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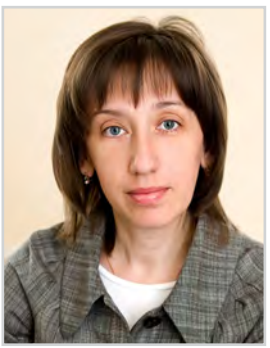

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Assessment of the impact of socio-economic factors on productivity increase

Abstract
Stimulation of productivity increase is a key task at the present stage of development of the economies of both Russia and Eurasian countries. The purpose of this article is to identify quantitative assessments of how various factors impact productivity increase and conduct a cluster analysis of the regions, based on the considered indicators that evaluate the impact of relevant factors on productivity. The authors use general scientific methods such as analysis and synthesis, econometric analysis and multidimensional statistics. To build the model, the authors of the article used statistical data relating to socio-economic development indicators for 85 Russian regions. As a result of the correlation and regression analysis, the following factors were identified: the average monthly wage, consumption of fixed capital, internal R&D costs, innovative activity of organisations, and tax burden. These factors have both positive and negative impacts on productivity. A cluster analysis was also conducted. It enabled to group the regions in terms of their productivity. Based on the analysis, the authors proposed the directions of improving the policy to increase productivity for each of the three clusters. For the regions included in the first cluster, it is necessary to apply methods of direct state regulation, for the regions of the second cluster - to pursue a policy of improvement of tax incentive mechanisms through the application

of regional tax benefits and the use of special tax regimes, for the third cluster - to implement a supportive productivity policy for maintaining stable indicator values. The study highlights the key areas of tax incentives, the use of which will increase productivity and achieve the goals of economic development - stimulation of human capital development, support of R&D and development of infrastructure.
It has been concluded that the tax burden negatively affects the growth of productivity. Therefore, the use of the mechanism of tax tools, such as tax benefits and preferences, can contribute to the achievement of goals of economic growth. The current economic policy should be focused on increasing the efficiency of all productive sectors, namely supporting the deployment of innovations, removing barriers to raising investment, and stimulating human capital and labour force by using the tax incentives.
Keywords: Productivity; Tax Burden; Tax Incentives; Econometric Model; R&D; Gross Domestic Product (GDP); Russia; EAEU
JEL Classification: E24; E62; C13
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Оцінка впливу соціально-економічних чинників на підвищення рівня продуктивності праці

Анотація. Підвищення продуктивності праці є ключовим завданням на сучасному етапі розвитку економіки Російської Федерації і країн євразійського економічного простору. Метою цієї статті є виявлення кількісних оцінок впливу різних чинників на підвищення рівня продуктивності праці та проведення кластерного аналізу регіонів на підставі розглянутих індикаторів, що допомагають дати оцінку факторам, що впливають на продуктивність праці. У роботі використано загальнонаукові методи, такі як аналіз і синтез, економетричний аналіз, а також метод багатовимірної статистики. Для побудови потрібної моделі було використано статистичні дані індикаторів соціально-економічного розвитку 85 суб'єктів Російської Федерації. Результатом проведеного кореляційно-регресійного аналізу було виявлено фактори, які мають як позитивний, так і негативний вплив на продуктивність праці, а саме: середньомісячна нарахована заробітна плата, ступінь зносу основних фондів, внутрішні витрати на дослідження й розробки, інноваційна активність організацій, податкове навантаження. Окрім того, проведено кластерний аналіз для типологізації регіонів за рівнем продуктивності праці. Виходячи з цього, авторами було запропоновано напрями вдосконалення політики підвищення продуктивності праці для кожного з трьох кластерів. Для регіонів, що входять до першого кластеру, доцільно застосувати методи прямого державного регулювання; для регіонів другого кластеру потрібно проводити політику щодо вдосконалення механізмів податкового стимулювання за допомогою застосування регіональних податкових пільг і використання механізмів особливих податкових режимів; для регіонів третього кластеру необхідно запровадити підтримуючу політику для забезпечення продуктивності праці та збереження стабільних значень індикаторів. У дослідженні виділено ключові напрями податкового стимулювання, дотримання яких дозволить підвищити продуктивність праці й досягти цілей економічного розвитку, а саме: стимулювання розвитку людського капіталу, сприяння НДДКР і розвитку інфраструктури.
Результати проведеного дослідження дозволили дійти висновку про те, що податкове навантаження негативно впливає на зростання продуктивності праці, тому використання механізму податкового інструментарію, а саме податкових пільг і преференцій, може сприяти досягненню цілей економічного зростання. Економічна політика повинна бути орієнтована на підвищення ефективності всіх виробничих секторів – підтримку впровадження інновацій; усунення бар'єрів, що знижують рівень капіталовкладень; сприяння розвитку людського капіталу через застосування податкових стимулів.

Ключові слова: продуктивність праці; податкове навантаження; податкове стимулювання; економетрична модель; НДДКР; валовий внутрішній продукт (ВВП); Росія; ЄАЕС.

