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***The influence of state regulation of education
for achieving the sustainable development goals:
case study of Central and Eastern European countries***

**Anna VORONTSOVA¹, Tetiana VASYLIEVA², Yuriy BILAN³,
Grzegorz OSTASZ⁴, Tetyana MAYBORODA⁵**

Abstract: Nowadays, we are becoming more and more convinced that the educational sphere cannot be underestimated and we do not pay enough attention to its development. After all, it is responsible for the formation of a well-developed and indifferent personality both in social and environmental problems, as well as qualified workers in accordance with the modern requirements of the world. In this context, optimal government regulation of education will contribute not only to economic growth and the acquisition of intellectual capital of the country, which will ensure its competitiveness and innovations, but also to balanced sustainable development, which is important on a planetary scale. This article is devoted to the analysis of the interrelation between indicators of state regulation of the education sector and the achievement of sustainable development goals. For this purpose, the method of integral indicators with elements of the method of principal components (for each sustainable development goal) was used, as well as regression models with fixed effects (to determine the presence and nature of the link between state regulation of the education and the goals of sustainable development). The basis for the study was the official data of 14 countries of Central and Eastern Europe for 2006-2016 years, which is presented as panel data. The obtained results made it possible to confirm the existence of such interrelation, where the most effective state instrument proved to be the state financing of the education sector.

Keywords: state regulation of education, sustainable development goals, state financing of education, Central and Eastern Europe countries.

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¹ PhD, Academic and Research Institute of Business Technologies “UAB”, Sumy State University, Sumy, Ukraine, email: a.vorontsova@uabs.sumdu.edu.ua

² Doctor of science, Prof., Oleg Balatskyi Academic and Research Institute of Finance, Economics and Management, Sumy State University, Sumy, Ukraine, email: tavasilyeva@fem.sumdu.edu.ua

³ Doctor of science, Prof., University of Social Sciences, Lodz, Poland, email: yuriy_bilan@yahoo.co.uk

⁴ Doctor of science, Prof., Faculty of Management, Rzeszów University of Technology, Rzeszów, Poland, email: gost@prz.edu.pl

⁵ PhD, Sumy State University, Sumy, Ukraine, t.majboroda@management.sumdu.edu.ua

Introduction

The education sector is an integral part of the country's national economy since it produces and forms such a resource as a qualified human capital, without which activity in any other sector is impossible. Besides, the right to get an education is one of the main human rights, approved at the international level in the Universal Declaration of Human Right and at the constitutional level of every observed country (Kubak et al., 2018). Considering such a global social and economic significance, the education sector was and remains one of the main economic spheres, the activity of which requires state intervention.

Nowadays, an essential vector of any country's development is to provide its sustainable development through implementation and adaptation of main ideas at the national level. In general, the sustainable development concept is based on the balancing of three key areas development: economic growth, social inclusion (Bayar et al., 2020; Androniceanu, 2019a) and environmental protection (Borocki et al., 2019). However, it is impossible to fulfil this task without the appropriate activities in the education sector. It determines the urgency of the selected topic, which consists in confirmation of the hypothesis regarding the link between education sector regulation and achievement of the sustainable development goals.

1. Literature review

The sustainable development conception was spread at the beginning of the 90s in XX century and firstly was officially used at the UNO conference in Rio de Janeiro, where "An Agenda For The 21st Century" (Agenda 21) was approved. Its formation was related to the people's understanding of the current limited resources, the economic development inefficiency and ecological problems aggravation that make the threat for the future (Androniceanu, 2019b). Later measures to extend the main postulates of the sustainable development conception and to implement the main ideas at the national level of the world countries were approved at the international community level. In this regard, the universal goals of sustainable development were investigated. At first, they were approved during 2000-2015 (8 goals), and then they were extended during 2016-2030 (17 goals), the main direction of which was oriented to the economic, social and ecological growth and the world countries' development.

