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The Impact of Socio-Economic Factors on the Regional Economic Security Indicator

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Abstract. The economic security of the region is one of the most important indicators characterizing the ability of the regional socio-economic system to achieve economic and social interests. The research takes into account one of these state-regional interests - sustainable economic growth. The aim of the study is to assess the influence of socio-economic factors based on the regression analysis method on the economic growth as an indicator of economic security of Russian Federation regions. The authors used regression modeling as the main method of analysis. The authors used regression models based on statistical data from 85 subjects of the Russian Federation for the period from 2014 to 2021. The most influential factors are the main factors of production (share of the employed population, fixed assets, and investments), foreign trade, which characterizes the openness of the region's economy, specializing of the region in the mining industry, and the share of the employed population with higher education (human capital). The analysis confirms the possibility of using analysis and modeling tools in the practical activities of executive authorities to solve problems in the field of monitoring the economic security of the region.

Keywords: Economic growth; Economic security; Regression analysis; Socio-Economic factors

1. Introduction

In modern foreign scientific literature, the concept of "Economic Security" and "Economic Insecurity" is considered by scientists at the micro level from the standpoint of an individual's personal economic security from potential economic losses (Osberg and Sharpe, 2014) or is presented as "the degree to which people are protected from economic losses" (Hacker *et al.*, 2014). But economic security is a complex phenomenon that can be analyzed at the level of countries and regions (Polyanin *et al.*, 2020). Economic security is the ability of the regional socio-economic system to ensure sustainable economic growth, social development of territories, and a high quality and standard of living for the population under the negative impact of various factors (Sverdan, 2015).

Ensuring economic security is an important task of state and regional institutions (Kahler, 2014). The ongoing processes of globalization have a significant impact on the possibility of achieving economic security in countries and regions (Kahler, 2014). Other challenges appear due to a digital transformation which effect the internal social and

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economic processes of regional development (Arteeva *et al*., 2022), including the formation of human capital (Zaborovskaia, Nadezhina, and Avduevskaya, 2020), development of various sectors of the economy such as agriculture (Eremina *et al*., 2022), manufacturing, mining, including gas and oil complex (Khaykin and Toechkina, 2021), and the formation of new types of economy like Digital economy and Circular economy based on new high-tech technologies (Berawi, 2020).

In the field of economic security research, authors use different methods, but regression modeling is less widely represented. The authors use the comparison method to assess developing human capital as a factor in ensuring economic security (German and Bobrovskaya, 2019) and to diagnose the state of the socio-economic system in terms of economic security (Fraymovich *et al.*, 2021). Authors (Antamoshkina and Rogachev, 2020) use the expert method of analyzing hierarchies to assess the food security of the Russian Federation and its regions. Authors (Smirnova and Listopad, 2020) use the correlation method to assess the relationship between economic security indicators such as physical capital, investment in fixed assets, share manufacturing industry in the economy, life expectancy, R&D expenses, income level, inflation, crime rate, external and internal debt. They also use regression modeling for asses the impact of this factors on GRP as an indicator of economic security to identify areas for the development of measures to ensure economic security in Russian Federation Regions from 2003 to 2017. The results of the study show that an increase in manufacturing industrial, investments in fixed assets, life expectancy, and the volume of domestic debt will lead to an increase in GRP, as well as a reduction in income differentiation and a decrease in external debt. However, this study did not take into account such an important factor as human capital.

In our opinion, for a deeper analysis of socio-economic processes at the regional level, it is necessary to comprehensively study the influence on the economic security of socio-economic factors such as main factors of production (assets, investment, labor), foreign trade, and structure of the economy, innovation development and human capital, using regression modeling method. The use of modeling methods allows for a deeper study of the influence of various factors on the possibility of achieving sustainable economic growth (Jones and Vollrath, 2013).

The theoretical background of the research is the neoclassical theory of economic growth that outlines how a steady economic growth rate results when three economic forces come into play: physical capital, labor, and technology (Solow, 2016). We also pay special attention to human capital as an important factor of economic growth (Wilson and Briscoe, 2004) in order to assess whether this factor is decisive for the economy of Russian regions.

