legislation of the Russian Federation. **20**, 2902 (2017)

suggested that a high level of financial risks generates financial instability. And a high level of risks does not only generate financial instability, but is more likely to improve the financial situation. In the works (Brigham and Ehrhardt 2013; D'Amico et al. 2018), the risk is defined as the possibility of negative consequences for the microeconomic entity or a simultaneous chance of increasing the organization's profits due to a high uncertainty of the business environment and the achievement of a financially insolvent situation (Zhe et al. 2012).

5 Conclusions

Thus, in this contribution, the main provisions of the FSSEE, recommended to use in assessing financial security of the organization, were defined. Summarizing, it should be said that these criteria for financial security should be considered in the aggregate of both quantitative and qualitative indicators. Systematic consideration of financial security of the organization will allow making decisions that can contribute to an increase in the level of the indicator under study.

Using a risk-based approach makes it possible to monitor financial security risks, taking into account their possibility. The existence of trend dynamics of changes in the risk level makes it possible to use the proposed methodology for strategic management of the company's financial security.

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Organizational and Economic Problems of Systemic Modernization of Enterprises of the Machine-Building Complex

A. B. Vishnyakova and B. Y. Tatarskih

Abstract The relevance of the research is connected with considerable attention to questions of modernization of enterprises of the machine-building complex. The development of the national economy is defined first of all by organizational and technological potential of the machine-building complex which value is underestimated so far. Researches show that in industrialized countries, particular importance is attached to this complex that is connected with production of means of labor and technical systems of ensuring economic and defensive potential. It should be noted that in the last 20 years in industrially developed countries, the share of machine-building production in the total amount of industrial output made from 30 to 50%, and it was 20% in Russia. At the same time, it is necessary to consider both qualitative characteristics of machine-building production and its demand in internal and external markets. The result of expenses characterizes mainly extensive development of the machine-building industry. Statement of the problem: justify the direction that can modernize the domestic machine-building industry on the basis of innovative—technological potential; represent the main directions connected with attraction of investment resources to the sphere of the machine-building complex in the conditions of sanctions and state policy of import substitution at increase in negative political factors. A research objective is to define development options of the machine-building complex in modern difficult economic conditions. Results of the research are to justify the organizational and economic mechanism of increase in rates of development of the domestic machine-building industry.

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1 Introduction

Improvement of productive forces of the Russian Federation is caused first of all by rates and efficiency of the industrial development. In the domestic industry, the most important is the machine-building industry that makes fixed assets of production. The machine-building complex (MBC) becomes an important factor that improves a material basis of all economic sectors. Successful realization of the NTP basic directions is impossible without acceleration of the MBC development. For the last decades, it is possible to observe negative consequences of realization of different types of economic reforms in the MBC which have led to destruction of technological, information and economic spheres in many regions of the country. Many enterprises of the MBC cannot significantly increase competitive potential for many reasons now. First of all, there is no long-term industrial policy. Secondly, there is no long-term concept defining the development strategy and placements of production forces in the Russian Federation. Thirdly, there is no necessary investment providing. Fourthly, innovative business is insufficiently developed in the machine-building complex.

Further development of the machine-building complex is caused, first of all, by growth rates of innovative and technological potentials in the long term and their role is decisive.

In the machine-building industry of Russia in transitional conditions to market relations, there was a big recession of production activity that is defined by a variety of reasons. First of all, lack of investments for the latest production; secondly, there was substantially a destruction of economic communications, information and technological space; thirdly, industrial and production funds and first of all the leading processing equipment become outdated. Unfortunately, so far the material basis does not develop in branches.

In the work of Pochukayeva (2012), it is mentioned that there is a need to develop the innovative sphere of branches of the machine-building industry in order to get progressive technologies. The developed environment of the Russian market of investment equipment shows a steady trend of growth in the sector of import equipment. Ensuring competitiveness of Russian producers is possible only on conditions of innovative and technological modernization of enterprises of the machine-building industry and growth of knowledge intensity of products. The development of the innovative sphere of branches of the machine-building industry in the direction of broad development of progressive technologies will provide transition to a qualitatively new level of industrial production. A widespread introduction of technologies and equipment of new generation will allow reaching such level of resource provision and quality of products which can promote essential increase in level of import substitution and competitiveness in foreign market of engineering products.

In the machine-building industry, the dynamics of electrical and technical equipment production resources decreases, and, therefore, the solution of questions of transition to modern technologies restrains and, as a result, it leads to the general

decrease in technical and organizational and economic levels of production. In the machine-building industry of Russia, privatization did not give the expected results for the majority of working people. As we can see from the data, the applied restructuring of enterprises of the machine-building industry often does not raise organizational and economic questions of further modernization of elements of the material basis. In the MBC, the repeated reduction in volumes of research and development became the reason of decrease in level of technological equipment at the enterprise that has predetermined the delay in launch of modernized production.

In the MBC of Russia, the negative impact of power technological multiformity amplifies and it is the most characteristic for procuring enterprises in the branch where rates of development of modern technologies increase very slowly.

The directions of financial support of scientific research institutes in branch and material and technical resources of skilled and experimental divisions of organizations with a high share of knowledge-intensive production are not developed in the machine-building industry yet. The strategy of increase in material and technical resources of the MBC is not defined.

Baranenko and Busygin (2014) in the works pay special attention to a strategic development model of innovative and industrial enterprises with use of hybrid forms of intercompany cooperation which can be used for updating and modernization projects.

Industry modernization in general and in some separate parts, in particular the machine-building industry, is the current problem connected with application of sanctions in a number of the countries against Russia. Mukhanova (2015) emphasizes this fact in her works. More and more industrial enterprises of the Russian Federation face the threat of refusal of Western technologies, cooperation with various foreign investors, reductions in purchases of foreign equipment and other accessories.

Cherkasov (2014) pays attention to methodical bases of modernization of the national industry taking into account factors of the scientific–technical capacity development of Russian enterprises defining stability of innovative processes at the national level.

Gorokhova (2015) analyzes the current state and directions for development of Russian industrial enterprises. The author pays attention to obstacles that enterprises face when realizing their competitive advantages.

The machine-building complex is a basis of the industrial branch in the country. The machine-building industry reflects the technological level of the state and also exerts impact on other spheres of economic activity of the country. Efymychev and Trofimov (2010) solve the problem having a very important economic value—the innovative development strategy of industrial enterprises. The authors consider theoretical and practical questions connected with the innovative development strategy.

In modern conditions, all specified range of problems plays an important role for improvement of the Russian machine-building industry.

2 Materials and Methods

In the course of the research, the following methods were used: methods of expert estimates and methods of scientific extrapolation of dynamic ranks.

The class of methods of expert estimates includes estimates like "interview," individual expert estimates and analytical expert estimates. The class of methods of extrapolation includes the following types: extrapolation of data on reasonable parameters of forecasting subjects, extrapolation of quantitative parameters of technical means, extrapolation of quantitative characteristics of scientific potential, extrapolation of qualitative estimates of technical means, extrapolation of indicators of level systems complexity.

It has allowed estimating the role of the machine-building complex in the Russian economy. Methods of expert estimates have allowed estimating objectively a development trend in dynamics of domestic machine-building industrial indicators. Methods of scientific extrapolation of dynamic ranks have allowed stressing the main tendencies in development of material and technical resources of the machine-building industry.

The results of the research which are contained in scientific publications of domestic and foreign authors about classical theory of modernization fundamental provisions of the general theory of systems, strategic management and others have formed the theoretical and methodological basis of this research.

The methods of the system, logical, structural and comparative analysis, statistical methods of information processing, financial analysis, decision-making, economic-mathematical modeling, assessment of efficiency of innovative and investment projects were used. The information basis of the research is data of Federal State Statistics Service of the Russian Federation, primary technical and economic and analytical information on machine-building enterprises, in particular, expert estimates, standard legal information, technical and economic indicators of the machine-building complex for the last 25 years, contained in domestic and foreign literature, in periodicals and also own research of the authors.

3 Results

The machine-building complex is the leading industrial complex of Russia which determines scientific and technological and production potential of all Russian economy. The statistics show that rates of labor productivity decrease, rates of modernization of material and technical resources are very slow, the quality of the made production is low.