The educational component is a meaningful constituent of the sustainable development conception, since it is distinguished not only as a global aim №4 but is widely observed among other indicators and tasks (Pryima et al., 2018; Kryk, 2016). At the beginning of the sustainable development conception introduction, much attention was paid to the environmental education, but soon its complex value was recognized at all levels of the sustainable development (Chapter 36, Agenda 21; Haseeb et al., 2019). It should be separately noted that within the framework of UNESCO, the global movement Education For All (EFA), which in

future was shown and included to the sustainable development goals (Center for Global Development, 2006), was parallel developed with the sustainable development conception. Education is an important component of the social sphere (Bondar & Paszkowski, 2019). It greatly defines the efficiency and quality at the state level, proved by studies of scientists, headed by Bilan Y. et al. (2019), Brychko & Semenog (2018), Vasilyeva T. et al. (2018) and Pauhofova et al., (2018). Education is also one of the macroeconomic stability factors, which is demonstrated in its turn through the global competitiveness and effects the economic growth respectively (Bilan (a, b, d, e) et al., 2019; Vasilyeva et al., 2019 and 2014; Pikhotskyi et al., 2018, Lyeonov et al., 2018, Palienco 2018, Abaas, 2018, Kolosok, 2015; Nicolescu et al., 2020; Rahman et al., 2019). It is equally important that education forms the innovative potential of the national economy in the country (Kolosok et al., 2018, Peresadko et al., 2014), creative industry (Bilan (c) et al., 2019) or industry 4.0 (Bilan Y. (f) et al., 2019, Kohnová et al., 2019) corporate social responsibility (Serhii et al., 2014; Androniceanu, 2019c). Based on the fact that this research was carried out among Central and Eastern Europe countries, different sides regarding the development of their economies (fiscal and tax system, banking and entrepreneurial activity sphere, investment position) in the context of relationship with educational, innovation sector also has to take place (Bercu et al., 2019; Grenääkovã et al., 2019; Raišienė et al., 2019; Bilan et al., 2018; Chygryn et al., 2018; Kolosok et al., 2018, Baburina et al., 2017; Androniceanu et al., 2020).

Due to the growing role of education in the modern world, more and more studies are being directed to the knowledge-economy sphere, which demonstrates its place change in the national economy and ecology system (Vaiciukevičiūtė et al., 2019, Skliar, 2018, Wierzbička, 2018, Smaliukienė et al., 2017, Vovk, 2017, Jikia et al., 2017, Balcerzak, 2016, Lyeonov & Liuta, 2016, Matošková, 2016, Marekha, 2016; Tamulevičienė & Androniceanu, 2020). In general, many works of the native and foreign scientists were devoted to the study of the relationship between separate indicators of the state policy in the education sector (Kowalska, 2016, Mazurek & Mielcová, 2019, Palascakova et al., 2019). In this case it is appropriate to research different modern instruments or forms of state policy, for example cooperation (Shvindina, 2019), public-private partnership (Zakharkin et al., 2019, Anatan, 2018), participatory financing (Petrushenko et al., 2017).

The most direct instrument of the state policy in the education sector is financing, the influence of which on the economic growth became the object for analysis in many scientific works (Pitoňáková, 2019, Rungsisawat et al., 2019, Guziejewska & Majdzińska, 2018, Kouassi, 2018, Golovchanskaya et al., 2018). The group of scientists, headed by Churchill S.A. (2017) investigated 29 studies about the relationship between government expenditure on education and economic growth. Besides they found a mostly positive relationship for developed countries and mostly statistically insignificant for less developed countries. The study of education financing peculiarities from the state and non-state sector (with the calculation of its necessary share) in OECD countries was studied by Vorontsova

A. (2018). It let to analyze the influence of the expenditure for education on the social and economic development indicators in Ukraine (Vasylieva, 2017), that revealed a direct impact on the country's economic development, reduction of the income distribution inequality, increase of employment and reduction of unemployment (with 5 years lag), the country's globalization and competitiveness level growth and on the tax payment by citizens. Hypotheses about the financial provision impact of the education sector on the decrease of corruption, crime level and migration in the country, have been rejected. Similar research regarding the impact of higher education on socio-economic performance and development was carried out by Volchik, V., Oganessian, A and Olejarz, T. (2018).