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Оценка влияния социально-экономических факторов на повышение уровня производительности труда

Аннотация. Стимулирование повышения производительности труда является ключевой задачей на современном этапе развития экономики Российской Федерации и стран евразийского экономического пространства. Целью данной статьи является выявление количественных оценок влияния различных факторов на повышение уровня производительности труда и проведение кластерного анализа регионов на основании рассмотренных индикаторов, оценивающих влияние факторов на производительность труда. В работе использованы такие общенаучные методы, как анализ и синтез, а также методы эконометрического анализа и многомерной статистики. Для построения модели использованы статистические данные в части индикаторов социально-экономического развития 85 субъектов Российской Федерации. В результате корреляционно-регрессионного анализа были выявлены факторы, оказывающие положительное и отрицательное воздействие на производительность труда, а именно: среднемесячная начисленная заработная плата, степень износа основных фондов, внутренние затраты на исследования и разработки, инновационная активность организаций, налоговая нагрузка. Помимо этого, проведен кластерный анализ для типологизации регионов по уровню производительности труда. Исходя из полученных результатов, были предложены направления совершенствования политики в рамках повышения производительности труда для каждого из трех кластеров. Для регионов, входящих в первый кластер, целесообразно применять методы прямого государственного регулирования; для регионов второго кластера требуется проводить политику по совершенствованию механизмов налогового стимулирования посредством применения региональных налоговых льгот и использования механизмов особых налоговых режимов; для третьего кластера следует проводить поддерживающую политику в области производительности труда с целью сохранения стабильных значений индикаторов. В исследовании выделены ключевые направления налогового стимулирования, применение которых позволит повысить производительность труда и достичь целей экономического развития – стимулирование развития человеческого капитала, содействие сфере НИОКР (R&D), развитие инфраструктуры.
В результате проведенного исследования сделан вывод, что налоговая нагрузка отрицательно влияет на рост производительности труда, поэтому использование механизма налогового инструментария, а именно налоговых льгот и преференций, может способствовать достижению целей экономического роста. Проводимая экономическая политика должна быть ориентирована на повышение эффективности всех производственных секторов – поддержку развертывания инноваций, устранение барьеров для повышения уровня капиталовложений, стимулирование человеческого капитала, рабочей силы с помощью применения налоговых стимулов.

Ключевые слова: производительность труда; налоговая нагрузка; налоговое стимулирования; эконометрическая модель; НИОКР; валовой внутренний продукт; Россия; ЕАЭС.

1. Introduction

Measuring the country's socio-economic well-being, gross domestic product (GDP) per capita and its growth is one of the most important indicators. The growth of gross domestic product is directly related to increasing productivity. A reduction of the labour force and a decrease in productivity in the context of a significant growth of elderly population leads to a slowdown of economic development and an increase of the state budget burden in the Russian Federation (Suslina & Leukhin, 2018). Stimulation of productivity is considered in some modern strategies of economic development. Ensuring sustainable and inclusive economic growth to increase the competitiveness and productivity of the economy is the main goal of the «Europe 2020» strategy. R&D and innovations are the key components of this strategy, while increasing productivity and creating new jobs are catalysts for more innovative products and services. Since innovations serve as the basis for sustainable growth and competitiveness of the economy in the modern world, there exists high popularity of supportive measures for innovations (Gurvich & Ivanova, 2018).

Today, there is a serious lag in the level of productivity between the leading countries and Russia. According to the research company Expert Marker, Russia takes 34th place in terms of productivity. Differences in productivity define most of the regional inequality in GDP of Russia, while employment or activity types are more uniform across the country. In 2018, at the federal level, there was developed and approved a national project known as «Productivity and Employment Support». The project specified the areas of the priority program «Increasing of Productivity and Employment Support». The national project, designed for 2018-2024, provides for several systemic measures aimed to stimulate the growth of productivity in enterprises of the non-resource sector, the target value of which should be at least 5% per year. Tax tools, such as tax preferences were used as one of the measures to stimulate the enterprises to increase productivity. As part of a national project, pilot projects (tax experiments) and their effectiveness assessment should be prepared and carried out in the participating regions. The federal project «Systematic Measures to Increase Productivity» provides for a financial support in the amount of RUR 11.8 billion: RUR 5.7 billion will be allocated from the federal budget and RUR 6.1 billion - from extra-budgetary sources. The subjects of the Russian Federation are recommended to apply regional tax benefits and to use special tax regimes (special economic zones, territories of priority development, etc.), which will allow to implement measures to increase productivity and attract investments leading to new jobs. By now, there are 129 enterprises in 22 regions of the Russian Federation participating in the program. A steady growth in productivity is possible by increasing the internal resources of enterprises, such as expanding innovative potential, increasing the capital intensity of production, borrowing of advanced technologies, and increasing managerial competencies and qualifications of employees.

2. Brief Literature Review

Study of productivity is one of the main topics in domestic and foreign literature. In a study by Xinshen Diao, Josaphat Kweka and Margaret McMillan (2018), the authors consider the influence of the informal sector on the record growth of productivity in Tanzania over the past 14 years. The calculations carried out in this work demonstrated that the contribution to the productivity increase by an average of 1% per year was made by small and medium-sized businesses receiving the state support. A study by A. I. Djido and B. A. Shiferaw (2018) addresses to the diversification of productivity between the agricultural and non-agricultural sectors. As a result of empirical studies, the authors concluded that there is a direct correlation between the diversification of incomes of the population and productivity, so government measures should be aimed at identifying barriers that hinder the increase of incomes of all groups of the population.