The data show that in 1996–2006, the economic potential of domestic machine-building industry slowly increased. It is connected with a variety of reasons and first of all with the fact that the material–technical base of the

machine-building industry is improved by low rates because of the insufficient volume of investment resources (Amosenok and Bazhenov 2014).

In Russia in the last 12–15 years, technical and economic indicators of enterprises of the machine-building industry did not raise for a variety of reasons. The most difficult situation was in sub-branches of the machine-building industry making knowledge-intensive production.

There is a sharp need for modernization of fixed assets. Our country needs effective modernization increasing profitability of machine-building enterprises (Bogatyrev and Minakov 2009).

In the domestic machine-building industry, the innovative technological break, that is transition to essentially new technologies and use of modern equipment, is required.

Negative tendencies in development of the machine-building industry of Russia result in its dependence on equipment of new generations from developed manufacturing countries.

Also the activity of the state in the field of the innovative potential development in leading industries is not noticeable. It is caused by the lack of theoretical—methodological justifications concerning the innovative and technological development strategy of key branches of the industry and first of all the domestic machine-building industry.

Necessary prerequisites for transformation of the Russian civil and defensive machine-building industry into the driver of future steady growth, the development of import substitution and export of civil machine-building production are: existence of vanguard high-tech productions and complexes of defensive, atomic, space-rocket machine-building industry, ferrous and nonferrous metallurgy which production is in demand in the world market, own engineering staff, capacious domestic market of equipment which partially should be improved during import substitution, measures of state support of import substitution and export of machine-building production. Serious restriction from demand for sustainable development of the machine-building complex is the saved-up lag in technological level and quality of many types of equipment and household appliances.

Relying on last experience of Russia and China, it is possible to offer the next three ways of overcoming lag and according increasing competitiveness and import substitution of machine-building production:

(1) Assimilate and transfer achievements of defensive industries (their leader positions are recognized in the world market) to the sphere of the civil machine-building industry;
(2) Assimilate achievements of foreign machine-building companies, attract them for collaboration;
(3) Use domestic scientific and technical developments taking into account foreign experience and use of accessories and components (Faltsman 2018).

The main reasons which have led to decrease in efficiency of technologies in the domestic machine-building industry in new conditions are: imperfection of

management methods of scientific and technical progress and also existence of ineffective mechanisms for attraction of foreign investments into the sphere of high technologies. Even state scientific and technical programs on development of new technologies often are not carried out.

The qualitative parameters for development of material and technical resources and characteristics of the NTP level have worsened recently in the MBC of Russia, and it does not allow creating conditions to increase the level of competitiveness of enterprises of the machine-building industry (Table 1).

As scientists note, the level of knowledge intensity of production decreased in recent years and reduced the volume of research and ROC due to the lack of funds for innovative activity at most enterprises making knowledge-intensive production. Sukharev (2017) in his works pays attention to development of innovative economy.

It is obvious that Russia strongly lags behind all leading countries of the world, both on volume and on the rate of a gain of products. Thus, the development of the machine-building sector is at a loss because of high wear and tear of fixed assets at machine-building enterprises. The wear is 65 and 75%, respectively. Rates of updating of technological base don't exceed rates of leaving of fixed assets (0.1–0.5% and 1.5–3.5% a year). These indicators are lower than the level of advanced industrial countries (World Bank 2015).

High-quality and system carrying out repair and maintenance of production equipment in optimum terms on the basis of diagnosing allows increasing

Table 1 Dynamics of the main qualitative characteristics of the machine-building industry development of the Russian Federation (%)

Indicator	1985	1990	1995	2000	2005	2010	2016	2017 estimate
Ratio of the major types of world-class production in a total amount of their production	21.0	10.0	7.0	4.3	4.5	4.4	4.2	4.3
Updating of products	3.4	6.5	4.2	4.4	4.5	4.7	4.3	4.4
Ratio of equipment equipped with microprocessors	2.2	3.4	3.2	3.2	3.5	3.8	4.4	4.5
Updating of fixed industrial assets	6.8	4.1	0.6	1.0	1.1	1.2	1.2	1.3
Automation of design-technology works	6.0	13.0	11.0	11.0	14.0	16.0	19.0	20.0
Ratio of workers occupied with manual skills	32.0	27.0	25.0	23.0	26.0	21.0	18.0	17.0
Ratio of investments into skilled and experimental base in volume of production capital investments	4.6	4.3	3.0	3.0	2.7	2.9	2.7	2.7

Sources Authors, based on materials of branch scientific–technical and reference journals

significantly reliability of cars and equipment and reducing labor input of all types of repair work and maintenance.

The data on costs of capital repairs of cars and equipment are provided in Table 2.

For the last 30 years, the quantity of parts in cars has increased by 2–2.5 times that complicates production of cars and increases labor input of repair work and maintenance. Data are presented in Table 3.

The statistical data allow estimating objectively the economic climate in the branch. Thus, the subsequent tendencies of development can give estimates of branches of the national economy (Manufacturing statistics—NACE Rev 2017).

Due to the slow leaving wear and tear outdated equipment, we note the tendency of increase in ration of repairmen. In certain cases, the advancing growth of number of workers occupied with repair and equipment maintenance is explained by the fact that the park of equipment quickly grows old. The data provided in Table 4 demonstrate it.

It leads to additional costs of repair and service of all types of production equipment. Maintenance and repair of equipment constantly become complicated because of this situation.

The effectiveness of scientific and technical and innovative activity and prospect for the economy to get out of the crisis in many respects depend on the quality of the organizational and economic mechanism for formation and realization of state scientific and technical policy. The analysis of dynamic macroeconomic indicators for the last two decades demonstrates that the objectives of state scientific and technical policy are not substantially achieved, and the scientific and technical sphere is in the crisis (Todosiychuk 2018).

Table 2 Specific costs of capital repairs of cars and equipment in main sub-branches of the machine-building industry, in kopeks for a ruble of cost of cars and equipment

Machine-building industry	1982	1987	1992	1997	2006	2010	2015	2017 estimate
Total	3.9	3.5	2.8	2.3	2.7	2.8	2.9	3.0
Including enterprises:								
Heavy engineering industry	2.8	2.5	2.0	2.1	2.8	2.7	2.7	2.8
Electro-technical engineering industry	2.0	1.8	1.7	2.5	2.0	2.1	2.2	2.2
Chemical industry	2.4	2.1	1.9	1.6	2.1	2.2	2.3	2.4
Machine-building industry	2.6	2.3	2.0	1.7	2.3	2.4	2.4	2.5
Equipment production industry	1.7	1.5	1.3	1.3	1.5	1.4	1.5	1.5
Automobile industry	2.7	2.3	2.3	2.3	2.6	2.7	2.8	2.9
Agricultural engineering industry	3.2	2.6	2.1	2.1	2.5	2.6	2.7	2.8
Construction industry	2.5	2.3	1.9	1.7	2.6	2.7	2.8	2.9

Sources Authors, based on materials of branch scientific–technical and reference journals

Table 3 Dynamics of repair complexity of capital production equipment in the machine-building complex (%)

Repair complexity of equipment	1987–1990	1992–1995	1997–2000	2004–2009	2010–2017
Total including:	100	100	100	100	100
Mechanical part	51–49	50–48	48–45	46–44	45–43
Electric part	49–51	50–52	52–56	54–56	55–57

Sources Authors, based on materials of branch scientific–technical and reference journals

Table 4 Average age of the leaving capital equipment in machine-building sub-branches for January 1, 2017 (years)

Indicator	Metal-cutting equipment	Forge and press equipment	Foundry equipment	Welding equipment
On average in 7 branches	20	21	16	15
Including: heavy engineering industry	22	21	16	14
Power engineering industry	20	18	13	11
Machine-building industry	19	18	13	11
Automobile industry	17	19	14	12
Agricultural engineering industry	20	19	14	14
Electro-technical engineering industry	17	17	16	15
Construction and road engineering industry	20	19	14	12

Sources Authors, based on materials of branch scientific–technical and reference journals

4 Discussion

The solution of national problems to ensure economic stabilization of the machine-building industry development assumes search of reserves to increase effective management of leading branches in which the machine-building industry is of particular importance. In developed countries, a huge significance was attached to this complex that is connected with production of means of labor and technical systems that can ensure the corresponding economic and defensive potential. In industrialized countries, such as the USA, Japan and Germany, the share of machine-building production in the total amount of industrial output makes from 35 to 57%, and it is only 19% in Russia. It is necessary to consider at the same time both qualitative characteristics of machine-building production and its demand in internal and external markets. Researches show that dynamics of outcomes and expenses characterizes mainly the extensive development of the domestic machine-building

industry. The development of production activity of the machine-building industry is expressed mainly in metal- and labor-consuming production that in real market conditions does not allow increasing efficiency of economic activity.