Other scientists (Benos, 2014, Mendy, 2018, Indiyati, 2018) focused their attention on the relationship of other indicators of the state education policy (enrolment rates, literacy rates, years of schooling) with economic development. Numerous works proved the positive influence of the education on reduction of poverty and growth of the income levels (Becker & Chiswick, 1966, De Gregorio & Jong-Wha, 2002, Bordean & Sonea, 2018), on the improvement of the health level (Lochner, 2011, Mattos, 2012), living standards improvement (Migala-Warchol, 2018), on social inclusion and public society development (Center for Global Development, 2006, Estes, 1995), global competitiveness (Kiselakova et al., 2018).

More complex studies regarding the relationship between education and sustainable development were also carried out (Didham, 2015, Bhandari, 2017, Gupta, 2017, Tvaronavičienė, 2018, Fomina et al., 2018, Kowo et al., 2019, Atkočiūnienė & Miroschnychenko, 2019). They were often limited by the level of the separate country (Malyarets et al., 2019, Mohanty & Dash, 2018, Dannenberg & Grapentin, 2016) or a community (Karnitis, 2017, Petrusenko et al. (2014).

2. Methodology of research

In order to investigate the nature of impact, made by the state regulation of education to achieve sustainable development goals, statistic data for 2006-2016 among 14 Central and Eastern Europe countries (Belarus, Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Slovakia, Slovenia, the Russian Federation, Ukraine) were selected. Their selection was caused by a number of common features in the historical and cultural development, geographical closeness and relative comparability of the statistic indicators. The current information is represented by means of the panel data, which have their own peculiarities in the analysis. In order to reveal the regression dependence during the panel data analysis, models with fixed or random effects are used. During the carried out comparison (Hausman test, comparison of results) a model with fixed effects was chosen. Thus, the equation will be as follows (Stock & Watson, 2007, Yevdokimov et al., 2018):

$$Y_{it} = \beta_1 X_{it} + \alpha_i + u_{it}, \quad (1)$$

where Y_{it} – the dependent variable, where i – entity, t – year;
 β_1 – a coefficient near X ;
 X_{it} – independent variable;
 α_i – the unknown intercept for each entity
 u_{it} – error term

It is necessary to select the indicators for the dependent variable, which describe the achievement level regarding certain goals of sustainable development. Although there are many works in this sphere, nowadays there is no methodology which will enable to follow the achievement of every goal among 17 approved ones in sustainable development. Besides, it was revealed that today, not all countries keep the statistical records of the detailed tasks and indicators within every goal. It greatly complicates the deep analysis to achieve the set landmarks and to form the integral evaluation for the comparison at the international level.

In this regard, in order to carry out our research, it was decided to develop own instruments of the integral expression of the global goals in the sustainable development at the level of the selected Central and Eastern Europe countries.

For that purpose, the statistic data massive of the World Bank, which has a separate base, called Sustainable Development Goals (SDGs), was used. Let us notice that indicators, shown there, may not totally comply with indices, given by the UNO to monitor the sustainable development, however, it is the closest and fullest at the world level.

According to some indicators the SDGs there was no statistic information that caused the necessity to exclude them from the study.

Thus, according to every SDG, the integral indicator was formed. It provided the following stages:

- 1) normalization of indicators;
- 2) identification of every component weight by the method of the principal-component factors (PCF);
- 3) calculation of the integral indicator.

At the first stage, the indicators were normalized. It distinguished stimulators (i.e. those, the increase of which will lead to the general index improvement by the goal) and destimulators (vice versa to the previous ones) and compared the initial data with the maximum and minimum value. For this purpose the following formulas are used (2 - 3):

– for indicators of stimulators:

$$\bar{y}_{ij} = \frac{y_{ij} - y_{\min}}{y_{\max} - y_{\min}}, \quad (2)$$

where \bar{y}_{ij} – a normalized i -indicator in j -year;
 y_{ij} – i -indicator in j -year;
 y_{min} – minimum i -indicator by all years;
 y_{max} – maximum i -indicator by all years.

– for indicators of destimulators:

$$\bar{y}_{ij} = \frac{y_{max} - y_{ij}}{y_{max} - y_{min}}, \quad (3)$$

As a result, all indicators take values from 0 to 1 and are completely comparable between each other for further stages in calculations.

Then the normalized data are analyzed by the method of principle-component factors (PCF), carried out automatically in STATA 11.1. As a result, the optimal number of factors (cumulative dispersion of which is not less than 75-85%) is defined. Kaiser criterion, as well as scree plot, were used to confirm the results.

