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INNOVATION AS THE BASIS FOR STIMULATING ECONOMIC DEVELOPMENT

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Abstract

In the context of a protracted economic crisis and a significant economic backlog, one of the few remaining opportunities for the country's development is innovation. For Russia, the shift from raw material orientation to new technologies and development of innovative products in order to ensure the competitiveness in world markets still remains an urgent task. This is particularly important since the country has enormous natural resources and significant, unfulfilled potential in this area. It is necessary to support infrastructural changes, which are an important element in enhancing competitiveness, ensuring import substitution, and improving the quality of life of the population. The study analyzes the current state of the economies of the world and the Russian Federation in the prism of changes related to the transitions of technological cycles that form the basis for economic growth, analyzes factors that affect innovations that ensure an increase in economic development. There is a need to ensure considerable state support for innovation through targeted investments in the most promising development areas. The discriminant analysis is used as a tool for analyzing the effects of factors on the development of economies, which allows setting the purpose of the study as the most significant factors that affect the development of innovation in the Russian Federation. The study provides a rationale that is critical for innovative development in the Russian Federation: labor productivity, internal R&D costs (in GDP), costs of technological innovations and investments aimed at the reconstruction and modernization of equipment.

Keywords: Innovation, technocenosis, economics, multiple discriminant analysis

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1. Introduction

Many researchers are devoted to the impact of innovation on economic development. Thus, Masiello and Slater (2012) note that the world economy is in a state of stagnation, fiscal incentives are no longer effective and the development of macroeconomic processes is only possible through innovations. Thompson and Stam (2021) study in detail the impact of SME innovativeness and state that the hypothesis that there is a universal program to stimulate innovation and proportional growth of macroeconomic processes of the economy in accordance with it is erroneous. At the same time, the authors argue that the availability of technology is not a determining factor in the development and prosperity of innovation and the economy. As a marker indicator, many researchers often suggest choosing the indicators of SME innovative activity, since on the one hand, SMEs are more influenced by macroeconomic shocks and on the other – they serve the basis for the development of the domestic economy of many states (Barnagyan, 2017; Dzhukha et al., 2017). It is quite interesting to note the opinion of Thompson and Steam (2021) that there are studies that suggest that innovation is influenced by supply stimulation and the availability of technologies, but there are alternative studies that argue that the preferences and incomes of the population provide for innovation development. In this aspect, the study of factors determining the development of innovation in the Russian Federation is beyond any doubt.

2. Problem Statement

The analysis and assessment of the factors influencing innovations allows revealing relationships of cause and effect of the lag of the state's economy and defining the need for measures of state support of innovations due to target investments into the most perspective development areas. The changes connected with transitions from one technological way to another complicate the development of the world economy and serve the prerequisites of many economic crises. The complexity of innovative evolution from the origin of the concept of ideas to the moment when it enters the market and its commercialization is caused by poorly predicted result and requires considerable financing. In this context, the definition of priority spheres of financing and their stimulation due to innovations plays a key role, thus defining the need to study the factors influencing the innovative development to a greater extend.

3. Research Questions

The object of the study is the analysis of statistical data of the IMF and Goskomstat of the Russian Federation on the GDP change in dynamics, definition of recession points (and subsequent rise) of the economies of innovatively developed countries. The object includes estimated characteristics of factors influencing the development of innovative economy.

4. Purpose of the Study

The purpose of the study is to determine the most significant factors influencing the development of innovations in the Russian Federation.

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5. Research Methods

The research methods include the multiple discriminant analysis with the discriminant function: d = b1x1 + b2x2 + ... + bnxn + a that allow accurately grouping the factors with the assessment of their extent of influence on GDP changes. SGWin is used as the means of program support.

6. Findings

The concept of innovation, which ensures continuous development of companies due to changes that ensure the adaptation of a control system to developing environmental conditions, is closely connected with the concept of technocenosis, which is the artificial system stimulating new branches of the economy due to new knowledge and progressive engineering and scientific decisions. Technological innovations are one of the reasons of nonequilibrium state of the economy providing its development (Brian, 2015). The emergence of new technologies is a continuous incentive to transformations, thus generating new uncertainty. Now, there is a transition from the V-shaped technological setup in the world economy (1980–2010): computers, low-tonnage chemistry, telecommunications, electronics, the Internet to VI and VII (2010–2019 – …): biotechnologies, nanotechnologies, living being design, investments in people, new environmental management, robotics, new medicine, production of socio-humanistic knowledge and technologies, design of the future and its management (technologies of assembly and destruction of social subjects) (Gavayler, 2018; Glazyev, 2016; Zhironkin & Gasanov, 2014).

