

# The Impact of Innovation Activity on the Standard of Living in Russian Regions

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**Keywords:** Innovation Activity, Standard of Living, Regional Development, Panel Data, Econometric Modeling, Sustainable Development, Russia.

**Abstract:** This study empirically investigates the impact of corporate innovation activity on the standard of living across Russian regions from 2017 to 2023. Utilizing panel data from 85 federal subjects and employing fixed effects models, the research analyzes the relationship between key innovation indicators and consumer expenditures per capita. The findings reveal a dualistic nature of innovation's influence. A positive, albeit weak, effect is observed from the volume of innovative goods and services. Conversely, a higher level of innovation activity among organizations correlates negatively with living standards in the short term. This adverse effect is attributed to rising structural unemployment, growing inequality, and inflationary pressures associated with the process of technological adoption and "creative destruction." The study concludes that while innovation is crucial for long-term growth, its benefits are not automatic. Policymakers must complement innovation incentives with robust social accompaniment measures, including labor market interventions, retraining programs, and inclusive infrastructure development, to mitigate transitional costs and ensure that technological progress translates into tangible improvements in population wellbeing.

## 1 INTRODUCTION

The global transition towards a sixth technological paradigm and the digital transformation of economies have established innovation as a central element of national and regional development strategies. Theoretically, the implementation of new technologies and processes leads to productivity growth, the creation of high-wage jobs, and the emergence of new goods and services, which collectively should contribute to an improved standard of living (Fagerberg, 2022). However, empirical data on the direct and unambiguous link between innovation activity and social well-being remain contradictory, prompting ongoing academic debate in this field.

The theoretical foundation of this research includes works elucidating the essence of the innovation process and its socio-economic consequences. Classical theories, originating from

Schumpeter (1934), emphasize the role of "creative destruction" as an engine of progress. More contemporary approaches, such as the "Triple Helix" model (Carayannis & Campbell, 2021, Leydesdorff, 2010), highlight the importance of interaction between the state, business, and universities for generating innovation. In turn, the theory of sustainable development integrates innovation into a paradigm requiring a balance between economic efficiency, social equity, and environmental sustainability (Schilirò, 2019).

Empirical studies demonstrate the ambiguous impact of innovation on the standard of living. A number of studies confirm a positive correlation between R&D investment, patent activity, and population income growth at the macro level (Gault, 2018). In particular, developed countries leading global innovation rankings typically also exhibit high quality of life indicators. However, the picture becomes more complex at the micro and meso levels.

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Research such as that by Lee & Clarke (2019) indicates that technological innovation can exacerbate inequality by increasing demand for highly skilled labor while simultaneously displacing low-skilled workers, leading to income polarization and rising structural unemployment.

Analysis within the context of institutional shocks and geopolitical instability is of particular importance. A recent study by Badykova & Dinmukhametova (2025), applying machine learning methods to analyze the determinants of financial performance of Russian companies during the sanctions period (2012–2023), revealed critical shifts in the structure of success factors. The authors found that the significance of strategic investments in R&D and corporate social responsibility (CSR) sharply declined after 2022, giving priority to operational stability and liquidity. This suggests that under systemic crisis conditions, companies are forced to sacrifice long-term intangible assets, including innovation potential, to ensure short-term survival. This finding is directly relevant to our study, as it points to a potential mechanism for the weakening positive impact of innovation on the standard of living during periods of macroeconomic instability: companies reduce investment, leading to a slowdown in the creation of new products and jobs.

Within the specific context of the Russian Federation, characterized by significant spatial differentiation in both socio-economic and innovation indicators, this issue is particularly relevant. Existing domestic studies, such as those by Medvedev (2022) and Shalaeva (2019), primarily focus on assessing the innovation potential and activity of regions. Research by Rafikov (2022) and Yanchenko (2024) touches upon the social aspects of innovation; however, comprehensive quantitative analysis considering the multi-component structure of the standard of living and regional specifics based on panel data is insufficiently conducted. Most works are either theoretical-methodological in nature or are limited to descriptive statistics and correlation analysis, failing to identify causal relationships considering the new economic realities.

Thus, an evident gap exists in the literature concerning the econometric assessment of the impact of innovation activity specifically on the standard of living of the population, accounting for spatio-temporal dynamics and institutional shocks in Russian regions. Addressing this gap, the present study aims to conduct such an econometric assessment using modern methods of panel data analysis. To achieve this aim, the following tasks are set:

- Formation of a system of interrelated indicators characterizing the standard of living and innovation activity at the regional level.

- Conducting descriptive and correlation analysis to identify preliminary patterns.
- Construction, verification, and interpretation of an econometric model with fixed effects to assess the net effect of innovations on the standard of living in Russian regions during a period that includes years of significant external political shocks.

The novelty of the research lies in the application of a fixed effects model to account for unobserved regional heterogeneity, as well as a comprehensive approach to variable selection, allowing for more reliable and policy-relevant results in the context of adaptation to new economic conditions.

## 2 MATERIALS AND METHODS

The empirical basis of the study consisted of official data from the Federal State Statistics Service (Rosstat) for the period 2017–2023 from 85 federal subjects. A system of indicators was formed for the analysis, including variables characterizing the standard of living, innovation activity, economic development, healthcare, and education.

