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The Impact of Firms' Activities on Regional Sustainable Development

Svetlana Gutman[1], Elena Rytova[1], Viktoriia Brazovskaia[1*], Angi Skhvediani[1]

[1]*Peter the Great Saint-Petersburg Polytechnic University, 195220, Polytechnicheskaya 29, Russia*

Abstract. This article examines the relationship between the goals and indicators of sustainable development at various levels of regional socio-economic systems. Various approaches to the assessment of sustainable development were analysed. To assess the impact of a company's activities in the social, environmental and economic spheres on the sustainable development of the region, a traditional econometric analysis was carried out using panel data. A set of socio-economic indicators was used to build an econometric model that evaluates the relationship between various elements at different levels of management. The indicator of life expectancy in the region was chosen as the final variable, as it reflects the totality of factors affecting the standard of living of the population. Based on an econometric analysis of interdependence, the indicators that can have an impact on the development of the region were identified. These indicators include the level of gross domestic product (GDP), the average salary in the enterprise, the costs of environmental protection, the levels of emissions produced by the company and the number of employees who have received higher education. In the course of the study, the authors confirmed the influence of a company's activities in the social, environmental and economic spheres on certain aspects of sustainable development in the Russian Federation.

Keywords: Company influence; Econometric model; Regional development; SDG; Sustainable development

1. Introduction

Issues related to sustainable development (SD) have become relevant in the past several decades. The idea of SD is consistent with the global nature of society's problems, and many states and their constituents use it to develop effective strategies for managing socioeconomic systems (Abed & Yakhlef, 2020). Today, over a hundred countries, especially well-developed ones, make decisions consistent with the concept of SD at the government level. In order to outline an effective strategy, countries should consider an integrated approach to ensuring and maintaining SD at all levels of the economy: both at the country level and at the level of the region, enterprise, etc. Moreover, it is necessary to accommodate the interests of all stakeholders (population, enterprises, regional government, etc.) in order to achieve the environmental, social and economic aspects of SD goals (SDG). If enterprises fail to participate or are not interested in implementing this concept, SD cannot be achieved in the region (territory) or in the country as a whole.

One of the most important indicators of regional development is the life expectancy of the population (Shaporova & Tsvettsykh, 2020). This is a complex indicator that reflects a

*Corresponding author's email: brazovskaya_vv@spbstu.ru, Tel.: +7-812-534-73-31
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number of factors affecting the living conditions of citizens. For enterprises, life expectancy in the republic can be influenced by reducing pollutant emissions into the environment. Another way to improve the duration, standard and quality of living is to provide social guarantees and payments to company personnel as well as maintaining high wage levels (Oláh et al., 2018). The level of education and skills of a company's personnel in its operating territory indicate the educational level in the region. Companies' assistance agreements with other organisations impact on the development of partnerships both within the republic and outside its limits. Thus, any activity of large companies in the region invariably affects the living conditions in the region and its sustainable development. In this regard, a question arises: 'What impacts do various company activities in the social, ecological and economic spheres have on SD in the region, and how can we evaluate them?" Therefore, the purpose of this work is to assess the impact of company operations in general on the SD of the region.

The idea of SD implies that economic, ecological and social spheres of life are interacting (Brazovskaia et al., 2021; Berawi, 2019). Consequently, if any of these spheres are influenced, the impact on all life domains must be considered. Also, it should be noted that some works are dedicated to studying the methodology that is used for assessing the SD of socioeconomic systems (Malagueño et al., 2018). Therefore, there is a need in the academic community to study the impact of companies' activities on certain aspects of SD in their regions.