Stimulation of innovations and R&D enhances technology transfer and its implementation ability. R&D is statistically and economically important, both in terms of technological progress and in terms of innovation. Human capital also plays an important part in increasing productivity. Technological progress is one of the most important factors affecting economic growth, therefore productivity, as a catalyst for scientific and technical progress, is a fundamental indicator. R. Khanna and Ch. Sharma (2018) published a study devoted to the dependence of investment in R&D and productivity in India's economy. Meng-Chi Tang (2017) studied the factors affecting productivity in transnational corporations. Gokhan Yılmaz (2016) examined the role of productivity and its main determinants, which varied depending on whether a country belonged to the group of middle-income countries or not. The growth factors of productivity were decomposed

into several components: «static structural changes» and «productivity of dynamic structural changes». As a result of the study it was concluded that the growth rate of productivity was significantly differentiated. In countries with average income the average growth rate of productivity was 1.93%, while in high-income countries - 4.37%, as well as there was a significant differentiation of the productivity level in various sectors. The results of a study by C. M. Bjuggren (2018) showed that the increase of productivity is closely related to an increase in both total factor productivity and capital intensity.

Gross domestic product per capita and its growth is one of the most important indicators of the country's economy and social well-being. B. M. Balk (2014) considered productivity as the main catalyst for real GDP growth. As a result of economic and mathematical analysis, his study proved close correlation between productivity and economic growth. Important indicators of economic welfare are real GDP, real GDP per capita and its trends. A stylized fact is that the trend of GDP per labour, that is in fact productivity, predominates in the trend of GDP per capita.

L. Marattin and S. Salotti (2011) considered the impact of such factors as: total population, productivity, number of workers, total active population (aged 15 to 64 years), and labour force on GDP. As a result of an econometric analysis of empirical data for 19 OECD countries, it was concluded that increasing the efficiency of labour resources (i.e. productivity) was the only necessary and sufficient condition for growth of GDP per capita.

The need to consider differentiation of productivity in various industries and regions was studied in the work by B. Kinfemichael and A. K. M. M. Morshed (2019). The authors noted that a sectoral analysis of productivity indicated that production was a major factor of convergence in the United States in 1987-1997. However, now the role of production has decreased under the influence of factors such as an interstate migration decrease, raise of housing prices in big cities, agglomerations and structural changes in the US economy. As a result, there has been an increase in the differentiation of productivity among the US states.

M.-A. Tarancon, M.-J. Gutierrez-Pedrero, F. E. Callejas and I. Martínez-Rodríguez (2018) discussed the correlation between productivity and production efficiency in 24 countries of the European Union (EU) for 17 years in their study. In this research an econometric data model was used. The indicator of productive efficiency was used as the result factor in the model. It was concluded that there existed a close correlation between the indicator of production efficiency and productivity.

It should also be noted that there were a number of authors who studied the impact of taxation on productivity. Thus, a study by G. Duernecker and B. Herrendorf (2018) examined empirical data in 12 OECD countries for 1970-2010 in order to identify the correlation between the increase of taxation and the structure of employment. According to the authors, an increase in the tax burden on labour income encourages people to replace labour in the household with market work. E. C. Prescott (2004) argued that differences in the tax burden on labour income were the main reason for the differentiation of productivity between Europe and America. Foreign studies also examined the effects of environmental taxes on the labour market and productivity (Chi Man Yip, 2018; Rausch & Schwarz, 2016; Walker, 2011).

Based on the considered works by foreign scientists, the authors conclude that productivity is an important catalyst for the growth of GDP, as well as the efficiency of the economy in various countries. Despite the great contribution to the study of productivity of foreign researchers, it should be mentioned that tax burden influence on this macroeconomic indicator is considered superficially. The tax burden is not considered as the main indicator affecting the growth of productivity.

Issues of productivity increase are studied by domestic authors. Growth factors of productivity are objective conditions that determine the possibility of productivity increase (Rachek & Miroshnik, 2013). The identification of factors increasing the level of productivity, and their systematisation were considered in the works by the following scientists: N. V. Amelina, E. A. Egorova, E. V. Kondratyev, Yu. P. Kokin, E. V. Kuchina, O. V. Kuchmaeva, N. V. Lyasnikov, M. A. Novoyatlev, Yu. M. Ostapenko, E. A. Polovkina, S. V. Rachek, A. I. Rofe, I. F. Ryabtseva, and P. E. Slender. The correlation between tax burden and productivity was also studied in the works by Russian scientists. Theoretical and methodological problems of productivity were studied in the research by I. A. Gunina (2018). The author concluded that it would be preferable to provide tax and other benefits to enterprises that produce innovative products and to ensure productivity growth of at least 5% per year. G. L. Popova (2015) analysed the connection between the tax burden and productivity in the context of the main types of economic activity. As a result of the cluster

analysis, the author concluded that there was a weak correlation between the growth of productivity and the tax burden in 2013. This fact pointed out to «sectoral imbalances in the economy, differentiated at the regional level». It should be noted that the author did not offer ways of tax incentives, with the help of which it would be possible to reduce the level of regional differentiation and increase the rate of productivity. She did not also consider other factors besides the tax burden, which had a direct impact on productivity. S. A. Anisimov (2012) proposed a dynamic model allowing study of the impact of taxation on the economy, depending on the way of spending the funds received by the state. The author indicated capital, labour and their productivity, as the main factors affecting GDP. As a result of the study for the period of 2001-2011, the author concluded «low dependence of GDP growth on the tax burden, which indicates the inability of the Russian tax system to affect the positive development of the economy seriously». M. O. Kakaulina (2014) used the statistical three-factor model by E. V. Balatsky to prove that the tax burden, depending on the period under review and on regional affiliation, affected the level of economic growth in different ways.