3. Empirical results

Let us show the results of PCF implementation to obtain the integral indicator by the SDG№2, which has only three indices (cereal yield (kg per hectare), the prevalence of anaemia among women of reproductive age (% of women ages 15-49), the prevalence of undernourishment (% of the population)) in Table 1.

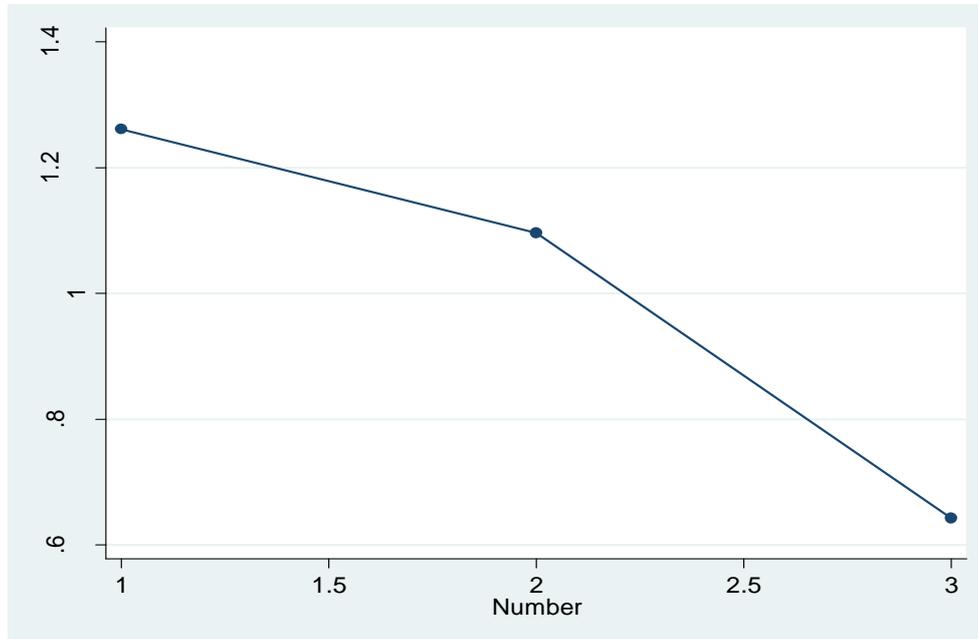
Table 1. Intermediate results of calculations PCF by SDG№2

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.26069	0.16419	0.4202	0.4202
Factor2	1.09649	0.45367	0.3655	0.7857
Factor3	0.64282	.	0.2143	1.0000
Factor loadings (pattern matrix) and unique variances				
Variable	Factor1	Factor2	Uniqueness	
var1	0.8474	0.1126	0.2692	
var2	0.6482	-0.6046	0.2143	
var3	0.3499	0.8475	0.1593	

(Source: Authors' calculations)

As we can see from the above table, two factors, which had a cumulative dispersion of 78.57%, comply with our conditions. In order to confirm our decision, let us give the scree plot graphic in Fig. 1. As we can see, the highest delay point of own indices falling down is at the level of 2, that confirms our conclusions.

Figure 1. Scree plot of eigenvalues after factor



(Source: Authors' calculations)

PCF also let to obtain the factor load of every variable in the selected factors, which is formed depending on their correlation and dispersion share. Within our study, we choose values which exceed 0.6-0.7. The selected factor loads are used to calculate the weight of every variable. For this purpose the following formula (4) is used:

$$w_i = \frac{f_i * d_k}{\sum_k f_i * d_k}, \quad (4)$$

where w_k – weight of i -indicator;
 f_k – factor load of i -indicator;
 d_k – share of general dispersion of k -factor.