The aim of the study is to assess the influence of socio-economic factors based on the regression analysis method on the economic growth as an indicator of economic security of Russian Federation regions. The results obtained will allow us to assess which factors determine the economic growth of regions and, therefore, are most important for ensuring economic security. These results can be used for the development of regional socio-economic policy in the interest of ensuring economic security.

2. Methods

The stages of the study of the impact of socio-economic factors on the regional economic security indicator are shown in Figure 1. In the first stage, we determined the dependent and independent variables. We selected the dependent variable based on the premise that: firstly, this indicator should be a criterion for achieving the economic security of the region; secondly, it should correlated with other socio-economic factors; thirdly, it

should be quantifiable. To assess economic security, authors usually use a system of economic and social indicators and an index method (Pak and Andronova, 2023; Akhmetshin *et al.*, 2018). However, despite the variety of indicators used, the main indicator that has a relationship with other socio-economic factors at the regional level is the gross regional product per capita (GRP per capita) and the growth index of GRP per capita (Jones and Vollrath, 2013). We chose the growth index of GRP per capita as a dependent variable in regression models (Δy_{it}).

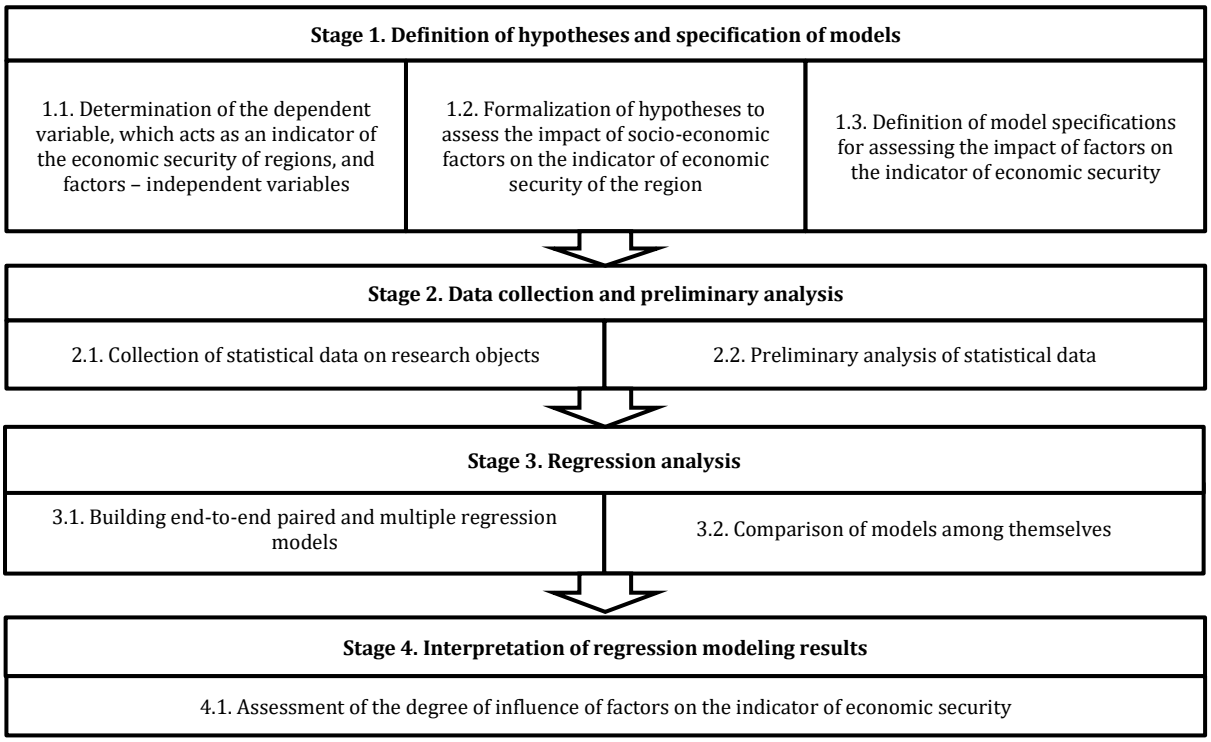


Figure 1 Stages of the study the impact of socio-economic factors on the regional economic security indicator

The selection of independent variables (regressors) was based on the provisions of the neoclassical theory of economic growth and the results of research assessing the impact of socio-economic factors on economic growth. We understand socio-economic factors as phenomena that influence economic growth whose nature is determined by economic processes in the region, such as economic and investment activity, foreign trade, as well as social processes, such as developing human capital.