The data show that economic potential of the domestic machine-building industry for the analyzed period was slowly increased. It is connected with a variety of reasons and first of all with the fact that the material–technical base of the machine-building industry improves by low rates because of the insufficient volume of investment resources.

In the machine-building industry of Russia, there is no decrease in specific consumption of metal and energy on unit of finished goods in the main sub-branches of the complex that contains growth of eventual outcomes. So for the last 10 years because of unstable "portfolio" of orders for the range of technologically adapted production, the size of profit of enterprises and other indicators reflecting eventual outcomes has decreased. Weak production activity at enterprises of the branch has not yielded positive eventual outcomes and economic stability yet. The imperfection of pricing does not allow giving the correct dynamics assessment of the standard indicator of profitability. For the analysis of efficiency, it is necessary to use resource capacity indicators of enterprises: for example, the workplace potential, indicators of technological progress and groups of outcome indicators: profitability, labor productivity, assets and equipment return, etc. The use of natural measuring instruments when researching development tendencies in production—the most important condition for studying factors influencing separate elements of the system on rates of production efficiency in the conditions of influence of factors of the external environment (including in the system of regions and large machine-building centers). In many respects, it allows increasing efficiency of the made economic decision at various levels of management (shop—production—enterprise in general). To analyze a real economic situation, technical and organizational, financial and economic indicators characterizing the potential and use of production resources were as: fixed business assets; manpower; material energy resources. In the domestic machine-building industry having the absolute decrease in volume of the made production in 1991–2015 almost by 2.7 times, the decrease in level of assets and equipment return was noted (Tatarskikh 2017). The functional "interface" of productive and non-productive departments worsens that leads to production disproportions and decrease in capacity of enterprises. At the same time, the structure of the park of capital processing equipment for the last 15 years practically did not change. Scientific and technological progress at enterprises has evolutionary character; there are more than 45 years traditional ways of metal working which very slowly increase metal recovery—the main constructional material.

In this branch in 1994–2016, the level of technological equipment increased no more than by ten percent; the sustainable tendency of decrease in the coefficient of shift utilization of equipment is noted. In other branches of the machine-building industry, this coefficient is only 0.3-0.4. The analysis of the main tendencies in development of material and technical resources of enterprises by cost measuring instruments does not give the objective characteristic of the level of managing that is generally connected with the repeated account of production and also with rise in price

of equipment which price annually increased in 1992–2014 for 3–5% with a growth of its productivity no more than 2–3%. The research of fixed production assets shows that the share of their active part does not correspond to the economically and technologically optimum level which enterprises of the machine-building industry, according to scientists, should have—55 to 60% of the total cost of funds. Non-compliance with this condition leads to reduction in reliability of elements in the production system and as a result leads to decrease in organizational and economic stability of enterprises of the machine-building industry of the country. In Russia's machine-building industry, there is a delay in rates of updating production assets for the last 15–20 years and it leads to their aging.

Now, in the country rather low economic and social indicators are noted that it is in many respects caused by decrease in efficiency of many industries, among which we can notice the machine-building complex, which value increases every year.

The machine-building complex is a basis industrial complex. It determines the scientific and technological and production potential of all Russian economy.

The Russian industrial enterprises in modern conditions are put before the solution of unresolved problems. One of the most serious problems is strengthening foundations of modernization that is the system innovative development and qualitatively new economic growth taking into account ecological requirements and management mechanisms of modernization (Vishnyakova 2016).

So far, the general economic situation does not allow solving problems of updating fixed industrial and production assets and therefore in the long term (8–10 years) it is difficult to count on high-quality improvement of the technical base of most enterprises of the machine-building industry.

In the domestic machine-building complex, the innovative and technological break, that is a mass transition to essentially new basic technologies and use of modern equipment, is required.

The structure of costs of technological innovations under the article "Costs for Research and Development" slowly changes in the machine-building complex of Russia and that is visible from Table 5.

Table 5 Dynamics of costs for technological innovations in the machine-building industry of Russia (in % to outcomes)

Article of expenses	1996	1998	2000	2005	2010	2016	2020 forecast
Research and development	24	26	27	31	32	33	34–35
Acquisition of rights for patents, licenses, samples	1	1	2	2	3	3	3–4
Education and training of personnel	1	1	1	2	3	3	3–4
Equipment and other components of fixed assets	47	46	41	40	38	39	39–40
Market researches	1	1	2	2	3	3–4	4–5
Other expenses	26	25	26	23	21	20	21–22

Sources Authors, based on materials of branch scientific–technical and reference journals

5 Conclusions

In the conclusion, it should be noted that the main organizational and economic actions of providing strategic objectives of innovative development of enterprises of the machine-building industry are:

- Develop technical and engineering and research centers with financial support of federal and regional government bodies;
- Provide or create conditions for effective innovative activity;
- Apply the theory and methodology for forecasting innovative technological capacity used by rival enterprises in the sphere of new technologies in corporations of industrialized countries.

Thus, summing up the result, we consider that it is necessary to hold the following events directed to increase the efficiency of machine-building enterprises:

1. Increase efficiency of strategic and advancing marketing of innovative technologies, with participation of scientists of Scientific Research Institute RAS, the leading higher education institutions and STC of large enterprises of the machine-building industry;
2. Improve the theory and methodology for forecasting innovative and scientific and technological capacity used by competitors in the sphere of new technologies in machine-building corporations of developed countries (the USA, Japan, Germany and Southern Korea).
3. Implement mechanisms of target economic incentives of leading experts occupied with developments of innovative technologies in the machine-building industry.
4. Improve the systems of standard and legislative, legal and methodical support of innovative and scientific and technological activity at enterprises of the machine-building industry that can increase efficiency of innovative and technological management on the basis of improvement the training in the leading profile at higher education institutions of the country and training abroad.
5. Develop a complex system of the economic and organizational development infrastructure of innovative technologies at advancing rates of their investment providing.
6. Develop a system coordination of organizational and economic interaction of factory and branch structures, higher education institutions and Scientific Research Institute RAS occupied with creation and development of progressive technologies in the machine-building industry.

The implementation of the offered actions will allow increasing efficiency of enterprises of the domestic machine-building industry significantly.

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Development Problems of the North Caucasus Recreational and Tourist Cluster in Russia

V. I. Barilenko, J. M. Tsugalov, N. N. Semenov and T. D. Krylova

Abstract The purpose of this contribution is to identify factors that impede the development of the recreational and tourist cluster of the North Caucasus in Russia. In recent years, the direction of tourist flows has changed significantly both from Russia and to Russia. The international tourism of Russians is declining with the simultaneous increase in the flow of domestic tourism. There is a need to expand the network of recreational and tourism facilities, to increase the range of services provided and improve their quality. The following results were obtained during the study: 1. The North Caucasus region of Russia is the most promising in the country for the development of recreation and tourism due to unique natural conditions, extensive experience in providing spa services and a sufficiently developed infrastructure. 2. The first development problem of the recreational and tourist cluster in the North Caucasus is the unresolved issue with the financing of the project. The existing programs for the regional development stipulate that 75% of the funding will be provided from regional budgets. Depressive regions, such as the constituent entities of the Russian Federation that are part of the North Caucasus Federal District, are not able to provide the level of financing necessary for a large-scale development of recreational and tourist zones. 3. The second development problem is complex confidential relations and the moral climate in the clustered association. The efficiency of a clustered association is based on decency and trust between cluster members, which is possible only when all participants can receive real economic benefits from integration. No one will develop other companies to the detriment of own interests. 4. The third development problem is a

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weak methodological reinforcement of new association activities. 5. The fourth development problem is the pronounced seasonal character of tourist activity characteristic for the given region of the country. The "dead" seasons of the North Caucasian resorts do not allow fully using the opportunities of the already created infrastructure, and lead to uneven employment of the population and are the cause of the unsustainable financial condition of resort organizations. A possible way to solve existing development problems is to develop a specialized state corporation for the Development of Recreational and Tourist Resorts in the North Caucasus, which must be provided with a state package of benefits and preferences. A number of privileges are offered, which are advisable to be provided by a new state corporation.