I. N. Dolgova (2012) developed a model of the industrial and regional correlation between the dynamics of the tax burden and the efficiency of the use of production factors. Based on this model, the author created a forecasting and analytical tool for assessing the correlation between the tax burden of the Russian budget system and productivity in the industrial and regional context. According to the study, I. N. Dolgova concluded that there was a direct connection between the level of tax burden and gross regional products of the constituent entities of the Russian Federation. Also, the calculations, made by the author for 2005-2010 showed a close correlation between indicators of the tax burden and productivity.

Thus, based on the studies reviewed above, it can be stated that the issues of the influence of various factors, including the tax burden, on productivity and economic growth were considered in the works of domestic and foreign scientists, but the results were ambiguous and controversial. The assessment was based on baseline data until 2015. In several works, there is a close positive connection between the level of tax burden and productivity. This fact indicates the ability of the tax system to both positively and negatively affect economic processes. The opposite opinion states a complete absence of any correlation between the indicators, which points to low tax regulation efficiency of the economy. The aim of our study was to review and identify quantitative assessments of the influence of various factors on productivity increase and to conduct a cluster analysis of Russian regions, based on the considered indicators.

3. Research Methodology

To conduct the present research, the authors used such general scientific methods as analysis and synthesis, as well as econometric analysis methods. At the same time, special attention is paid to the application of correlation and regression analysis for the influence of several factors, including the tax burden, on productivity, as well as the clustering of constituent entities of the Russian Federation. The rate of productivity growth is similar to the rate of economic growth. One of the reasons for this ratio may be that the increase of productivity is associated with improved competitiveness. A competitive advantage appears in those areas where productivity growth occurs, which allows them to maintain and increase market share in the global economy, thereby contributing to economic growth. Productivity increase is one of the main sources of high efficiency in economy that contributes to national income. Studying the dynamics of productivity indices and GDP in Russia for the period of 2003-2017, we can note similar trends of these indices rates growth (Figure 1).

The growth of productivity has a direct positive impact on the economic development of the constituent entities of the Russian Federation, as well as on the country in general. Considering this fact, it is an urgent task to conduct the research and analysis of factors affecting the level of productivity. Based on the studied materials, we point out and consider the dynamics of the main factors that affect productivity at the macroeconomic level. Technological factors provide an increase of productivity due to scientific and technological progress. The state of technological equipment and the level of its innovativeness affect the efficiency of industrial production and the results of enterprises. The current state of fixed capital involved in the production process indicates a low degree of fixed capital renewal and a high level of its consumption. In 2017, more than 49.5% of fixed capital was completely consumed, and the value of the coefficient of fixed capital renewal was only 4.3%. This figure is lower than the value of 2012-2013, and it indicates deterioration in the state of the logistics base in Russia as a whole.

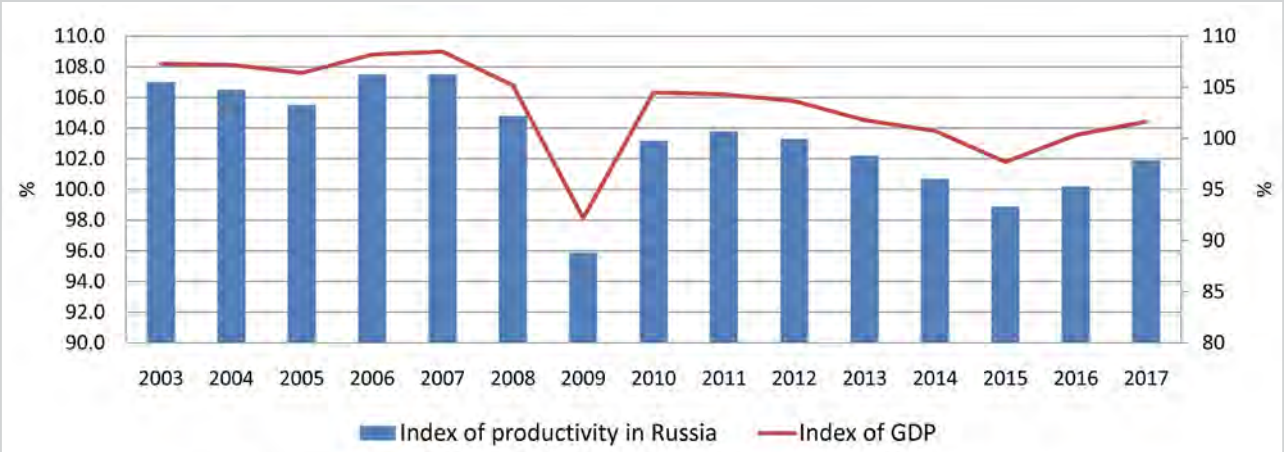

Figure 1:
Dynamics of productivity indices and GDP for 2003-2017
Source: Official data of the Russian Federal State Statistics Service (Rosstat)

One of the ways to enhance productivity is to increase investment and innovation activity. The efficiency of economic entities increases with the growth of investment in fixed capital. To achieve the target indicators of productivity growth of 5%, a positive increase in the amount of attracted investments is required annually. In 2017, the growth of investment in fixed capital in comparison with 2018 amounted to 185%, an increase of RUR 7,245.7 billion. The index of physical investments in fixed capital in 2017 increased in comparison with 2015 and reached 104.8%, yet it did not reach the level of 2011 which amounted 110.8%.