In accordance with the prerequisites of the basic Solow model, economic growth is set using a production function described by three groups of factors: physical capital, labor, and the total productivity of factors characterizing scientific and technological progress, given exogenously (Solow, 2016). The studies of N.G. Mankiw, D. Romer, D.N. Weil, P. Romer, R.J. Barro, J.W. Lee and other researchers expand the theory of economic growth by including factors of scientific and technological progress and human capital to the list of the main production factors (Wilson and Briscoe, 2004). Based on the results of this researches, we identified the main factors of production, which include the value of fixed assets per capita, investments in fixed assets per capita, and share of the employed population. As a factor of scientific and technological development, we used the indicator of internal research and development per capita. This indicator is used to study the development of regional innovation systems (Rudskaya *et al.*, 2022). As a factor of human capital, we used the share of the employed population with higher education and the share of the employed

population with secondary specialized education (Bilan *et al*. 2020; Cuaresma, Doppelhofer, and Feldkircher, 2014). We selected economic structure factors characterizing the openness of the economy and the involvement of the region in foreign trade activities (Rahman and Alam, 2021), as well as factors characterizing the industry specialization of the region (agriculture, industry, and mining). We also used GRP per capita in period t-1 as an in independent variable to assess how the value of GRP per capita in the past affects the increase in the current period (Mudronja, Jugovic, and Skalamera-Alilovic, 2020). The list of variables is presented in Table 1.

We used the growth index of these variables (Δx_{it}) calculated through the ratio of the values of indicators in period t to the value of the indicator in period $t-1$ and values of variables for the previous period (y_{it-1}, x_{it-1}). In order to ensure the linearity of the models, we chose the logarithmic form (ln) as the main functional form of variables.

Thus, within the framework of the study, we tested the hypothesis that the positive increase in socio-economic factors and past values of variables leads to a positive increase in GRP per capita.

Table 1 Variables for modeling

№	Variables	Label
1.	The growth index of the gross regional product per capita	ΔrGDPpc$_{it}$
	The main factors of production	
2.	The growth index of the value of fixed assets per capita	ΔrCFApc$_{it}$
3.	The growth index of investments in fixed assets per capita	ΔrIFApc$_{it}$
4.	The growth index of the share of the employed population of the region	Δshempl$_{it}$
	Factors of the structure of the economy	
5.	The growth index of foreign trade turnover (import+export) per capita	ΔrVTOpc$_{it}$
6.	The growth index of the share of revenue from the sale of goods, products, works, and services in the mining industry	Δshrmining$_{it}$
7.	The growth index of the share of revenue from the sale of goods, products, works, and services in the manufacturing industry, %	Δshrmnfact$_{it}$
8.	The growth index of the share of revenue from the sale of goods, products, works, and services in the agricultural sector (including fishing), %	Δshragrclt$_{it}$
	Factors of innovative development and human capital	
9.	The growth index of internal research and development costs per capita, million rubles.	ΔrRDpc$_{it}$
10.	The growth index of the share of the employed population with higher education, %	Δemplvo$_{it}$
11.	The growth index of the share of the employed population with secondary vocational education, %	Δemplspo$_{it}$

At the second stage, a preliminary statistical analysis of the selected indicators was carried out. Then, pooled OLS (Ordinary Least Squares) regression models were built to assess the closeness of the relationship between variables, as well as to assess the influence of independent variables on the indicator of economic security. Within the framework of the end-to-end regression model, paired and multiple regression models were tested.

Open data published on the official websites of the Federal Statistics Service (including the website of the Unified Interdepartmental Information and Statistical System, EMISS) were used as sources of information. Data on 85 subjects of the Russian Federation for the period from 2014 to 2021 were selected for the analysis. In order to be able to compare data by year, all cost indicators were brought to the prices of 2014 (this variable is marked with *r*). We used the software product *Stata 14* for OLS regression modeling.