These transformations are connected with complications in the development of the world economy that entails new economic crises. It is known that at the beginning of each production cycle the breakthrough is provided at the expense of front lines in the technological relation of the industries. Besides, it is necessary to keep in mind that the transitions to the next setup are ensured by appropriate resources. Many researchers note a special role of information technologies in the development of modern economy, however they poorly stimulate the involvement of some resources (which should be in sufficient amount) for use in breakthrough high technologies of the formed setups.

Unfortunately, lag in the development of STP achievements led to the fact that the Russian Federation mostly remains the buyer of perspective technologies and new types of products of foreign competitors. Nevertheless, the obsolescence of capital during the crisis forces to draw attention to new technologies, attracting necessary investments for ensuring the growth of the economy.

The existence of such structure as Skolkovo where huge amounts of money are “pumped” into cannot be the basis for competitiveness enhancement since the participation of globally known foreign companies in this innovative center only leads to the “leakage” of progressive productive ideas of domestic developers thus ensuring the profitability of foreign firms, but not improving the competitiveness of the Russian economy. In this situation it is more reasonable to lean on the scientific bases developed in the Novosibirsk Campus, Zelenograd, MIPT in Dolgoprudny, large scientific centers in other cities where there is a link between scientific centers, universities and advanced enterprises. The technological setup ensures S-shaped characteristic of a production cycle which is completed at the last stage with the development crisis.

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The main phases of the innovative process include the following stages: formation of a conceptual idea → development of a product (technology) → mass disposal of innovation for the purpose of obtaining a commercial benefit. The first two stages generally include costs, and they account to 70 % of all costs of a new product. Profit is obtained only in the course of replication required in the market of the innovative product.

The complexity is that the efficiency of the first two stages requires decent financial support of the work of scientists, designers and technologists, but business is not ready to invest a lot for these purposes (in fact "to freeze") in view of big risks connected with the expected result which is poorly forecasted.

As more than 70 % of organizations providing the scientific and technical capacity of the Russian Federation is in state property, the state has to be the main source of investments into innovations. Figure 01 shows the GDP indicators of advanced countries of the world according to the IMF (World Economic Outlook) (bln. dollars).