1 Introduction

The intensive increase in domestic tourism in Russia caused the need to develop recreational and tourism clusters. The creation and development of such associations will simultaneously solve problems in the areas of finance and employment in a number of regions of the country (Asaul 2004; Vnukova 2010; Ryaboshapko and Korkina 2012; Samostrokova 2012). The ideology of clustering implies the voluntary integration of organizations into a non-commercial partnership to enhance the efficiency of joint activities and regional development. At the same time, an important condition for effective joint activity is a high level of trust and decency among participants in the cluster (Samostrokova 2012). The maximum efficiency of the cluster is achieved when it includes complementary organizations, which creates opportunities for the development of joint ventures and achieve synergies. When providing unification of organizations in a recreational and tourist area, it is impossible to achieve a synergistic effect. It is difficult to form a necessary level of trust in recreational and tourist clusters: In the market conditions, no one will develop other companies to the detriment of own interests.

The development of recreational and tourist clusters is highly relevant for the North Caucasus region in Russia, where there is a large surplus of labor resources, developed infrastructure, unique natural conditions. The formation of such clusters is provided for by federal programs (State Program of the Russian Federation "Development of the North Caucasus Federal District for the period up to 2025" 2010; Official Web site of OJSC "Resorts of the North Caucasus" 2017); however, there is no breakthrough regional development. It is necessary to identify the reasons restraining the development of the recreational and tourist sphere of the North Caucasus and propose measures to overcome them.

2 Materials and Methods

The research methodology is based on the use of an institutional approach, analysis of literature and normative acts, and official statistics. The authors also used macroeconomic analysis, which allowed briefly reviewing development problems of recreation and tourism in the North Caucasus. Particular attention is paid to the practical aspect of proposals for the development of a territorial recreational and tourist cluster.

3 Results

In recent years, there has been a significant change in tourist flows of Russians. For political and economic reasons, the volume of tourist trips outside the country is declining, while the scale of domestic tourism is increasing at the same time. In 2016, the volume of tourist services on the domestic market of Russia increased by 8.1% as compared to the previous year and exceeded 200 billion rubles. Therefore, to develop a regional recreational and tourist cluster, it is recommended to create a state corporation, which must provide a number of financial benefits.

4 Discussion

The composition and orientation of the inbound and outbound flows in the last period have changed greatly (Table 1).

Table 1 Trends in changes in tourist flows in Russia in 2014–2016 (thousand people)

States	Tourist streams to Russia			Tourist streams from Russia		
	2014	2015	2016	2014	2015	2016
General characteristics including	25,438	26,852	24,571	42,921	34,390	31,659
Germany	584	553	566	1435	1111	1057
Egypt	11	15	11	2880	2244	0,3
Israel	150	162	179	361	299	303
China	874	1122	1289	1731	1284	1676
Poland	1772	1725	1017	1608	1322	1104
USA	245	233	239	310	237	225
Turkey	263	239	43	4216	3460	797
Ukraine	8436	8912	8569	2558	1657	1804

Source Russia in Figs. (2017). Statistical Digest. Moscow: Rosstat (Federal State Statistics Service), p. 165–166

As a positive trend, we can note an increase in the flow of tourists to Russia from China, Israel. The number of tourists from Turkey and Egypt has decreased, which is explained by restrictions imposed by governments due to terrorist acts and the deterioration of relations between these countries and Russia. Despite the leadership of Ukraine, the main flow to Russia from this country is represented by labor migrants and not by tourists.

In the face of ongoing sanctions, geopolitical complexities and other risks, a large number of Russian citizens have sharply reduced the opportunities for foreign tourism and they are increasingly using the potential of domestic resorts. There is an obvious need to expand the volume and composition of services provided by tour operators and hotel companies in the Russian market, as well as to improve the organizational and economic schemes for providing them to various categories of customers.

From the position of development of the domestic tourism market in Russia, the most promising is the North Caucasus region. This is a traditional place of tourism and recreation of the country's population with a developed infrastructure and a network of highways. In the region, there are numerous tourist facilities and health resorts that provide a wide range of recreational services. The North Caucasus region has serious natural advantages. However, they remain unrealized due to low investment attractiveness of the region, unstable social and political situation and complex criminal situation.

In the course of market transformations, there was a sharp deterioration of the situation in this region: Many industrial enterprises were closed, and resorts and health resorts fell into decay in the absence of investments. By the middle of 2000 the region became depressed, unemployment increased, the economic and ethno-political situation worsened, and terrorist activity began to develop. For the regional development, the North Caucasus Federal District (NCFD) was established, and in 2010 the Government of the Russian Federation approved the Strategy for the Social and Economic Development of this District until 2025 (State Program of the Russian Federation "Development of the North Caucasus Federal District for the period up to 2025" 2010). One of the main provisions of the Strategy was the development of a regional tourist cluster. The implementation of the strategy includes the development of the real sector of the economy, the development of innovative industries, the creation of new jobs, and the improvement of the living standards of the population. However, to date, the socioeconomic situation in the region remains very difficult.

Subsidies from the federal budget reach 60% of local budgets, which is 1.5 times higher than in other regions. The funds of the federal budget are directed primarily to maintain the social sphere, and only a small part goes to the development of the real sector of the economy. The share of processing industries does not exceed 15%, while the average for the country is 19%. The share of the agrarian sector in the regional economy reaches 22% (the average for Russia is 5%).

The tourist attractiveness of the region is negatively affected by the prevailing significant surplus of labor resources with a very low standard of living for a significant part of the population. The level of official unemployment significantly

exceeds the average for the country and ranges from 8 to 55% for various constituent entities of the Russian Federation that are part of the district. Insufficiently developed network of educational institutions, primarily higher education, does not allow organizing effective retraining of staff necessary for quality rendering of tourist services.

The country's leadership is taking active steps to improve the situation in this region. The Strategy for the Social and Economic Development of the North Caucasian Federal District until 2025 was developed, approved by the decree of the Government of the Russian Federation No. 1485-p of September 6, 2010. To implement this Strategy, Vnesheconombank established the "North Caucasian Development Corporation," which implements measures of consultative and supportive nature, promotes attracting investments, develops industrial parks, creates business areas, provides financial advisory services, etc. However, this corporation does not make any real investments in the regional development. By the Decree of the Government of Russia from February 27, 2016, No. 148 additions and changes to the state program were made for the development of the NCFD until 2025, including an increase in funding.

The Strategy for the Development of the NCFD is complemented by a number of programs adopted in the constituent entities of the Federation. Thus, the State Program "Development of Tourism, Resorts and Youth Policy in the Republic of Karachay-Cherkess for 2017–2020" was approved (Resolution of the Government dated October 31, 2013 No. 364).

In accordance with these government documents, the following main directions for solving the problems have been established:

- Create a modern tourist infrastructure;
- Improve the image and organize active promotion of tourist potential;
- Increase transport accessibility of perspective tourist centers;
- Ensure a high level of safety for tourists;
- Develop human resources.

The main problem is the unresolved issue of financing development programs of the recreation and tourist cluster of the North Caucasus. It is assumed that the financing will be implemented:

- At the expense of the federal budget (on a competitive basis and upon agreement);
- At the expense of local budgets (as agreed);
- At the expense of investors.