3. Results and Discussion

3.1. Results of a preliminary study of factors

Figure 2 contributes a cartogram of the GRP per capita distribution by subjects of the Russian Federation for 2014 (a) and 2021 (b). The highest values of the GRP per capita in 2014 and 2021 were achieved in economically developed regions of the country as well as in the regions specializing in the mining industry.

The leaders in terms of GRP per capita among regions specializing in the mining industry are Nenets JSC (6.553 million rubles, the share of revenue of mining enterprises in the total revenue of organizations in the region 75%), Yamalo-Nenets JSC (5.585 million rubles, the share of the mining industry 75%), Khanty-Mansiysk JSC-Yugra (2.298 million rubles, the share of the mining industry - 75%), Chukotka JSC (1.927 million rubles, the share of the mining industry 68%). Among the economically developed regions of the country, the leaders are Moscow (1.284 million rubles) and St. Petersburg (1.168 million rubles). These regions also have the highest values of the cost of fixed assets per capita and the volume of investments in fixed assets per capita.

There is a positive trend in the number of regions with GRP per capita: if in 2014 the median value of the indicator was 0.291 million rubles, then in 2021 – 0,388 million rubles. The largest increase is observed in the Magadan region (+136.43%), Sevastopol city (+149.88%), Murmansk region (+134.01%) and St. Petersburg (+126.59%). A large increase in the value of GRP per capita may be associated with a decrease in the population rather than economic growth, which is due to the calculation of this indicator. For example, in the Magadan region, the population in 2021 decreased by 7% compared to 2014, and in the Murmansk region by 5%. However, in regions such as St. Petersburg, there is an increase in population by 5%, and in Sevastopol, the increase was 34%, which suggests that the increase in the value of GRP per capita in these regions attributable to the economic growth. The lowest values of GRP per capita are mainly in the regions of the Southern and Caucasian Federal Districts (such regions as the Republic of Ingushetia, the Chechen Republic, the Kabardino-Balkarian Republic, the Republic of Dagestan, the Republic of Crimea), as well as the Republic of Tyva.

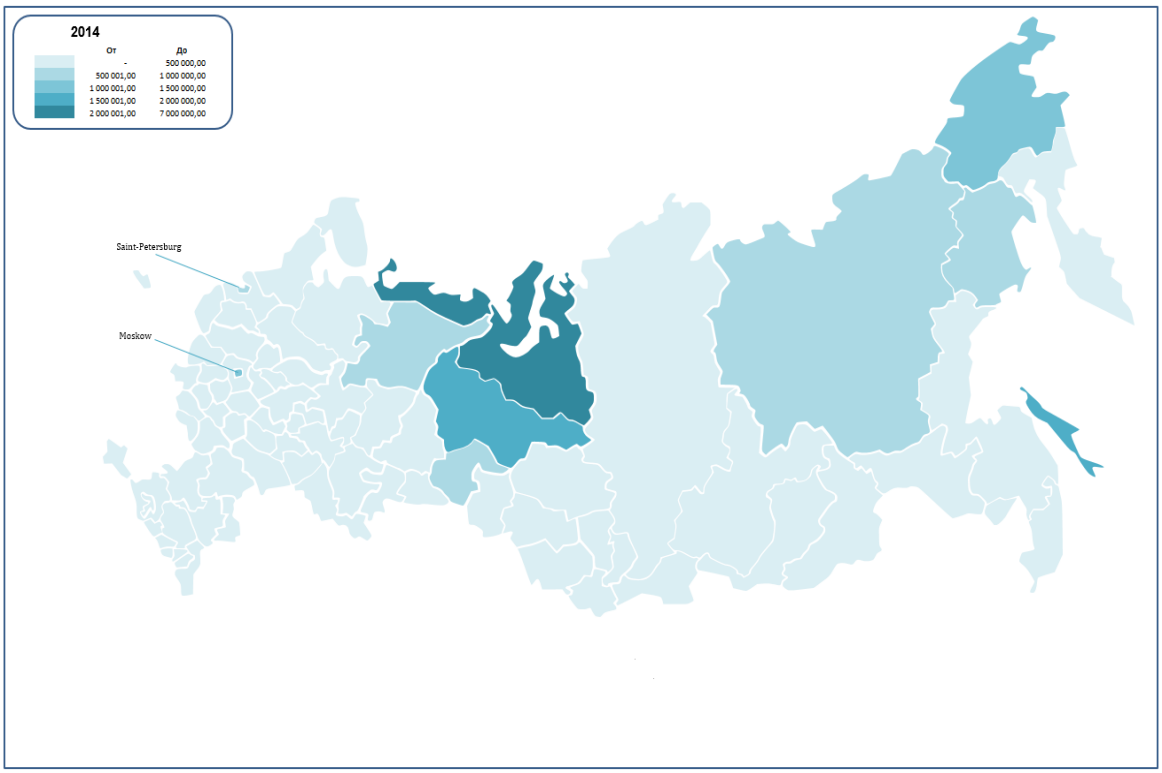
In the regions with the highest GRP per capita values, the highest values of the share of the employed population are observed. The average growth rate of the employed population share in the country for the period from 2014 to 2021 amounted to 4.9%. A slight increase may be attributed to a decrease in the share of the employed population in 52 subjects of the Russian Federation in 2021 compared to 2014.