To monitor the progress toward SDG 3 (Ensuring a healthy lifestyle and promoting well-being for all at any age), the World Health Organisation (WHO) has reviewed several comprehensive indicators, including 'life expectancy', 'healthy life expectancy' and 'number of deaths under the age of 70'. These indicators show not only progress in achieving the goals included in SDG 3 but also progress in achieving other health-related goals. Guzel et al. (2021) argued that achieving a healthier society and increasing life expectancy is the basis for progress in SDGs 3 and 17. However, this is not possible without economic, social and political integration between governments, companies and societies. Dietz and Jorgenson (2014) drew attention to the fact that one of the key development goals of countries is increasing life expectancy, which, in turn, depends on the well-being of citizens and the amount of harmful emissions. Dalevska et al. (2019) presented a methodological approach for comprehensively assessing the socio-economic parameters of countries' SD based on the current UN information base. They propose an assessment of the degree of development of international trade and investment relations, the level of life expectancy, the standard of living and the prosperity of international entities under the influence of sources of economic growth. Özgür et al. (2021) explored the relationship between various indicators of SD and the size of the informal economy. The authors included life expectancy in the group of variables associated with the level of health of the population. As a result, the authors found that the size of the informal economy sector is negatively related to the life expectancy of the population.

Concluding the literature review, we can say that life expectancy is a frequently used indicator for assessing the SD of countries and regions. At the same time, however, existing studies do not assess how the activities of individual companies affect the regions and their SD through indicators such as life expectancy.

2. Methods

The different regional and company indicators can be used to study the dynamics of socioeconomic development of a region. Also, they can be used as the basis for building econometric models that assess interrelations between various elements of the socioeconomic system at different levels of management. The goal of the econometric model, in this case, is to confirm the significance of cause-and-effect relationships and to verify the hypothesis about the influence companies' activities have in the social, ecological and economic spheres on individual SD aspects of the region as a whole.

Establishing the relationship between the indicators of the region and the company with only one example object does not make it possible to extend the findings to other similar objects. Accordingly, the authors decided to study a number of regions that differ in many ways, but all have large enterprises that could have a significant impact on regional development. Hence, a data panel was formed, including 10 Russian regions and the 10 largest companies in various industries for the period from 2009 to 2018. These regions were selected based on the presence of a large enterprise (company) that makes a significant contribution to the economy of the region. The data contain statistics about the same objects for a series of subsequent time periods. From the perspective of regression analysis, using these data increases the volume of the sample that is considered and makes the assessment parameters of the regression model more effective. Moreover, using the panel compensates for many negative aspects of applying only spatial or time data (Clark et al., 2020). In this case, no information is lost, unlike the first case, where it is lost because the development dynamics of the objects are not fully considered, and the second case, in which the heterogeneity of the objects themselves cannot be considered at all (Lutsenko, 2018). We analyse panel data using the following modelling approaches:

1. Pooled data regression. The parameters of the model (m+1) are assessed using the least squares (OLS) method by all nt observations. It makes sense to use this method if it is assumed that there are no heterogenic characteristics of the observation objects or time points. Otherwise, the prerequisites of the OLS regarding the residual sums are violated.

2. Fixed effects models. These models imply that each of the studied spatial objects has individual non-observed effects. Using this model makes it possible to control the bias of the estimates caused by individual effects of the objects.

3. Random effects models. Differently from fixed effects models, random effect models expect that even though the distinctions between spatial objects exist, they are random.

In the first stage of the regression analysis, factors that could influence the dependent variable are determined. In this study, the hypothesis suggests the presence of considerable cause-and-effect relationships between the company's SD indicators and the indicators showing the level of SD in the region. The life expectancy of the region's population was chosen as the dependent variable. According to the methodology used to calculate this indicator (Toson & Baker, 2003), life expectancy reflects the total influence of the social, economic and ecological factors on the living standard and can be an important measure of the socioeconomic development of territories, as an increase in the living standard of the region's population is the main strategic goal of regional authorities. In the second stage, indicators of the companies were selected that, according to the hypothesis, could reflect the influence of the company on the social, economic, and ecological circumstances in the region.