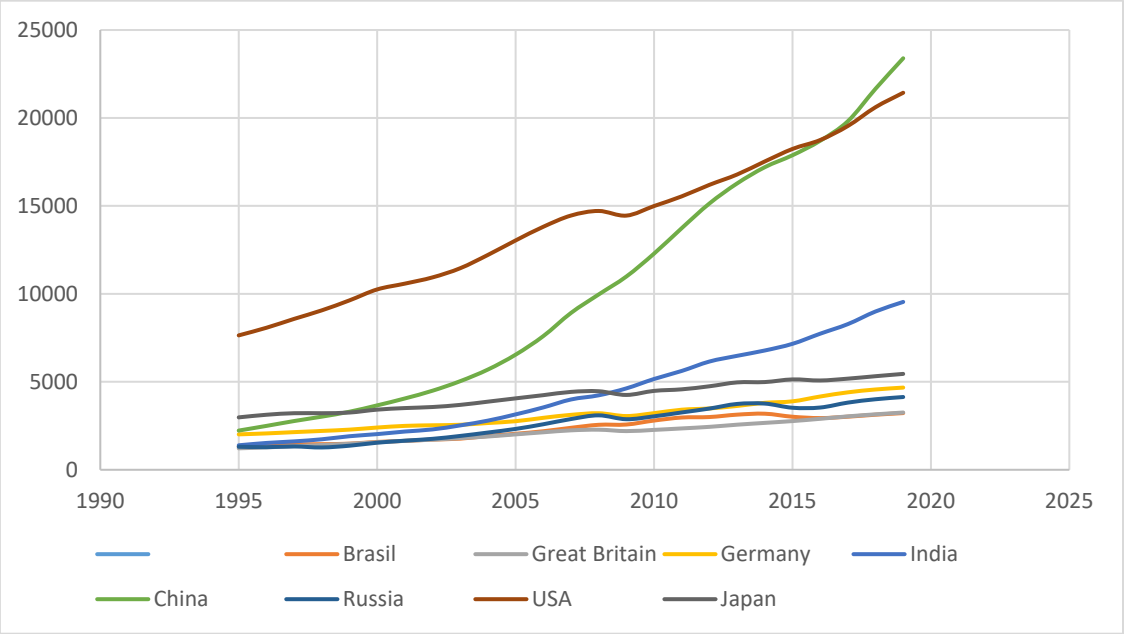

Figure 1. Change of the GDP of advanced countries of the world and Russia from 1995 to 2019 (Compiled by the authors based on materials: International monetary fund. World Economic Outlook databases; World Statistics)

The figure shows the decline in the economies of innovatively developed countries in 2008, and a further rise shows the beginning of a new technological cycle. Let us reflect on Figure 02 (according to the IMF) the GDP change in the Russian Federation (billion dollars), where the recessions occurred in 2008 and 2016.

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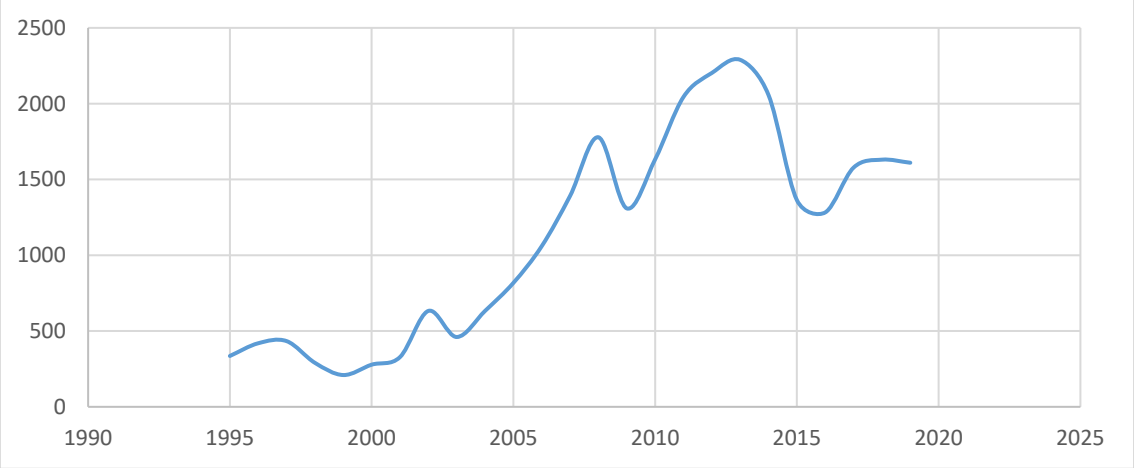

Figure 2. GDP of the Russian Federation in billion dollars. (Compiled by the authors based on materials: International monetary fund. World Economic Outlook databases; World Statistics)

Statistical reporting of the State Statistics Committee confirms the decline in 2008, but does not reflect the second recession in 2016 (Figure 03).