The largest share of the employed population is in the service sector (58.4%), contributing approximately 52.9% to the country's GDP. The smallest share of the employed is in the mining industry (1.6%), yet this sector accumulates 10.1% of the country's GDP. The least productive industry is agriculture, with 6.3% of the employed population, contributing 4.7% to the country's GDP.

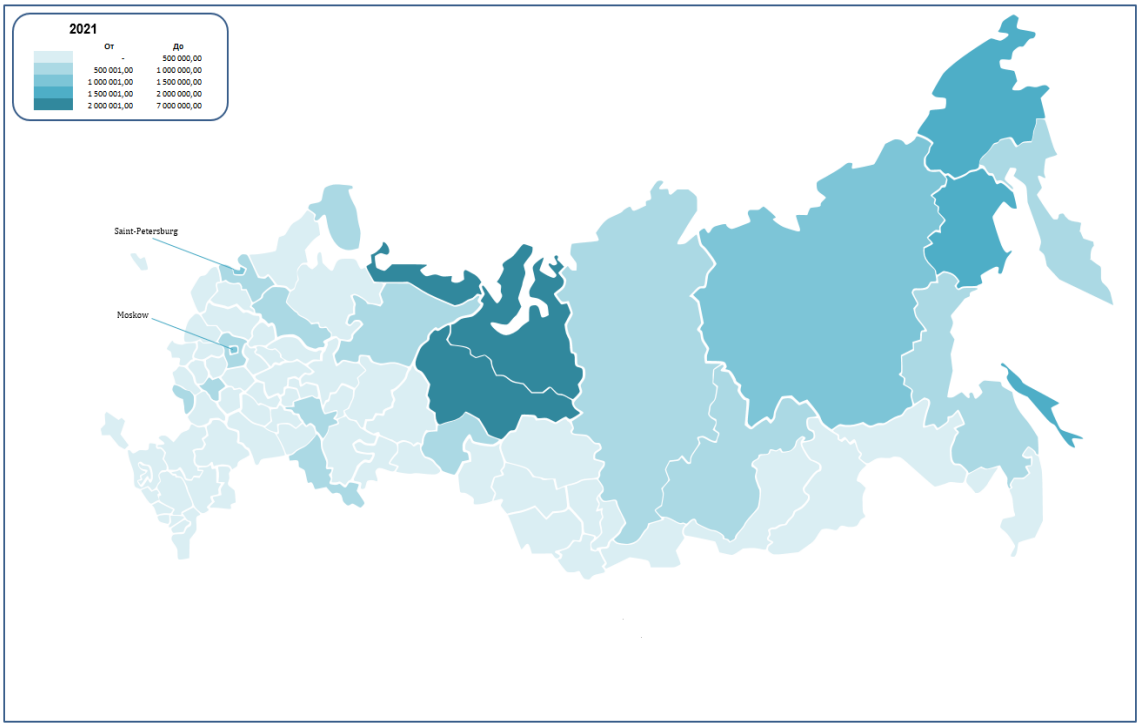
Economically developed regions have high values of the indicator of foreign economic activity. According to the results of 2021, the largest volumes of foreign trade turnover were observed in such regions as Moscow (42.6% of the total foreign trade turnover), St. Petersburg (7.2%), Moscow Region (5.7%), Khanty-Mansiysk Autonomous Okrug (2.3%) and the Republic of Tatarstan (2.2%), close the list of regions by volume of foreign trade turnover, the Republic of Ingushetia, Sevastopol and the Republic of Kalmykia – these regions account for less than 0.001% of the total volume of foreign trade turnover.