The main role in the improvement of productivity is played by innovative factors, such as the level of innovation implementation in production. Increasing the R&D costs enables the transition to an industrial-innovative economy, which is the goal of public policy. Over the reviewed period, the share of domestic expenditures on R&D in GDP decreased, and in 2017 this figure was 1.11%, which indicated a low level of spending on innovations. The innovative activity of organisations, which characterised the proportion of enterprises engaged in innovations, was also reduced. In 2017, the value of the indicator was only 8.5%, which was 0.9% less than the level of the post-crisis period of 2009. The coefficient of inventive activity (the number of domestic patent applications for inventions filed in Russia per 10 thousand people) was also decreased.

At the macroeconomic level, productivity can also be affected by labour factors such as the number of people employed and average wage in the country. During the period reviewed, there was an increase of the average monthly nominal wage. Therefore, the increase in 2017, compared to 2008, reached 226.5%. The number of employees also increased, however the increase was not significant and amounted 4%.

Another factor affecting productivity is the tax burden, but, as we have noted earlier, there is no consensus for how the level of tax burden affects productivity and what the scale of this effect is. On the one hand, increasing tax burden means growth of Russian budget system revenues, which stimulates both the increasing GDP and productivity. On the other hand, reducing tax burden with tax incentive instruments, such as tax benefits and preferences, can provide an increase in productivity and GDP.

To assess the impact of technological, innovative, labour factors, as well as the tax burden on the level of productivity, and conduct cluster analysis, we used the initial values of seven indicators of these factors from 85 constituent entities of the Russian Federation.

4. Correlation-regression analysis of the influence of factors on productivity

The development of a multifactor model for assessing the impact of various factors on productivity is an urgent task. The authors of the article have identified and examined the following indicators that influence the growth of productivity:

- the average monthly salary of employees, RUR (independent variable x_1);
- the average annual number of employees, thousand people (independent variable x_2);
- investments in fixed capital, RUR million (independent variable x_3);
- consumption of fixed capital, % (independent variable x_4);

- internal R&D costs; this group includes R&D costs for new products, services, and methods of their production, new production processes, engineering, as well as other costs for technological innovation (independent variable x_5);
- innovative activity of organisations, % (independent variable x_6);
- tax burden, % (independent variable x_7).

To build the correlation-regression model, the authors used data on 85 Russian subjects. Productivity is a dependent variable. The data source is the Federal State Statistics Service.

In order to conduct a regression analysis and clustering of the constituent entities of the country according to the level of productivity and socio-economic indicators affecting productivity, it is necessary to build a matrix of pair correlation coefficients to eliminate duplicate parameters and identify strong statistical dependencies. The matrix of pair correlation coefficients is presented in Table 1. The analysis of the matrix allows to conclude that the intercorrelation of such parameters as the average annual number of employees (x_2), internal R&D costs (x_5), and investment in fixed capital (x_3), is high and the parameters x_2 and x_5 should be excluded when building the correlation-regression models.

To build the regression model, the following indicators were used:

- productivity (y, dependent variable);
- the average monthly salary (x_1);
- consumption of fixed capital (x_2);
- internal R&D costs (x_3);
- innovative activity of organizations (x_4);
- tax burden (x_5).

Table 1:
The matrix of pair correlation coefficients

Correlation coefficients	y	x_1	x_2	x_3	x_4	x_5	x_6	x_7
y	1.00	—	—	—	—	—	—	—
x_1	0.56	1.00	—	—	—	—	—	—
x_2	0.06	0.21	1.00	—	—	—	—	—
x_3	0.35	0.52	0.83	1.00	—	—	—	—
x_4	0.06	-0.19	-0.14	-0.06	1.00	—	—	—
x_5	0.06	0.30	0.92	0.78	-0.19	1.00	—	—
x_6	-0.04	0.08	0.30	0.25	0.06	0.26	1.00	—
x_7	-0.05	0.04	0.03	-0.04	-0.07	0.00	-0.04	1.00

Source: Calculated by the authors

The correlation between most variables is weak and extremely weak, average correlation of 0.56 occurs only between productivity and average monthly wage. Thus, the exclusion of any parameters can be considered inappropriate.