Thus, it is planned to receive financial resources on a competitive basis in the form of grants to the budget of the Republic of Karachay-Cherkess. At the same time, 70–75% of the funds for the implementation of the Federal program should represent the budget of the Republic of Karachay-Cherkess. The volume of financing for the years of program implementation ranged from 73 to 165 million rubles, which is clearly insufficient to address the problems. The depressed region is

not able to provide the level of funding necessary for a large-scale development of recreational and tourist zones. The limited financial capacity of the region makes it possible to channel funds that are to solve tasks only operationally, but not strategically.

The advantage of the cluster is the ability to combine financial resources for the implementation of investment projects. But in the depressed regional economy, such resources may simply not be available to the participants of integration. Another advantage of clusters is the possibility of reducing the cost of production and services, due to a synergistic effect (e.g., the use of unified transport and distribution networks). But such a reduction is possible if the cluster includes mutually complementary organizations. When providing unification of organizations with only a tourist profile, the achievement of a synergistic effect is impossible.

The second development problem is related to the fact that the efficiency of a clustered association can be based only on decency and trust between the participants of the cluster (Samostrokova 2012). But such trust is possible only when all participants can receive real economic benefits from integration. No one will develop other companies to the detriment of own interests.

The third development problem of the tourist cluster of the North Caucasus in Russia is a weak methodological support the association activities.

No less important, the fourth development problem is the pronounced seasonal character of tourist activity characteristic of the given region of the country. These are "dead" seasons of the North Caucasian resorts that do not allow to fully make use of the opportunities of the already created infrastructure, lead to uneven employment of the population and are the reason for the extremely unsustainable financial condition of resort organizations. The solution to this problem could be a full system development on the basis of available resorts providing high-quality medical services that are all-seasoned. However, it is obvious that such a decision requires significant state support measures.

The possible way to develop a tourist cluster is the creation of the state corporation for the development of resorts in the North Caucasus. The efficiency of such structures is proved by the Russian practice of the state corporation for the construction of Olympic facilities and the development of the city of Sochi as a mountain climatic resort (Federal Law No. 238-FZ 2007). Such a corporation could carry out a unified management of resorts in the North Caucasus, receive various kinds of benefits and preferences from the state. The creation of a specialized state corporation will require the preparation and adoption of a special federal law, in which it is necessary to present the purpose and tasks of the new structure, the terms of its activities, measures of state support.

Recommended measures of state support

1. Organize targeted federal funding for the activities of the state corporation with a special allocation of funds for the development of socially important medical services provided by resort organizations. The amount of funding, by year, is determined on the basis of the business plan of the corporation.

2. Release the property complex transferred to the state corporation from taxes.
3. Enable the corporation to form special funds and use them for the development of a tourist cluster.
4. Provide the state corporation with holidays in terms of VAT for five years, before the introduction of tourism facilities (including medical tourism) in new territories.
5. Provide some privileges to small business organizations participating in the regional development as subcontractors of the state corporation. The targeting, types, and magnitude of benefits in coordination with government agencies are determined by the corporation itself, depending on the specific nature of the work performed.
6. Provide the corporation with the opportunity to conduct tenders for the services provided outside the framework of the law on public procurement.
7. Provide some privileges on promotion of tourist, health, and medical services provided by organizations of the state corporation.
8. Provide preferential tariffs for the transportation of consumers of tourist services, arrange charter flights to the region of the North Caucasus Resorts.
9. Organize targeted training of specialists for tourism organizations in the leading universities and training centers of the country.

Similar privileges and preferences apply to other Russian state corporations. They do not violate the competitive situation in the sphere of tourism in the region and in Russia and will contribute to the solution of the important social and economic development problem of the tourist cluster of the North Caucasus.

5 Conclusions

The development of the recreational and tourist cluster of the North Caucasus in Russia is impossible without an active assistance and support of the state. The well-known regional development programs stipulate that 75% of the financing of federal programs should be implemented by regional budgets. However, the subjects of the Russian Federation that are part of the North Caucasus Federal District cannot provide the necessary level of funding because of their depressiveness. Therefore, to develop a regional recreational and tourist cluster, it is recommended to create a state corporation, which must provide a number of financial benefits.

Such actions do not violate the competitive situation in the sphere of tourism and will contribute to the solution of the important social and economic problem of the recreational and tourist cluster of the North Caucasus.

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Technological and Economic Justification of Development Tendencies of the Russian Petroleum Refining Industry

A. V. Streltsov and G. I. Yakovlev

Abstract The relevance of solution of the stated issue is caused by the fact that development of the country's petroleum refining industry becomes one of the most important problems of economic modernization of the Russian Federation, which is still providing more than a half of revenues of the state, and which is at the same time the basis of export and acquisition of currency earnings. The purpose of this contribution is identification of issues of modern petroleum refining and justification of its prospects in conditions of objective obsolescence of an active part of the main productive assets and also high turbulence of the external environment, generally caused by universal change in technological modes, energy saving policy, instability of supply and demand in the global oil market. The main research methods are the complex and system analyses, which allow revealing system and local problems of development of the modern petroleum refining, disclosing interrelations and interdependence of management entities and receiving methodological tools of problem solution as a research result. The significant factors defining scientific and technological and organizational state of the petroleum refining branch are revealed and considered. They are necessary for development of events for increase in its technological level by the model of public–private partnership. The research results: the authors developed theoretical and methodological approaches to organization of sustainable development of the refining complex, which are connected to new technological solutions, processes on increase in depth of refining of crude petroleum. Materials of this contribution can be useful for experts in the field of technological and economic development of enterprises, for heads of the ministries and departments of the petroleum refining sector, managers of enterprises and also researchers of problems of development of the fuel and energy complex.

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1 Introduction

In modern conditions, the economic development of the Russian Federation still depends on the efficiency of functioning of its oil and gas complex. It determines a considerable share of gross domestic product, an essential part of revenues in the federal budget, and it is the basis of foreign trade. According to trends of post-industrial development, the country's government is conscious of the need of decrease in oil and gas dependence of the state budget from the existing 60–33% by 2020, according to the statements of the Minister of Finance (Korolev 2017). However, in conditions of preservation of the former economic paradigm, absence of structural transformation of the national-economic complex and real results of the stated import substitution policy, notable diversification of tax revenues for the short-term period is represented as a problematic one, except for mobilization of the source of increase in taxes on the income of natural persons and property of the population. Table 1 is drawn up according to data of the Federal State Statistics Service of the Russian Federation and shows steadily remaining high share of production and export of petroleum in economy for the last 2016–2017 (Federal State Statistics Service 2018).

Table 1 Production, delivery to refining and export of petroleum

	January–September 2017		September 2017 (million tons)	In % by	
		In % by January–September 2016		September 2016	August 2017
Petroleum production, including gas condensate, million tons	409.2	100.5	44.5	97.7	96.3
Delivered to refining million tons	211.8	100.5	22.7	99.1	92.5
Export million tons	191.0	100.6	20.1	102.2	92.7
Share of export in production (in %)	46.7	–	45.2		
Specific weight of petroleum export in the total Russian export volume	26.9	96.3	–	–	–
Specific weight of petroleum export in export of fuel and energy goods (%)	44.2	100	–	–	–

Source Authors According to the data of the Federal Customs Service, including data on mutual trade with member states of the Eurasian Economic Union (EEU). The information is presented as on November 8, 2017

The data of the table show a significant share of the oil and gas sector in the country's economy, which is also the basis of its foreign trade. Besides, export of crude oil does not decrease lower than 50% of the production level during all the post-reform time. It obviously testifies to the raw model of the economy. Not incidentally, for the last 45 years fuel and energy branch of the country gained priority development among other types of economic activity. Therefore, functioning of the oil and gas complex, including petroleum complex, is quite reasonable nowadays. The countries are estimated as rather effective, where the volume of extraction of hydrocarbon crude, export, and rather high profitability is steadily supported or even increases (Korzhubaev and Eder 2012).