The regression analysis of the data was carried out using the Stata package. In the first stage, a correlation analysis was conducted for the chosen indicators to assess the presence and directions of the relationships. Then, different variations of the models were built, and each was tested to meet the principles of the Gauss–Markov theorem. Finally, a model with the best characteristics based on the totality of the conducted tests was selected. In order to verify the hypothesis about the interrelationship between the company's activities in the social, ecological and economic spheres and the SD of the region, traditional econometric analysis was carried out using panel data.

For these variables, statistics were collected for the period from 2009 to 2018 for the 10 regions and 10 regional companies, respectively. The following regions were chosen for the study: the Republic of Sakha (Yakutia) – Public Joint Stock Company (PJSC) 'ALROSA'; Murmansk Region: PJSC 'MMC Norilsk Nickel'; Leningrad Region: PJSC 'Sovcomflot'; Tumen Region: JSC 'Transneft Siberia'; Vologda Region: Public company 'Severstal'; Sverdlovsk Region: PJSC 'T Plus'; Perm Krai: EuroChem plc.; Krasnoyarsk Krai: PJSC 'MMC Norilsk Nickel'; Nenets Autonomous District: JSC 'Zarubezhneft'; Yamalo–Nenets Autonomous District: OJSC 'Novatek'. Large enterprises that develop corporate SD strategies and provide open data are based in these regions.

The life expectancy in the region was selected as a final variable, as it reflects a totality of factors affecting the living standard of the population. In the course of the analysis, an attempt was made to reveal the dependence of life expectancy on such indicators as gross regional product, unemployment rate, average salary in the large enterprise in the region, current environmental costs of this enterprise, number of jobs given to the population, CO2 emissions of the company, tax payments made by the enterprise to the regional budget, the number of licenses and patents of the company, the share of the company in the sector and the share of employees with higher education in the enterprise. In the analysis, we assumed that the selected company indicators would have the largest influence development level of the region. Table 1 lists the selected variables.

Table 1 Variables for the econometric model

Variable	Designation	Unit of measurement
Final variable		
Life expectancy	OPZ	Number of years
Factor variable		
GRP per capita	GRP	thousand $
Unemployment rate	YB	%
Average salary in the enterprise	SrZP	$
Current environmental costs of the enterprise	OOS	mil. $
Number of jobs provided to the population of the region by the company	RabM	Number of jobs
CO2 emissions of the enterprise	CO2	thousand tons
Tax payments made by the company to the regional budget	Nalog	mil. $
Number of licenses and patents of the company	LP	Pcs.
Share of the company in the sector	Dolya	%
Share of employees with higher education in the enterprise	RabVO	%

The econometric analysis of the panel data was performed using the STATA package.

3. Results and Discussion

The preliminary analysis in this research involved studying a correlation matrix (Table 2). It can be concluded from this correlation matrix that life expectancy (OPZ) has a weak correlation with the majority of the indicators, except for GRP. Then, we proceeded to the next stage, which involved conducting a regression analysis (Table 3) on the combined data.