We used the initial data on 85 Russian regions and productivity as the dependent variable to build the regression equation. The relationship between independent and dependent variables can be expressed as a linear function. In this case, in the absence of residues heteroskedasticity, we obtain the equation:

$$Y = 1683.39 + 0.05x_1 + 25.83x_2 + (-0.002)x_3 + (-23.34)x_4 + (-8.50) . \quad (1)$$

We check the significance of the multiple regression model (1) and its parameters. Table 2 presents the parameters for checking the significance of the multiple regression model. According to the regression statistics, the coefficient of multiple determination for the regression equation is 36%. Therefore, the variation of the explanatory variables included in the regression equation, caused the variation of the resultant variable by 36%. The multiple correlation coefficient is 60%, it indicates a moderate connection between the dependent and independent variables. The actual value of the Fisher F - test is 8.83. The table value of the Fisher test is approximately 2.33 for $\alpha = 0.05$. Since the actual value of the Fisher F - test is larger than the tabulated

Table 2:
Table of variance analysis obtained by applying the option «Regression» in the SPP Excel

Indicators	df	SS	MS	F	Significance F
Regression	5.00	48219280.07	9643856.01	8.88	0.000001
Residue	79.00	85810096.88	1086203.76	—	—
Total	84.00	134029376.94	—	—	—

Source: Calculated by the authors

one, the regression equation is significant and can be used for further analysis. Student's *t*-test showed that the most significant factor affecting productivity is the average monthly salary.

Based on the regression equation, there is both direct and indirect correlation between productivity and the independent variables of the model. According to the regression coefficients, several conclusions can be made. There is a positive direct connection between productivity and the average monthly salary. If average monthly salary changes by RUR 1 thousand, productivity will increase by RUR 0.05 thousand. The connection between the tax burden of a constituent entity of the Russian Federation and productivity is the opposite: a 1% decrease in the tax burden stimulates the growth of productivity by an average of RUR 8.5 million *ceteris paribus.* There appear difficulties while assessing the influence of the remaining three factors on productivity. Since, based on the regression coefficients, an increase of R&D costs, as well as an increase of the innovative activity of organisations, does not lead to productivity increase, consumption of fixed capital growth increases productivity. We cannot say with a high degree of probability that the statement above is true, since these three parameters are insignificant.

5. Cluster analysis of the constituent entities of the Russian Federation

The authors used data on 85 subjects of the Russian Federation by 7 indicators (presented in Section 4) and productivity to conduct a cluster analysis. The Federal State Statistics Service was used as the data source. The «Statistica» program was the main tool to conduct clustering. At first it was necessary to standardise the initial data to conduct cluster analysis, since the data had different dimensions. Data standardisation was carried out in «Statistica». Based on the obtained data, a multidimensional classification of 85 subjects of the country was performed. The classification was based on algorithms for ascending hierarchical clustering using the Ward method, with the Euclidean distance being the distance metric. The potential ambiguity of the objects grouping obtained in the process of clustering is noted by experts as an acceptable phenomenon due to the possible complexity of the detected structure, its initial uncertainty and characteristic features of various classes of a significant part of the objects (Mkhitaryan, 2016).

A cluster analysis of 85 regions of the Russian Federation, based on the parameters, is presented in Figure 2. Using a dendrogram, three clusters with a different number of regions can be distinguished. The clusters of the constituent entities of the Russian Federation are presented in Table 3.

Based on the average values of subjects' indicators in each of the clusters presented in Table 4, it has been concluded that there is a significant differentiation in the level of productivity and the values of indicators evaluating the influence of other factors. The first cluster is the most numerous - it is represented by 47 regions of the Russian Federation, such as the Krasnodar Territory, Rostov Region and the Republic of Adygea. The cluster is characterised by the lowest average productivity, while the tax burden of these regions is on average 16.1% only. The second cluster includes 25 constituent entities of the Russian Federation. The average productivity is RUR 796 thousand. The level of fixed capital consumption is the highest in this cluster, and accounts for an average of 56.2%. The cluster is characterised by the highest regional tax burden. Indicators of innovation are significantly higher than in the first cluster. The third cluster consists of 13 regions and includes entities such as Moscow, St. Petersburg and the Kamchatka Territory. The cluster is characterised by the highest average productivity, which is several times higher than in other clusters. Indicators of innovation and labour factors are the highest and there is the lowest average tax burden in this cluster.

According to the cluster analysis, based on the methods of multivariate statistics, a conclusion can be made - there exists regional differentiation of the productivity level. Thus, the following characteristics of each cluster should be pointed out. Based on high productivity and other indicators of Cluster 3, there are reserves for increasing the tax burden, hence, a supportive policy in the field of productivity should be maintained in these regions to keep stable values of indicators. In the regions forming Cluster 2, there is a need to improve the mechanisms of tax incentives, namely through the application of regional tax incentives and the use of special tax regimes targeted at investment activity stimulation, as well as the reduction of the degree of consumption of fixed capital. The lowest indicators of productivity and other parameters in the regions of Cluster 1 lead to a need of direct state regulation in these entities, since the tax burden is already low. It should be stressed that both regression and cluster analyses let us make an unambiguous conclusion that productivity directly depends on the average monthly salary. It indicates the need to conduct the activities of stimulating the increase of wages in the regions of Cluster 1 and Cluster 2. As a result, it will have a positive synergistic effect on the growth of productivity.