At the same time, defining the current state of the petroleum complex of the Russian Federation, it is necessary to investigate its technological and organizational components in more details. First of all, functioning efficiency of a number of adjacent and providing branches: oil-producing, drilling, machine-building, transport, oil refining and selling. It is connected with the fact that effective activity of the petroleum complex in general is defined by conditions of oil sales in foreign market. Rather high world price for oil in conditions of in-Russian lower prices for resources allows keeping rather high level of profitability of the petroleum complex in general. At the same time, as a rule, the level of technical, technological development of certain elements of this complex (petroleum production, oil refining) insignificantly differs from similar characteristics of other industries of the Russian Federation, where serious issues are accumulated and require solution and considerable investments (Lenkova et al. 2017).

The issue of development of the domestic petroleum refining branch becomes especially sharp in discussions of both theorists and practitioners, top managers of the companies, producing and consuming oil products in conditions of challenges, generated by the existing geopolitical crisis, rapid development of the energy saving technologies and development of "green" power. Many government documents began to be devoted to this subject as public authorities always paid much attention to development of the petroleum refining industry in the Russian Federation. Among current documents, it is possible to mention the Energy strategy of the Russian Federation up to 2030 (Energy strategy of Russia until 2030, 2018), the General scheme of development of petroleum branch of the Russian Federation until 2020 (General scheme 2011), etc. At the same time, it is possible to allocate a number of questions to the certain provisions of these documents, taking into account the fact that from the moment of their acceptance (The Energy strategy—is accepted by the Government Resolution of the Russian Federation dated 13.11.2009), the characteristics of the oil market and the market of petroleum products changed repeatedly and critically that is shown by Kapustin (2018).

Commitment to raw orientation of the petroleum complex is sufficiently fixed in these documents. For example, Mikhailov (2011) notes that the major indicator—consumption of petroleum products per capita at the level of 1.3–1.6 thousand people is supposed to be reached in 2030, while the value of 1.6 thousand people could be already reached in 1990. Owing to acceptance of the number of documents and, especially, technical regulations on fuel and emissions: "About requirements

for emissions by automotive vehicles, released in the territory of the Russian Federation, of harmful (pollutant) substances," "About requirements for automobile and aviation gasoline, diesel fuel and petcoke" (Resolution 2008) and the carried-out modernization of petroleum refinery in 2016, the Russian Federation completely moved to production and sale of the 5th class of motor fuel in the domestic market. However, the European Union countries already switch to the Euro-6 standard. Considering that this objective is still not set in the Russian Federation, it means that the Russian light petroleum products will not correspond to the European standards. And as a result, they will not be used for the intended purpose in the markets of the developed countries but will be improved to the Euro-6 class.

An important issue of development of the oil refining industry, connected with specifics of the modern Russian economy, is consequences of the so-called tax maneuver, which is introduced for increase in sustainability of the financial state of the economy of the Russian Federation. Reduction of differentiation between export taxes on petroleum products and oil, increase from 1/1/2016 to 4/1/2016 in rates of excise duties on motor fuel exerted extremely negative impact on profitability in petroleum refining. At the same time, it is possible to mention positive factors, in particular, decrease in basic rates of export tax on light petroleum products, noted by Tsertseil and Kookueva (2017).

However, the set of these factors defined fixing of the tendency on decrease in yield of in-Russian refining for vertically integrated oil company and reduction of its volumes. According to various forecasts, made by Kutuzova (2017a, b), it will decrease to 275–278 million tons in 2018, in 2019—to 273–278 million tons and in 2020—to 271–278 million tons. At the same time, Lukoil agreed about refining of 300 thousand tons of oil in Canada (Kutuzova 2017a, b).

2 Materials and Methods

The theoretical and methodological research basis is:

- Principles of the complex analysis, allowing the authors to cover a wide range of aspects of the state and dynamics of petroleum refining in the Russian industry;
- Principles of the system analysis, enabling to study measures, taken while solving the problem of increase in efficiency of oil refining at different levels of the management hierarchy of economy of the Russian Federation. The interrelations between the subjects of technological and organizational development of the petroleum refining industry are studied in the chain "the state—branch—industrial enterprise" while solution of problems of more effective use of raw oil products and the extraction level of useful components, efficiency of government interventions;

– The comparative analysis, enabling to develop conclusions about the level of solution of the problem of advanced petroleum refining in the Russian economy and to draw an analogy to foreign experience.

The experimental research basis: Russian industrial enterprises of the petroleum refining industrial sector, governing bodies of the national economy.

Investigation stages: Theoretical justification of the need of improvement of equipment and technologies for activity in the petroleum branch in the Russian Federation was made in 2010–2017 in studies of the authors (Streltsov and Eroshevsii 2017; Streltsov et al. 2015; Yakovlev 2013). The applied research methods enabled to estimate the importance of challenges afflicting the Russian petroleum industry, high dependence on the level of the world prices, the actual dichotomy of oil export and establishing in-Russian refining. In conditions of high world prices, the export is estimated by managers of the vertically integrated oil companies (VIOC) as more favorable transactions than development of refining capacities and demanding investments in development of secondary processes.

It is shown that a special role in the country's petroleum complex is played by oil refining industry. On the basis of the produced petroleum goods, it provides steady functioning of the economy of the Russian Federation in general, the essential volume of payments in the budget, meeting the requirements of defense capacity of the country. Both activity of other enterprises and organizations and the level of human well-being in many respects depend on its stable work. However, despite even rather big size of the realized capital investments, the large volume of depreciation of the fixed assets, first of all, the moral one is accumulated in the petroleum refining industry, and it is at variance with the modern universal requirements for organization of the technological schemes of oil refining of many enterprises. It generates big risks and problems in development of domestic oil refining. Taking into account the branch importance, it can become a limiting factor upon transition to higher growth rates of economy of the Russian Federation.

3 Results

It is identified that now it is possible to allocate a number of problems in domestic petroleum refining. According to the reasons of their emergence, they can be systematized in three groups:

– Determined by peculiarities of historical development,
– Stipulated by development specifics of the petroleum refining industry in conditions of modern Russian economy,
– Caused by the influence of current macroeconomic factors of the external environment (Fig. 1).

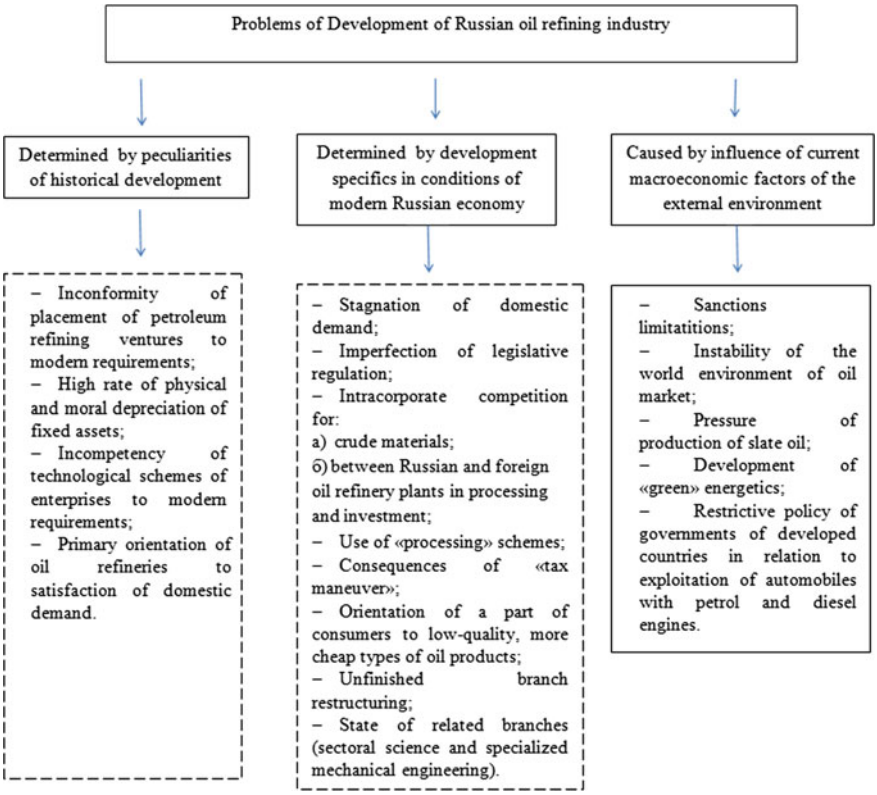

Fig. 1 Actual problems of development of the Russian oil refining industry. *Source* Authors

The first one includes imbalance of placement of petroleum refining ventures for various regions of the country, high rate of physical and moral depreciation of fixed assets, primary orientation of oil refineries to satisfaction of domestic demand, incompetency of configuration and technological schemes of the majority of enterprises to modern requirements. It determines lower share of production of secondary processes in comparison with other industrialized countries.