The largest share of employed in the Russian Federation have secondary vocational education (45.2%) and higher education (34%). According to the results of 2021, the highest concentration of employed with higher education was recorded in the Central

Federal District (40.6%), with secondary vocational education – in the Ural Federal District (48.9%). There is a slight tendency to reduce the share of those employed with secondary general education in favor of higher levels of education. At the same time, there are regions with positive growth rates of those employed without basic general education, mostly remote regions from the federal center.



(a)



(b)

Figure 2 Cartogram of the distribution of GRP per capita by subjects of the Russian Federation for 2014 (a) and 2021 (b)

3.2. Results of regression analysis

As part of the regression analysis, paired regression models were constructed. These models aimed to estimate the influence of the GRP per capita in the t-1 period, along with the growth indices of the main factors of production and the values of factors in the t-1 period, on the GRP per capita growth index. The results are presented in Table 2.

Table 2 Results of regression analysis of main production factors (step 1)

Variables	Models		
	m1_1	m1_2	m1_3
$lnrGDPpc_{it-1}$	-0.025	-0.021	-0.028**
$\Delta lnrCFApc_{it}$	0.078***		
$lnrCFApc_{it-1}$	0.032**		
$\Delta lnrIFApc_{it}$		0.095***	
$lnrIFApc_{it-1}$		0.027*	
$\Delta lnshempl_{it}$			0.503***
$lnshempl_{it-1}$			0.182***
** p<0.05, ** p<0.01, *** p<0.001*			

At the next stage, we constructed multiple regression models in which factors of the structure of the economy, innovative development, and human capital were gradually added to the listed factors. The results are presented in Table 3.

In the final step, we constructed a multiple regression model that considered all variables. The model was built using the stepwise tool of Stata, which automatically discarded insignificant variables from the model at a 10% significance level. As a result of excluding outliers from the m1_12 model, the m1_13 model was built at a 10% significance level and the m1_14 model at a 5% significance level. The results of step 3 are presented in Table 4.

Table 3 Results of regression analysis (step 2)

Variables	Models						
	m1_4	m1_5	m1_6	m1_7	m1_8	m1_9	m1_10
$lnrGDPpc_{it-1}$	-0.106***	-0.087***	-0.098***	-0.088***	-0.089***	-0.090***	-0.088***
$\Delta lnrCFApc_{it}$	0.073***	0.063***	0.068***	0.065***	0.066***	0.065***	0.066***
$lnrCFApc_{it-1}$	0.029**	0.029**	0.036**	0.035**	0.034**	0.035**	0.032**
$\Delta lnrIFApc_{it}$	0.076***	0.069***	0.062**	0.069***	0.070***	0.071***	0.074***
$lnrIFApc_{it-1}$	0.034**	0.022	0.015	0.021	0.023	0.022	0.024
$\Delta lnshempl_{it}$	0.421***	0.448***	0.522***	0.491***	0.500***	0.486***	0.496***
$lnshempl_{it-1}$	0.177***	0.199***	0.224***	0.198***	0.184***	0.186***	0.180***
$\Delta lnrVTOpc_{it}$	0.072***						
$lnrVTOpc_{it}$	0.006						
$\Delta lnshragrclt_{it}$		-0.060***					
$lnshragrclt_{it-1}$		-0.000					
$\Delta lnshrmining_{it}$			0.019**				
$lnshrmining_{it-1}$			0.005**				
$\Delta lnshrmnfact_{it}$				-0.043**			
$lnshrmnfact_{it-1}$				0.001			
$\Delta lnrRDpc_{it}$					0.023		
$lnrRDpc_{it-1}$					0.001		
$\Delta lnemplvo_{it}$						0.004	
$lnemplvo_{it-1}$						0.037	
$\Delta lnemplspo_{it}$							0.033
$lnemplspo_{it-1}$							0.014
** p<0.05, ** p<0.01, *** p<0.001*							