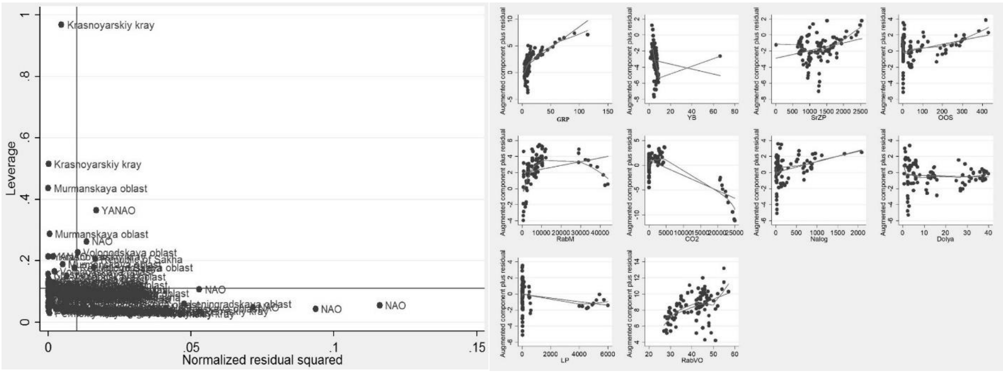
Table 2 Correlation matrix

	OPZ	GRP	YB	SrZP	OOS	RabM	CO2	Nalog	Dolya	LP	RabVO
OPZ	1.000										
GRP	0.5287	1.000									
YB	-0.1219	-0.169	1.000								
SrZP	0.0769	-0.096	0.245	1.000							
OOS	0.0635	-0.097	0.387	0.5320	1.000						
RabM	0.0317	-0.054	-0.017	0.0403	-0.032	1.000					
CO2	-0.0756	-0.241	0.014	-0.0392	-0.015	0.928	1.000				
Nalog	0.0736	-0.144	0.270	0.5771	0.947	-0.049	-0.048	1.000			
Dolya	0.0722	0.261	0.156	0.6611	0.324	0.122	-0.041	0.312	1.000		
LP	-0.0715	-0.110	0.331	0.3714	0.774	-0.088	0.0332	0.682	0.416	1.000	
RabVO	0.2487	0.222	-0.183	-0.2809	-0.276	-0.516	-0.598	-0.236	-0.407	0.3689	1.00

Table 3 Result of the regression analysis of the pooled data

Model / Variables and model parameters	**Pooled regression**
GRP	0.068***
	(0.012)
YB	-0.011
	(0.030)
SrZP	0.0009
	(0.0006)
OOS	0.0008
	(0.006)
RabM	-0.00007
	(0.0001)
CO2	0.0002
	(0.0001)
Nalog	0.001
	(0.002)
LP	-0.0002
	(0.0003)
Dolya	-0.003
	(0.032)
RabVO	0.09*
	(0.04)
Constanta	63.75***
	(1.66)
Model parameters	
N	100
R^2	0.409
$R^2 adj$	0.343
RMSE	1.596
Standard errors in parentheses.	
** p<0.05, ** p<0.01, *** p<0.001*	

In general, the model produced is significant (F(10,89)=6.16; Prob>F=0.0000). The coefficient of determination is 0.41, while the corrected coefficient of determination is 0.34, which means that the dispersion of the selected indicators explains only a slight share of the OPZ dispersion, and the specification of the model should be verified. Only two coefficients of the equation are significant (GRP and RabVO). The model obtained is not of high quality.



(a) (b)

Figure 1 (a) Graph of Student-t residuals plus leverage; (b) Augmented partial residual graphs for linearity analysis

In order to determine the causes of the poor quality of the model, diagnostics were performed. An outlier analysis of the model was conducted using Student-t residuals and leverage in the first stage of the diagnostic (Figure 1 a, b). No outliers were found. In addition, a dfbeta test was performed for all variables, which did not reveal influential observations capable of displacing the coefficients of the analysed variables. Then the linearity of the relation between the selected factor variables and the dependent variable was verified.

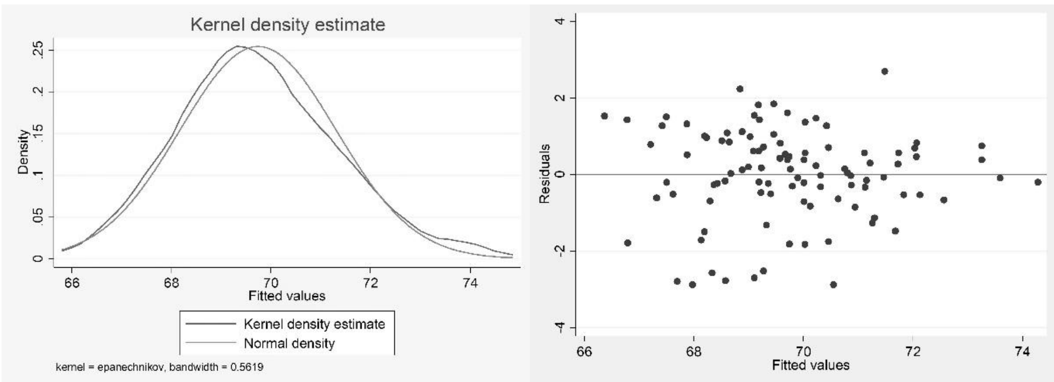
The linearity test revealed non-linear relationships between some variables and the endogenous variable (Figure 2). Thus, it was decided to transform some variables into logarithmical form to achieve greater linearity. The selection of the correct functional form helped to improve the initial model significantly (Table 4).