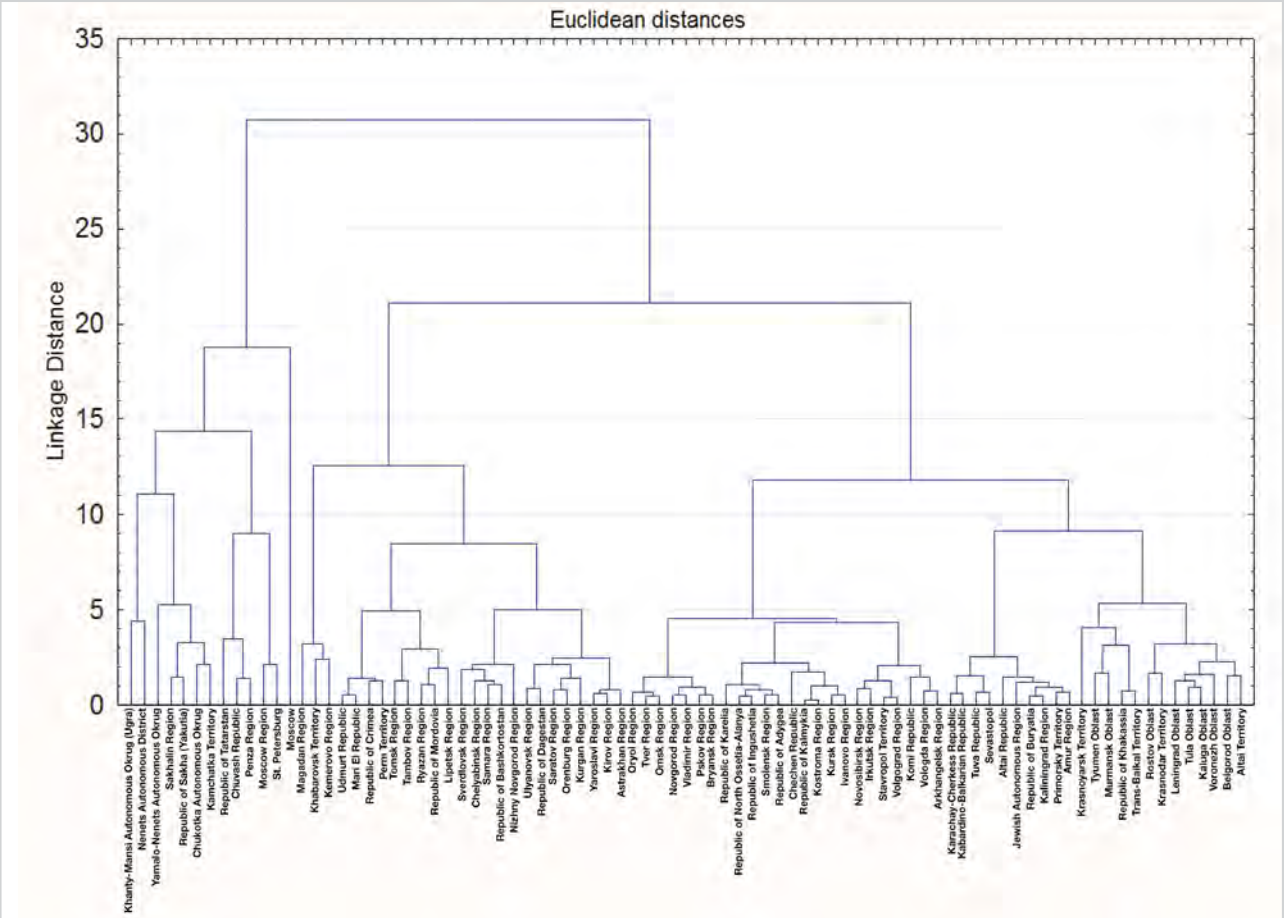

Figure 2:
Cluster dendrogram by Ward method for 85 cases, distance metric - Euclidean distance
Source: Compiled by the authors

Table 3:
The constituent entities of the Russian Federation by clusters as a result of multidimensional classification

Cluster	Quantity	The constituent entities of the Russian Federation in each cluster
Cluster 1	47	Altai Territory, Belgorod Oblast, Voronezh Oblast, Kaluga Oblast, Tula Oblast, Krasnodar Territory, Leningrad Oblast, Rostov Oblast, Trans-Baikal Territory, Republic of Khakassia, Murmansk Oblast, Tyumen Oblast (without the Khanty-Mansiysk Autonomous Okrug (Ugra) and the Yamalo-Nenets Autonomous Okrug), Krasnoyarsk Territory, Amur Region, Primorsky Territory, Kaliningrad Region, Republic of Buryatia, Jewish Autonomous Region, Altai Republic, Sevastopol, Tuva Republic, Kabardino-Balkarian Republic, Karachay-Cherkess Republic, Arkhangelsk Region, Vologda Region, Komi Republic, Volgograd Region, Stavropol Territory, Irkutsk Region, Novosibirsk Region, Ivanovo Region, Kursk Region, Kostroma Region, Republic of Kalmykia, Chechen Republic, Republic of Adygea, Smolensk Region, Republic of Ingushetia, Republic of North Ossetia-Alanya, Republic of Karelia, Bryansk Region, Pskov Region, Vladimir Region, Novgorod Region, Omsk Region, Tver Region, Oryol Region.
Cluster 2	25	Astrakhan Region, Kirov Region, Yaroslavl Region, Kurgan Region, Orenburg Region, Saratov Region, Republic of Dagestan, Ulyanovsk Region, Nizhny Novgorod Region, Republic of Bashkortostan, Samara Region, Chelyabinsk Region, Sverdlovsk Region, Lipetsk Region, Republic of Mordovia, Ryazan Region, Tambov Region , Tomsk Region, Perm Territory, Republic of Crimea, Mari El Republic, Udmurt Republic, Kemerovo Region, Khabarovsk Territory, Magadan Region.
Cluster 3	13	Moscow, St. Petersburg, Moscow Region, Penza Region, Chuvash Republic, Chukotka Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Nenets Autonomous District, Republic of Sakha (Yakutia), Kamchatka Territory, Republic of Tatarstan, Sakhalin Region, Khanty-Mansi Autonomous Okrug (Ugra).