The resulting variable ( $y$ ), reflecting the standard of living, was selected as consumer expenditures per capita (rubles), as it more accurately reflects the real material well-being of households compared to saved income.

The set of independent variables included:

- $x_1$  – Number of families registered as needing housing (thousands of people).
- $x_2$  – Unemployment rate (%).
- $x_3$  – Number of personnel engaged in research and development (people).
- $x_4$  – Level of innovation activity of organizations (%).
- $x_5$  – Volume of innovative goods, works, services per capita (million rubles).
- $x_6$  – Gross Regional Product per capita (rubles).
- $x_7$  – Consumer Price Index (December to December of the previous year, %).
- $x_8$  – Morbidity rate per 1000 people.
- $x_9$  – Commissioning of residential buildings per 1000 people.
- $x_{10}$  – Life expectancy at birth (years).
- $x_{11}$  – Cost of Living Index.

The initial wider set of variables was reduced using stepwise exclusion based on correlation matrix analysis and coefficient significance in the regression model to avoid multicollinearity and comply with the assumptions of the least squares method.

For the analysis of panel data (595 observations: 85 regions \* 7 years), three models were sequentially estimated: a pooled model, a random effects model, and a fixed effects model. The final choice in favor of the fixed effects model was made based on the Wald test (p-value < 0.001) and the Hausman test (p-value < 0.0001). This choice indicates the presence of unobserved individual characteristics of the regions that correlate with the regressors. Statistical analysis and modeling were performed using the Python programming language and the linearmodels library.

### 3 RESULTS AND DISCUSSION

Descriptive statistics revealed significant right-sided asymmetry in the distribution of key indicators, such as GRP per capita and the volume of innovative products, indicating substantial inequality between regions. Preliminary analysis also showed the presence of expected relationships: an inverse correlation between innovation activity and the unemployment rate, and a direct relationship between the volume of innovative goods and life expectancy.

The results of the fixed effects model estimation are presented in Table 1.

Table 1: Regression analysis for the fixed effects analysis model.

Variable	Coefficient	P-value
Y-intercept	-3.15e+04	0.012
x1 – Number of families needing housing	-224.61	<0.001
x2 – Unemployment rate	-1394.9	<0.001
x3 – Number of R&D personnel	-0.2301	0.094
x4 – Level of innovation activity	-102.73	0.009
x5 – Volume of innovative goods/services	0.0244	<0.001
x6 – GRP per capita	0.0023	<0.001

Variable	Coefficient	P-value
x7 – Consumer Price Index	601.86	<0.001
x8 – Morbidity rate	-6.1634	0.004
x9 – Housing commissioning	4.8813	<0.001
x10 – Life expectancy	353.09	0.001
x11 – Cost of Living Index	-3.524	0.021
R-squared (within)	0.7828	

The obtained results allow for the following conclusions:

- The influence of innovation indicators is ambiguous. An increase in the volume of innovative goods and services (x5) has a statistically significant positive, albeit weak, effect on consumer spending. At the same time, an increase in the innovation activity of organizations (x4) is associated with a decrease in the standard of living. This can be explained by the effect of "creative destruction": automation and the introduction of new technologies lead to structural unemployment and increased skill requirements, which in the short term reduces the income of part of the population.
- Key determinants of the standard of living. The unemployment rate (x2) has the greatest negative impact: its increase by 1 p.p. leads to a decrease in consumer spending by 1395 rubles per person. Life expectancy (x10) and housing commissioning (x9) demonstrate the expected positive influence. The growth of the consumer price index (x7) naturally leads to an increase in nominal expenditures.
- Regional specificity. The fixed effects model confirmed the presence of significant unobserved differences between regions. Analysis of individual effects showed that the largest positive contribution to the standard of living is made by Moscow, Saint Petersburg, and regions with a high share of extractive industries, while a number of republics and

regions of Central Russia show persistently negative effects.

Discussion of the results indicates that in the Russian context, innovation activity, while being a source of long-term growth, is associated with significant social costs at the implementation stage. This underscores the need not merely to stimulate innovation, but to manage the process of technological transformation.

## 4 CONCLUSIONS

The conducted research allowed for a quantitative assessment of the complex impact of innovation activity on the standard of living in Russian regions. Econometric modeling based on panel data confirmed the hypothesis of an ambiguous nature of this influence. On the one hand, the performance of innovations in the form of the volume of new goods and services contributes to the growth of welfare. On the other hand, the procedural component – innovation activity – in the short and medium term can have a negative effect, exacerbating the problem of unemployment and inequality.

The main practical conclusion of the work is that policies aimed at stimulating innovation must be inextricably linked with measures of social accompaniment. These include: active labor market policies, retraining and skills upgrading programs, development of digital infrastructure ensuring equal access to the benefits of innovation, and targeted support for population groups most vulnerable in the process of technological change.

Prospects for further research are seen in an in-depth analysis of sectoral and typological differences between regions, as well as in the use of more detailed indicators characterizing various types of innovations (technological, process, organizational) and their direct impact on individual components of the quality of life.

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