According to Adushev (2015), the problems with placement of oil refinery plants determine periodically appearing deficiency in certain oil products in some regions of the country, for example, in the Far East. The majority of plants are situated in the continental part of the Russian Federation that complicates possibilities of export. Domestic oil refinery plants were created for satisfaction of domestic demand that is why there are almost no export-oriented oil refinery plants in the Russian Federation, which are conveniently located from the export "corridor." By calculations of a number of authors, as soon as oil product expanded beyond oil refinery, its price increases almost twice, if it is long distance sale—by three times.

If oil products are transported by means of railway, then there appear considerable costs from 30 to 80 dollars per 1 ton of oil products (Ryabov 2013).

The considerable rate of accumulated wear of fixed assets is connected with the fact that the main capacities of existing enterprises were projected and created in the 1950s–1980s. Therefore, despite periodically conducted modernizations, data of oil refinery plants were not new. For example, there was start-up of the plants of the Central Federal District: Moscow oil refinery—in 1938, Ryazan oil refinery—1960, Yaroslavl oil refinery—1961; a number of plants of the Volga Federal District: Nizhny Novgorod oil refinery—1956, Perm oil refinery—1958, Novokuibyshev oil refinery—1951, Kuibyshev oil refinery—1945, Syzran oil refinery—1942, Saratov oil refinery—1934, Ufa oil refinery—1938 (Adushev 2015). Taking into account a considerable decommissioning of a number of outdated capacities of primary processing, nowadays the service life of various installations, manufactures, technological processes exceed standards by 2–2.5 times.

Toughening of requirements to the quality of oil products (especially ecological ones), which took place in the 1980s, resulted in considerable change in technological schemes of oil refinery plants and the structure of products in foreign industrialized countries. As a result of the market reforms of the 1990s and radical branch restructuring, the Russian oil companies have already begun modernization of their oil refining capacities. It has led to lag of oil refining of the Russian Federation in competition with foreign companies (Belova et al. 2017).

It should be also noted that in the period of their construction in the 1950s-1980s domestic petroleum refinery plants were mostly formed without qualitative, ecological requirements to oil products, without sufficient development of secondary processes and with a small depth of processing of raw materials. It has considerably risen in the Russian Federation in the recent years (see Fig. 2); however, it significantly lags behind similar values of industrialized countries (the depth of oil refining in the USA is 90–95%, in Europe—85–90%), but also OPEC member

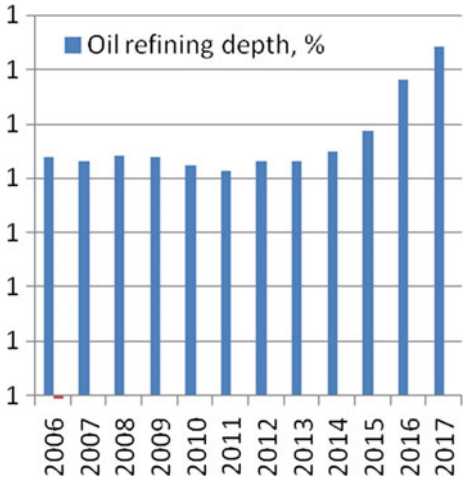

Fig. 2 Dynamics of the indicator of oil refining depth in the Russian Federation. *Source* it is drawn up according to the data of the Russian State Statistics Committee (2018), expert appraisals ("Oil industry: 2017 results and short-term prospects 2018" 2018)

countries (about 85%). The depth of oil refining did not fall lower than 80% in the former USSR (Adushev 2015).

In conditions of the modern Russian economics, the following problems caused by development specifics of the oil refining industry can be considered. In the modern branch structure, the petroleum refining ventures are the part of the large vertically integrated oil companies (VIOC). VIOC can form their income not only from sale of manufacture of oil refinery plants—petroleum products, but also from export of hydrocarbon crude. In this regard, depending on the level of the world prices, export of oil to the world markets can become more profitable for VIOC, than its in-Russian processing, which also requires implementation of investment projects on development of secondary processes (Smith 2014).

Comparison of the coefficient of efficiency of the average annual production capacity in oil refining industry (see Fig. 2) with data on petroleum export shows decrease in the level of use of the average annual enterprise capacity in 2014–2016. At the same time, the petroleum export grew by 13.4% and reached 254 million tons in 2016, that is 2 million tons bigger than the maximum in 2007, and in 2017 the oil export grew by 1.3% in comparison with 2016, the refining volume practically did not change (−0.1% by 2016) (Oil industry 2018).

It should be also noted that the largest Russian VIOC have refinery capacities abroad, including industrialized countries. For example, Lukoil owns three plants in Europe (Romania, Italy, Bulgaria) and also 45% of shares of oil refinery plants in the Netherlands, Gazpromneft has the NIS complex in Serbia and also the Mazyr oil refinery (Belarus) in joint use, Rosneft is a co-owner of three oil refinery plants in Germany, controlling at the same time more than 12% of the German petroleum refinery capacities and also indirectly owns 21% of stocks of the Mazyr oil refinery (Belarus) and plans to participate in construction of a petrochemical complex on Java Island (Indonesia) (Kutuzova 2017a, b). Therefore, the Russian VIOC have one more alternative: to increase in-Russian refining or to develop extra Russian refinery capacities.

The last option can be rather estimated as a negative one, because new workplaces are not created in the Russian Federation, added cost and taxes do not stay in Russia. It also should be noted that possession of a number of foreign assets is a problem for VIOC, especially in conditions of the mutual sanctions and limiting Russian policy and a number of the Western countries (Khmeleva et al. 2017).

The fact that almost all oil refinery plants work in conditions of "give-and-take raw materials" ("processing") is among the most important features of the Russian oil refining industry. The cost of refining is determined by the VIOC management company. Therefore, the profitability of activity of oil refinery plants is not quite of market character, it is the parameter, which is regulated by VIOC. By estimates of some authors, the conducted comparative analysis of profit and product costs of oil refinery plants, working in conditions of give-and-take raw materials, and calculated values of these indicators (under refusal of the processing scheme) showed that there are more saleable products by 12.4 times, and the profit is higher by 9.5 times in the latter case (Wu et al. 2017). Wide dissemination of the non-processing scheme would allow accumulating necessary resources for modernization of oil

refinery plants more quickly, to increase profitability of the enterprise (Ryabov 2013). Characterizing modern development of oil refining, it is possible to designate one more specific characteristic—unfinished branch restructuring (Shaimieva 2011).

While characterizing the problems of the Russian oil refining, it is possible to mention also a number of moments connected with legislative regulation of the industry, with setting of purposes and priorities of its development. Despite the intention of the state to liquidate small, technological oil refinery plants ("samovars"), they remain highly profitable and increase refining volumes, producing non-excisable substitute types of motor fuels for the in-Russian consumer. Refining light oil or gas condensate, they are quite competitive in comparison with large complex oil refinery plants, which process average and below average oil and located far from export exits. At the same time, petroleum products, produced by them, do not correspond to the requirements of modern standards. Oil products themselves and the work of these enterprises in general raise many issues regarding compliance with ecological requirements.

Speaking about the issues, determined by specifics of the modern Russian economy, the critical state of the domestic petroleum engineering industry should be mentioned. Notably, there is a specific "vicious circle" in interaction of oil refining and mechanical engineers. Due to the lack of qualitative domestic analogs, the most part of newly introduced equipment in the process of implementation of investment projects in oil refining is imported. Its use can be also determined by contractual liabilities while acquisition of modern import technologies. It, in its turn, causes also decrease in demand for production of the Russian petroleum engineering industry.