Source: Compiled by the authors

6. Results

According to the official data of the Russian Statistical Service, the labour force will decrease by 1 million people in 2016-2020 (from 76.3 million people in 2016 to 75.3 million people in 2020). At the same time, the contribution of employment to economic productivity will gradually decline from 35% to negative indicators by 2030. Based on this fact, increasing productivity is a key factor in ensuring economic development. The solution to the problem of productivity increase is

Table 4:
Average values of parameters in clusters

Cluster #	Average values							
	Productivity, RUR thousand	Monthly average salary, RUR thousand	Average annual number of employees, thousand people	Investments in fixed capital, RUR million	Consumption of fixed capital, %	Internal R&D costs, RUR million	Innovative activity of organisations, %	Tax burden, %
Cluster 1	791.7	30,495.3	615.5	114,725.6	46.3	3,121.1	6.3	16.1
Cluster 2	796.0	31,093.7	879.8	144,147.7	56.2	9,108.3	8.1	26.4
Cluster 3	2491.8	59,177.5	1611.7	536,231.4	48.6	48,509.2	12.2	13.6

Source: Compiled by the authors based on the cluster analysis conducted according to Rosstat data

closely related to the feasibility of companies' investments in fixed capital in accordance with the emerging new paradigm of production organisation (Fourth Industrial Revolution).

It may be concluded that productivity correlates with wages and tax burden. An increase of the tax burden in the constituent entities of the Russian Federation reduces opportunities for productivity growth. In our opinion, the effective use of tax incentive tools will make it possible not only to reduce the tax burden in the regions, but also to achieve the goals of economic development. To increase productivity and to achieve the goals of economic development, the following key areas of tax incentives should be highlighted:

1. Human capital development stimulation. Tax incentives aimed to raise collaboration of higher education and public and private corporations, as well as the involvement of educational institutions in research activities for business will contribute to the development of human capital. The use of tax incentive tools in the field of education can complement the existing system of state financial support.
2. R&D assistance. The main obstacle to the development of R&D is insufficient investment at the early stages, since there are difficulties in determining commercial success. Thus, the low level of R&D sphere inhibits innovation activity. Stimulation of innovative activity in different sectors will strengthen the process of the modernisation of the Russian economy and contribute to economic growth in general.
3. Infrastructure development. Infrastructure has a direct impact on long-term economic growth, acting as a factor of production. In addition, since an increase in accumulated capital contributes to GDP growth, infrastructure stimulates the development of other production factors (labour, land and entrepreneurial abilities), thereby indirectly affecting economic growth (Steshenko, 2018).

7. Conclusions

In the regions of the Russian Federation, leading in terms of socio-economic development, i.e. Moscow, St. Petersburg and Moscow region, productivity is higher, industries are more productive in compare to less developed regions of Russia. Productivity and employment are directly related to regional characteristics, so measures aimed at reducing differentiation between regions with high and low productivity, i.e. the use of horizontal tax incentives aimed at building infrastructure, are likely to effectively contribute to regional convergence. Productivity is closely connected to the standard of living. In Russia productivity, measured as the ratio of GRP to the average annual number of employees, has a high regional differentiation. This article focuses on identifying the main factors that have both positive and negative effects on productivity increase.

The scientific novelty of the study lies in several aspects: the development of an econometric model for the assessment of the impact of socio-economic factors on productivity; gathering the subjects of the Russian Federation into clusters which allows to offer ways to improve the effectiveness of the policy in the field of productivity increase. Based on the econometric model, there was carried out the analysis to determine the impact of the factors (average monthly wage, investments in fixed capital, tax burden, internal R&D costs, etc.) on productivity. According to the analysis the closest positive direct correlation exists between productivity and average monthly wage. Tax burden adversely affects the growth of productivity, therefore, the use of the mechanism of tax instruments, namely tax benefits and preferences can help to achieve the goals of economic growth. The current economic policy should be focused on increasing the efficiency of all productive sectors, especially

supporting innovations by erasing barriers for fundraising, and stimulating human capital and labour force by using tax incentives. Applying the methods of multidimensional statistics, we have identified three clusters based on the labour, innovation and technological characteristics.

The results of the study can be used by the Ministry of Finance and the Government of the Russian Federation to develop areas to improve tax policy. It can also be used by the Ministry of Economic Development in terms of improving policies in the field of regional productivity increase. In a market economy, the growing influence of tax regulation is directly related to ensuring stability between the level of tax burden and the efficiency of economic activity of its entities. Thus, the development of this study may consist of the methodology for assessing the effectiveness of tax tools for productivity stimulation.

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