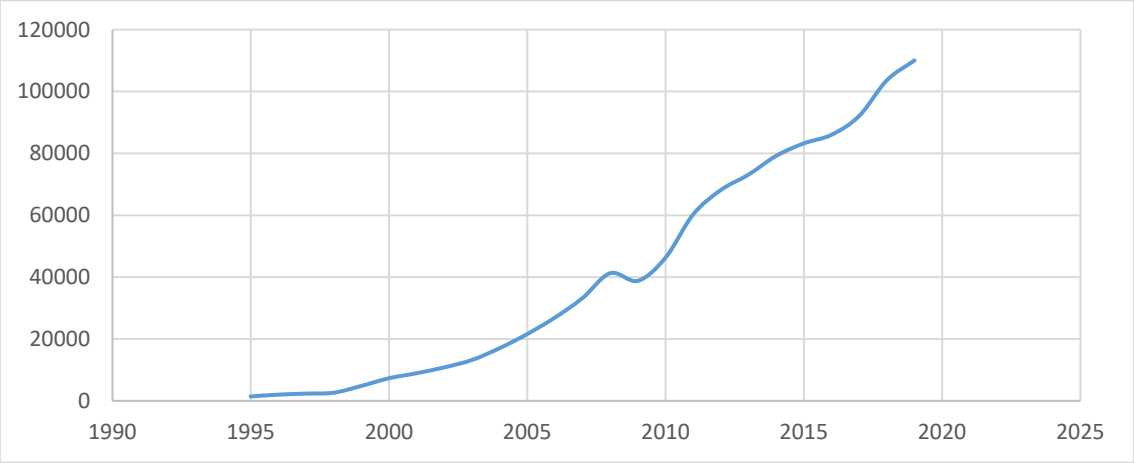

Figure 3. Russia's GDP in billion rubles. (Compiled by the authors based on materials: Federal State Statistics Service)

The access to leading positions is ensured by the development of the geoclimatic zone on the basis of unique techno-social adaptation (Badalyan, 2009). Aoki (2001), Hayami (2001), Estudillo et al. (2010) note that the main problem of the developing resource-rich economies is a search of ways to invest the natural rent to the development of the human capital and infrastructure – the only guarantee of the supported growth.

Let us summarize the statistics of Goskomstat reflecting the influence of innovations on the growth of the economy in the Russian Federation in Tables 01–03.

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Table 1. Indicators influencing innovations in the Russian Federation – Part 1

Period	GDP, bln dollars	Labor productivity index for the economy as a whole (in % compared to the previous year	Capital-labor ratio	Capital productivity ratio	Share of economic sectors in GDP
2011	60282.5	103.8	103.5	100.3	19.7
2012	68163.9	103	99.3	100.4	20.3
2013	73133.9	102.1	100.8	101	21.1
2014	79199.7	100.8	113.5	88.7	21.87
2015	83232.6	98.7	96.8	101	21.51
2016	86010.2	100.1	100.9	101.2	21.91
2017	92089.3	100.2	103.9	97.73	22.14
2018	103626.6	102.8	103.95	98.42	21.05
2019	110046.1	102	104.72	97.35	20.49

Table 2. Indicators affecting innovation in the Russian Federation – Part 2

Period	Number of R&D organizations. (thousand units)	Specific weight of research products in GDP	Internal current research costs, mln. rub	Share of internal R&D costs in GDP	Costs of technological innovations, mln. rub
2011	3492	19.6	568386.7	1.01	45480.05
2012	3566	20.2	655061.7	1.03	48862.56
2013	3605	21	699948.9	1.03	54988.2
2014	3604	21.6	794407.9	1.07	58034.2
2015	3775	21.1	854288	1.1	64234.2
2016	3774	21.3	873788.7	1.1	66255.6
2017	3780	21.8	795407.9	1.11	71613
2018	3777	21.1	854288	1	75985.54
2019	3790	21.6	873778.7	1.03	80358.07

Table 3. Indicators affecting innovation in the Russian Federation – Part 3

Period	Share of investments for reconstruction and modernization in a total amount of investments	Share of investments in fixed assets	Volume of innovative goods of manufacturing industries, mln. rub (in current prices)	Dollar to ruble exchange rate
2011	19.3	20.7	3072531	30.35
2012	19.5	21	3037407	32.19
2013	18.8	21.4	3258255	30.37
2014	17.4	20.8	3308455	32.65
2015	16.8	20	3401317	56.23
2016	16.7	21.3	3944179	72.92
2017	16.5	21.4	3587040	60.65
2018	16.6	20	3679902	57.6
2019	16.3	20.6	3772764	69.47

Notes:

1. Here, the capital-labor ratio is calculated fraction from the division of the quantum index of fixed assets of year t to year (t–1) and the quantum index of total labor costs of year t to year (t–1) in comparable prices.