Table 4 Results of regression analysis (step 3)

Variables	Models			
	m1_11	m1_12	m1_13	m1_13
$lnrGDPpc_{it-1}$	-0.121***	-0.126***	-0.122***	-0.116***
$\Delta lnrCFApc_{it}$	0.063***	0.064***	0.032	
$lnrCFApc_{it-1}$	0.029**	0.031**	0.035***	0.030**
$\Delta lnrIFApc_{it}$	0.052**	0.055**	0.041*	0.047*
$lnrIFApc_{it-1}$	0.028*	0.028*	0.027*	0.027*
$\Delta lnshempl_{it}$	0.425***	0.398***	0.466***	0.457***
$lnshempl_{it-1}$	0.217***	0.224***	0.202***	0.198***
$\Delta lnrVTOpc_{it}$	0.071***	0.071***	0.073***	0.073***
$lnrVTOpc_{it}$	0.008*	0.008*	0.009*	0.009*
$\Delta lnshragrclt_{it}$	-0.059***	-0.059***	-0.058***	-0.059***
$lnshragrclt_{it-1}$	0.004			
$\Delta lnshrmining_{it}$	0.024***	0.024***	0.020**	0.020**
$lnshrmining_{it-1}$	0.006**	0.005**	0.005**	0.005**
$\Delta lnshrmnfact_{it}$	-0.036**	-0.035**	-0.036**	-0.037**
$lnshrmnfact_{it-1}$	0.001			
$\Delta lnrRDpc_{it}$	0.014			
$lnrRDpc_{it-1}$	-0.001			
$\Delta lnemplvo_{it}$	0.071			
$lnemplvo_{it-1}$	0.083**	0.065**	0.053*	0.054*
$\Delta lnemplspo_{it}$	0.028			
$lnemplspo_{it-1}$	0.019			
** p<0.05, ** p<0.01, *** p<0.001*				

Figure 3 shows a matrix of partial residual graphs based on the m1_13 model, visualizing the revealed linear relationships between variables. The graphs show a clear negative linear relationship between the growth index of GRP per capita and growth index of GRP per capita in the period t-1, with the growth index of the share of manufacturing and agriculture industry. There are positive linear relationships between the growth index of GRP per capita and other indicators which detailed interpretation is presented in the *Discussion of Obtained Results* section.

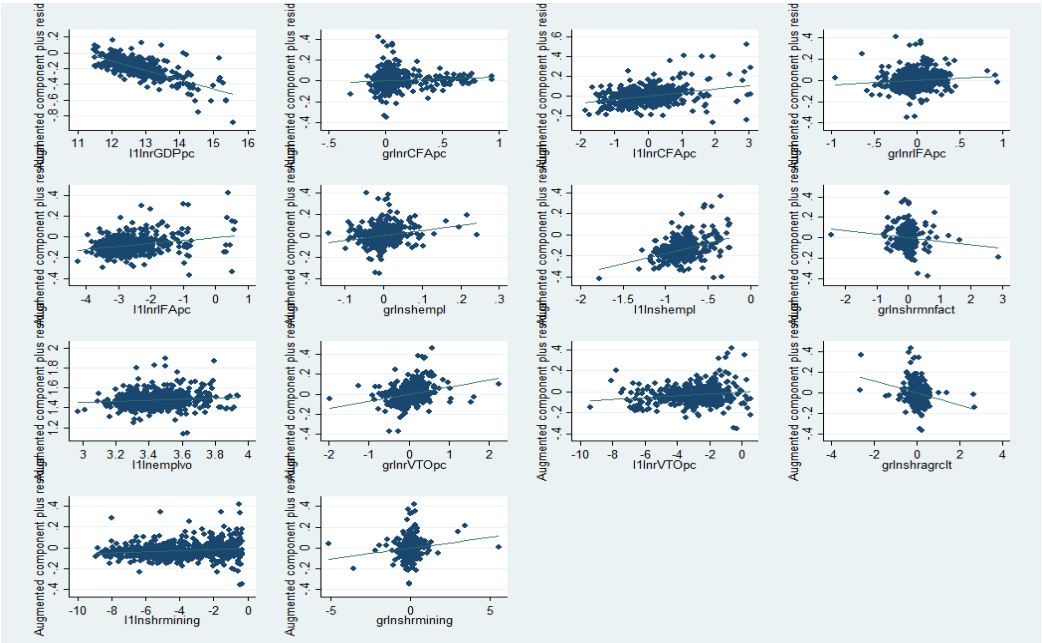


Figure 3 Matrix of partial residual graphs (model m1_13)