Table 4 Result of the regression analysis of the transformed data

Model / Variables and model parameters	Pooled regression with transformed data	Final pooled regression
lnGRP	2.000***	2.236***
	(0.302)	(0.214)
lnYB	-0.524	
	(0.372)	
SrZP	0.001***	0.0014***
	(0.0004)	(0.0004)
lnOOS	-0.861***	-0.603***
	(0.173)	(0.126)
lnRabM	0.447	
	(0.229)	
lnCO2	0.629***	0.618***
	(0.097)	(0.074)
Nalog	0.0009	
	(0.0007)	
LP	0.0002	
	(0.0001)	
lnD	0.109	
	(0.234)	
RabVO	0.204***	0.173***
	(0.033)	(0.024)
Constanta	50.662***	54.041***
	(2.64)	(1.471)
Model parameters		
N	100	100
R^2	0.686	0.634
$R^2 adj$	0.651	0.615
RMSE	1.164	1.222
Standard errors in parentheses.		
** p<0.05, ** p<0.01, *** p<0.001*		

In general, the model produced is significant (F(10;89)=19,44; Prob>F=0.0000). The coefficient of determination is now 0.686, while the corrected coefficient of determination is 0.651. This increase in the determination coefficient can be seen in Table 3. The significance of the factor variable coefficients improved. The next step involved analysing this model for factor multicollinearity. The VIF (variance inflation factor) test did not show substantial collinearity between the factor variables. However, the analysis of the correlation matrix revealed substantial relationships between the current environmental costs of the enterprise and the tax payments made by the company to the regional budget as well as between the number of jobs given by the company to the population of the region and CO2 emissions. Moreover, some variable coefficients are not significant. Due to this, the specification of the model was corrected. A more favourable econometric model was obtained through several iterations (Table 3). The final model is significant (F(5;94)=32.59; Prob>F=0.0000). The coefficient of determination is now 0.634, while the corrected coefficient of determination is 0.615. The following variables remained in the final model: GRP, average salary, environmental costs, CO2 emission levels and the share of personnel with tertiary education.

Since multicollinearity and non-linearity were excluded from this model, it was necessary to test the specification and residuals of the model. In order to verify the specification of the model, the Ramsey omitted variable test (OV test) and linktest were performed. While the corrected R2 is somewhat lower than R2, which could be evidence of problems with the specification, according to the results of the OV test, there are no omissions in the model (OV-test: F(3;91)=0.28; Prob>F=0.8379). In order to confirm these results, a linktest was run, which showed problems with the specification. The results indicated problems with the specification of the model and the presence of omitted variables. However, this was assumed from the beginning, as the lack of a comprehensive statistical database for enterprises and regions did not allow us to include in the analysis all the necessary variables that emerged from the literature review. Next, we tested for normal distribution and homoscedasticity of the residuals (Figure 2).