2. The capital productivity ratio is calculated as the fraction from the division of the quantum index.

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In order to determine the significance of influences of the given indicators, let us use multiple discriminant analysis, which is an alternative to the regression analysis, when the dependent variable is not a quantitative, but a nominal variable. The analysis uses the following discriminant function: d = b1x1 + b2x2 + ... + bnxn + a, where: x1 and xn – variables corresponding to the considered cases; b1-bn and a – coefficients to be evaluated by the discriminant analysis. Therefore, it is necessary to determine such coefficients so that the values of the discriminant function can be divided into groups with the maximum clarity. Figure 04 shows the summary obtained using SGWin.

```
Data input: observations
Number of complete cases: 9
Missing value treatment: listwise
Standardized: yes

Number of components extracted: 4

          Principal Components Analysis
-----------------------------------------------
Component                  Percent of    Cumulative
 Number      Eigenvalue     Variance     Percentage
     1        8,03543        57,396        57,396
     2        2,26827        16,202        73,598
     3        2,11098        15,078        88,676
     4        1,04561         7,469        96,145
     5        0,251709        1,798        97,943
     6        0,16282         1,163        99,106
     7        0,0915259       0,654        99,760
     8        0,0336465       0,240       100,000
     9        4,01661E-16     0,000       100,000
    10        1,45414E-19     0,000       100,000
    11        0,0             0,000       100,000
    12        0,0             0,000       100,000
    13        0,0             0,000       100,000
    14        0,0             0,000       100,000
-----------------------------------------------
```

Figure 4. Initial report of the method of principal components (MPC) (Compiled by the author)

The figure shows that the column *eigenvalue* contains the eigenvalues of principal components arranged by size, and the greatest percent of dispersion is the labor productivity index (57.396), share of internal R&D costs in GDP (16.202), costs of technological innovations (15.078) and the share of investments for reconstruction and modernization of equipment (7.469). The weights of the principal component features are shown in Figure 05.

```
Data input: observations
Number of complete cases: 9
Missing value treatment: listwise
Standardized: yes

Table of Component Weights

          Component    Component    Component    Component
              1            2            3            4
          ------------ ------------ ------------ ------------
X1        0,2008       0,210898     0,361101     -0,485178
X10       -0,180134    -0,358522    -0,417099    0,019849
X11       -0,3263      0,19136      0,136518     -0,129495
X12       0,347436     -0,0205356   -0,0455098   -0,0544632
X13       0,0670175    -0,325756    -0,18138     -0,776549
X14       -0,323776    0,172336     0,160126     -0,152548
X15       -0,303915    0,211382     -0,133713    -0,149056
X3        -0,0442629   -0,382589    0,544359     -0,00671298
X4        0,119857     0,42055      -0,453482    -0,198922
X5        -0,242183    -0,397287    -0,190368    -0,0330494
X6        -0,334871    0,164011     -0,118469    -0,0426816
X7        -0,313591    -0,231356    0,053836     -0,148259
X9        -0,341021    0,0267377    -0,0285717   0,134899
Y1        -0,310821    0,217327     0,206264     -0,115105
```

Figure 5. Principal component characteristic weights (Compiled by the author)

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Figure 06 shows the projection of the studied factors.

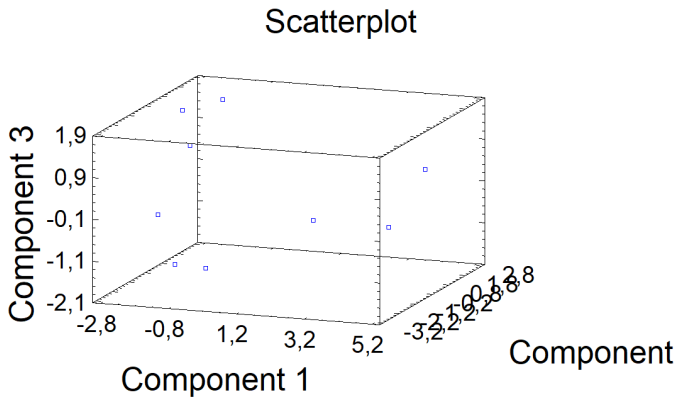

Figure 6. Projection of studied factors into the space of the first three principal components (Compiled by the author)

7. Conclusion

The production cycles reflecting the GDP change of innovatively developed countries in dynamics are considered. The discriminant analysis is used as the tool to analyze the influence of factors on the development of economies. The study allows concluding that the following are the most important in ensuring the innovative development in the Russian Federation: labor productivity, internal R&D costs (in GDP), costs of technological innovations and investments directed to reconstruction and modernization of equipment.

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