Almost the same approaches function in regard to other domestic organizations. Foreign companies, which conduct construction of the majority of units of secondary processing at the Russian oil refinery plants, as a rule, prescribe in agreements that they will carry out preparation of pre-project and working documentation independently, they often build materials and additives into their projects, being guided by producers of foreign industrialized countries (Yuan et al. 2017). As a result, Russian organizations almost do not participate (except for a number of permissive and minor procedures) in implementation of projects on modernization of oil refinery plants. Therefore, transition of the Russian VIOC to the Russian technologies and equipment is very important from the point of view of import substitution and cost saving as domestic analogs are much cheaper.

Mentioning the need of increase in degree of development of secondary processes in oil refining, it is necessary to consider one more problem connected with the fact that the qualitative level of oil products always determines demand (Andrianov 2017a, b). And energy balances of many regions of the Russian Federation still continue to be focused mainly on fuel oil consumption. The automobile transport, despite fast rates of its updating, is not quite ready to transition to more qualitative and expensive types of petrol. The same characteristic refers in full to the significant share of motorists. Due to it, high specific weight of fuel oil remains in the structure of production of petroleum products (see Fig. 3). It should

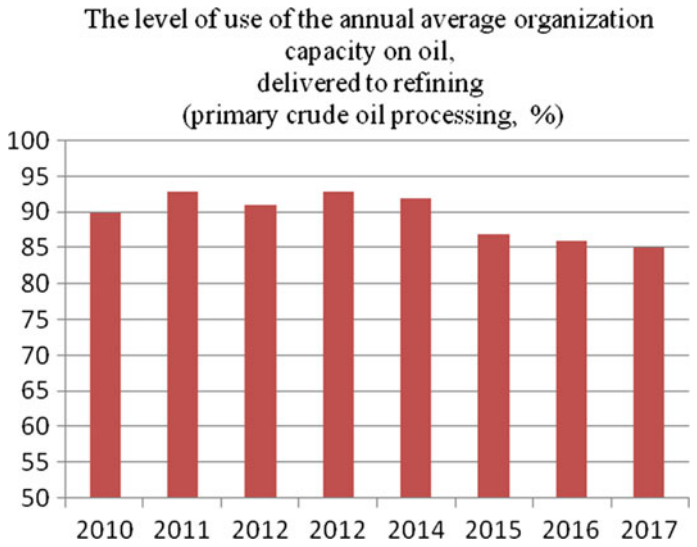

Fig. 3 Level of use of the annual average organization capacity on oil, delivered to refining (primary crude oil processing, %). *Source* it is drawn up according to the Russian State Statistics Committee (2018), expert appraisals ("Oil industry: 2017 results and short-term prospects 2018", 2018)

be mentioned that increase in the share of diesel fuel is mostly determined by considerable increase in its export. However, its further prospects seem uncertain as sales of cars with diesel engines are reduced in Europe.

Over 2017, the volume of production of petrol decreased by 1.8% (−0.7 million tons) to 39.2 million tons that can be caused by stagnation of domestic demand. In December, production of diesel fuel decreased by 2.7%; however, over 2017 it increased by 0.8% to the level of 2016. It was provided by stable domestic and external demand. Production of fuel oil in 2017 in Russia decreased (−10.3%) for the third year in a row in view of the conducted tax policy (Oil industry: 2017 results and short-term prospects 2018).

The issues of the third group, caused by influence of the current macroeconomic factors of the external environment, include impact of sanctions restrictions and the world environment of the oil market. The essence of the forming issues of this group is connected with the fact that oil refining industry differs on high inertia of development, big capital intensity that defines long-term character of updating programs. Investment projects, which are carried out at petroleum refinery plants, are characterized by big payback periods. All this makes projects of updating of oil refining plants rather vulnerable to various external influences and especially to their combinations.

Sanctions itself could not exert significant influence on the modernization process of the Russian oil refinery plants. However, their effect coincides with instability of the world price for oil. It leads to reduction and, respectively, to rise in price of free

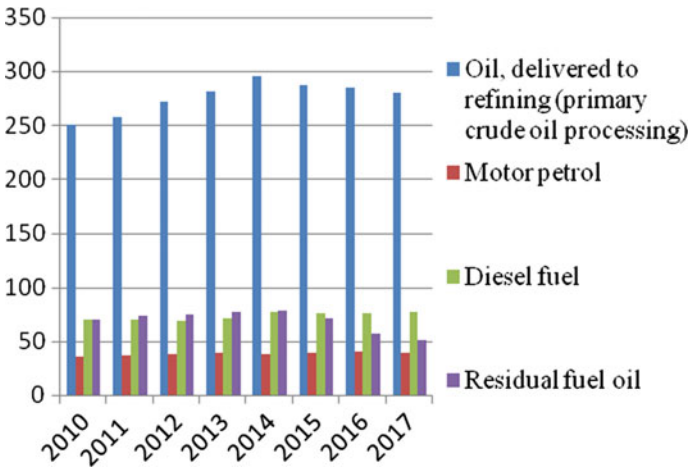

Fig. 4 Production of the most significant types of petroleum products in the Russian Federation for the period of 2010–2017 (million tons). *Source* it is drawn up according to the data of the Russian State Statistics Committee (2018), expert appraisals (Oil industry: 2017 results and short-term prospects …, 2018)

monetary resources, which can be attracted by oil refining plants to financing of investment projects. Postponement of terms of their realization and deterioration in indicators of efficiency is its consequence (Andrianov 2017a, b) (Fig. 4).

At the same time, there can be one more problem. Use of materials, reactants, catalysts of specific foreign producers can be stipulated within license agreements on acquisition of certain technologies. In case of their value appreciation or replacement, time and mobilization of free monetary means are required. However, their attraction is quite difficult.

4 Discussion

The existing issues of development of the oil refining industry of the Russian Federation are the target of numerous scientific studies and provisions of normative and legal documents, determining average and short-term prospects. Various approaches, starting from requirements of abandonment of oil and gas fields for descendants to activation of search of new fields even on the shelf of the Arctic seas, are offered for their solution. Nevertheless, in the foreseeable future, the well-being of many developing countries will be based on extraction and processing of hydrocarbon crude (Yáñez et al. 2018; Kontorovich and Livshits 2017).

At the same time, we should mention a big role of the state regulation in this process. Adoption of technical regulations on fuel and emissions and rather "rigid" position of public authorities on their application stimulated VIOC to modernization

of their oil refining assets of branch leaders—enterprises of the developed countries (Han et al. 2015).

Understanding of the modern issues of Russian petroleum refining, existence of various offers on their solution and also ambitious tasks in acceleration of development of the Russian economy determine the need of elaboration of a new development strategy of the oil refining industry of the Russian Federation, on the innovative and energy saving basis (Levinbuk and Kotov 2015; Chernikova and Polishchuk 2017).

5 Conclusions

Effective development of the Russian oil refining industry, increase in its competitiveness in internal and world markets, requires solution of the emphasized issues and formation of a complex of events, which are meant for the long-term period. The system of administrative, tax, economic measures, including direct assistance from government institutions is necessary for implementation of VIOC plans for modernization of oil refining capacities. For realization of the last, the form of public–private partnership is represented as a perspective one. The last tax measures resulted in deceleration and delay of investments into oil refining while it is in the middle of its modernization cycle.

The existing tax system does not stimulate load of oil refinery plants, their modernization, increases interest of VIOC in export of oil or half stocks. It is necessary to strengthen work on transition to production of fuels of the Euro-6 class, to shift a significant part of tax burden to the sphere of extraction. At the same time, it should be remembered that oil extraction is influenced by different negative factors; that makes it harder to maintain their competitiveness.

Building of new oil refinery plants with modern technology of deep petroleum refining not far from export "exits," refusal of "processing" schemes will enable to increase profit in oil refining considerably, to increase competitiveness of its production also in the world market.

Despite the effect of a number of negative factors of internal and external nature, extension of modernization processes of the Russian oil refinery plants, increase in development degree of secondary processes is necessary. Maintenance of high degree of investment activity in the branch is necessary for this purpose.

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