(a) (b)

Figure 2 Graphic tests for normal distribution of the residuals of the model (a) and graphic test for heteroscedasticity (b)

The graphs obtained demonstrate that the distribution of the residuals of the model is close to normal (a slight deviation from normality in the right tail). For heteroscedasticity testing, the graphical test (Figures 8b) and the Breusch–Pagan (chi2=6.44; Prob> chi2=0.0112) test were performed, showing weak heteroscedasticity of the residuals. Some heteroscedasticity is characteristic of real economic data. It means that the obtained estimations of the coefficients of the model equation will all be non-displaced and linear, but their effectiveness is questionable. However, this insignificant heteroscedasticity can be ignored, as it does not substantially distort the analysis results. Using econometric analysis, we obtained a model of the dependence of the final variable from the factor variables. The function of the simple linear regression model takes the following form (formula 1):

$$OPZ_{it} = 54.04 + 2.24\bullet \ln GRP_{it} + 0.001\bullet SrZP_{it} + 0.6 \bullet \ln OOS_{it} - 0.62\bullet \ln CO2_{it} + 0.17\bullet RabVO_{it} + v_{it} \quad (1)$$

where I =1..10 is the number of the region, t=1…10 is the studied year, and v is the random error.

In order to determine the final form of the regression model, models with fixed and random effects were constructed. Using the Wald test, the Breusch–Pagan test and the Durbin–Wu–Hausman test, the three types of models were compared to each other. The results showed that the linear regression model with pooled data was the best model for this research. Thus, the analysis revealed the most significant corporate-level indicators that can impact life expectancy in the region. The indicator 'GRP' does not refer directly to the results of a particular company. However, its value is formed as a result of the activities of enterprises in the region. Thus, if the GRP grows by 1%, life expectancy will increase by 0.0224 years, all other things being equal. If the average salary grows by 1 dollar, life expectancy will increase by 0.001 years. If the environmental costs increase by 1%, life expectancy will grow by 0.006 years. If the number of employees with tertiary education increases by 1%, life expectancy will increase by 0.17 years. A 1% growth in CO_2 emissions will reduce life expectancy by 0.0062 years. Thus, the growth of all indicators except enterprise CO_2 emissions contributes to an increase in life expectancy. Regarding the abovementioned factors, companies can influence the level of SD both at the corporate and regional levels.

This study proposes observing the SD of territorial systems based on the influence of factors at the corporate level. The influence of some macro-level factors has already been considered, for example, GRP (Rotova, 2020) and CO_2 emission levels (Jafrin et al., 2021). At the same time, some factors were identified through which companies can influence the SD of territories. For example, in this study, the factor 'average salary in the enterprise' was considered; previously, scientists considered 'income level' as a factor reflecting the wealth of people (Hill et al., 2019). Since the level of emissions is typically considered a factor influencing the environmental aspect of SD, the factor 'current environmental costs of an enterprise', which was included in the final model in this study, shows that the environmental situation in the region can be influenced by the amount of money spent by large companies in the region on environmental protection activities. Education as an influencing factor on life expectancy in the region and, consequently, on its SD, was considered mainly based on the level of education of the population of the whole country. The authors considered the extent to which increased life expectancy is associated with structural changes in the population caused by an increase in the level of education (Luy et al., 2019). The significant factor 'proportion of employees with higher education in the enterprise' identified in our study allows us to consider the impact of the level of education on life expectancy at the corporate level.

5. Conclusions

The authors studied the relationship between the regional and corporate level of economic management and identified the main indicators that reflect the impact of a company's activities on the SD of the region in which it operates. As an indicator of the SD of the region, life expectancy was chosen as an indicator that equally depends on all three parameters (economic, social and environmental). By influencing the indicators included in the model, it is possible to increase the level of SD of the region. Econometric analysis of this relationship helped to identify the indicators that have the greatest impact on the development of the region, expressed in this study as life expectancy. These indicators include the level of GRP, average wages in the enterprise, environmental protection costs, emissions levels and the number of personnel with higher education. By influencing these factors, companies can impact the level of SD at both the corporate and regional levels. The results of this study show that when forming a strategy to achieve SD in individual territorial systems, the corporate factor should not be overlooked. The activities of large companies that affect the region in all three ways (economic, social and environmental parameters) should also be reformed. This study provides a basis for governing authorities to make progress in achieving the SDGs at the corporate level.

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