3.3. Discussion of Obtained Results

The results of the research allow us to conclude the following. A positive relationship was revealed between the GRP per capita growth index and the main production factors:

the index of growth in the value of fixed assets, as well as the value of fixed assets in the period t-1 at only 10% significance level; the index of investment growth in fixed assets, the value of fixed assets in the period t-1. These findings align with results from prior research (Smirnova and Listopad, 2020). The index of growth in the share of employed in the total number of the population and the share of the employed in the period t-1.

The revealed relationship between the GRP per capita growth index and the foreign trade turnover growth index, as well as the value of foreign trade in the t-1 period, correspond to the results of studies on the positive impact of economic openness on economic growth (Rahman and Alam, 2021).

A positive relationship was revealed between the GRP per capita growth index and the share of those employed with higher education in the period t-1. This relationship suggests that in those regions where the largest share of those employed with higher education was observed, economic growth was more intense. The results obtained correspond to the results of a study on the positive impact of human capital on economic growth (Bilan *et al.,* 2020; Cuaresma, Doppelhofer, and Feldkircher, 2014).

At the same time, a negative relationship was revealed between the GRP per capita growth index and the GRP per capita in the t-1 period. The results obtained differ from the early research results (Mudronja, Jugovic, and Skalamera-Alilovic, 2020). This may indicate that regions of the Russian Federation with higher GRP per capita have lower rates of economic growth, and vice versa: regions with low GRP per capita have higher rates of economic growth. In our opinion, this trend is rather statistical in nature and is due to the effect of a «low base». For the Russian Federation, this trend is characteristic and confirmed at the macro level (Shokhin *et al.*, 2021).

It should be noted that, as in the study (Smirnova and Listopad, 2020), the relationship between GRP per capita and R&D expenditures turned out to be insignificant. There is a negative relationship between the growth index GRP per capita and the share of revenue of organizations in the agricultural sector, which suggests that economic growth is declining in regions where agriculture dominates the economy. Similar results were obtained in a study that found that in agricultural regions, the availability of human capital contradictorily reduces economic growth (Cadil, Petkovova, and Blatna, 2014). In contrast to the results of the study (Smirnova and Listopad, 2020), our models showed a negative relationship between economic growth and the manufacturing industry. This result may be related to the problems of socio-economic development of Russian regions specializing in the agro-industrial complex described in the literature, as well as the problems of «old industrial regions» reflected in the research of Russian scientists (Sorokina and Latov, 2018).

4. Conclusions

In our study, we combine the theory of economic security with the theory of neoclassical economic growth in terms of using factor analysis methods to study the influence of socio-economic factors on the indicator of economic security of the region. The conducted factor econometric analysis on the example of the subjects of the Russian Federation based on data from 2014 to 2021 confirms the possibility of using these tools in the practical activities of executive authorities in terms of monitoring the economic security of the region. The proposed and tested approach to the study of the socio-economic factors that influence on the indicator of economic security is universal and can be applied to other countries and regions if there is a sufficient amount of statistical information and software. The methods used to identify the correlations between the factors of socio-economic development and the indicator of economic security (GRP per capita), can be used for

classifying and identification of destabilizing and stimulating factors of economic security. This allows the justification for the preventive measures development to respond to changes in the intensity of the impact of destabilizing factors (threats) economic security and scientifically substantiates adjusting the state policy in the field of industrial development, investment, foreign economic activity, as well as human capital development. The limited set of social indicators presented in the form of human capital did not allow us to fully study the impact of the social sphere on economic growth and, consequently, to assess the contribution to ensuring economic security. The most important further direction will be the improvement of the indicator set. It is so important to study the impact of factors such as the quality of life in the region, the presence of informal institutions such as corruption and bureaucracy, and the level of criminality of society on the economic security of the region.

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