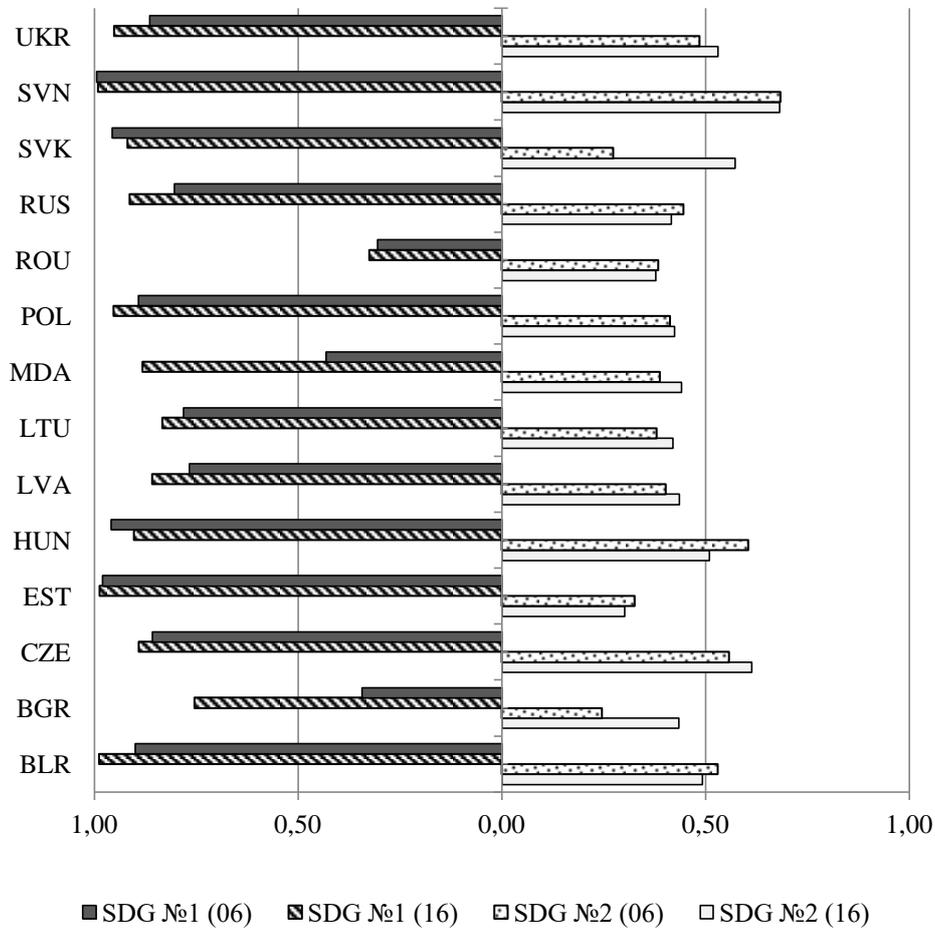
The integrated indicator, which describes SDGPN₂, will be calculated by the following formula (5), which provides the weighing of the normalized data for the calculated weight for them:

$$I_{lm} = \sum \bar{y}_{ij} * w_i, \quad (5)$$

where I_{lm} – integral indicator, which describes the labour market state during j -year.

As a result, the following integral indicators on SDGN $\text{\textcircled{2}}$ were obtained for the selected countries, which we will compare with SDGN $\text{\textcircled{1}}$ for 2006 and 2016.

Figure 2. Comparison of the integral indicators regarding the SDGN $\text{\textcircled{1}}$ and SDGN $\text{\textcircled{2}}$ for 2006 and 2016 in some countries of Central and Eastern Europe



(Source: Authors' calculations)

As we can see there is another dynamic to achieve the sustainable development goals in the selected countries by these two goals. In general, the integral indicators by SDG№1 to prevent poverty were slightly increased. It was caused by the crisis phenomena in the economy of these countries. According to SDG№2, the indicator is improved in most countries, and it solved the problem of poverty and agricultural development.

The similar calculations were carried out for all other SDGs (integrated indicators for 2016 are given in Figure 3). Thus, massive of dependent variables were formed – Y.

Analyzing the above diagrams, one can say that sustainable development goals are achieved at different levels. The lowest indicators have goals 17 (to establish the partnership), 9 (industry, innovations, and infrastructure), 15 (to protect and to restore the land ecosystem), 11 (sustainable development of cities and communities) and 5 (gender equity). Let us mention that the Russian Federation is essentially distinguished by these goals. It is caused by the fact that they include indicators, which are measured in the natural units, and this country has a huge area.

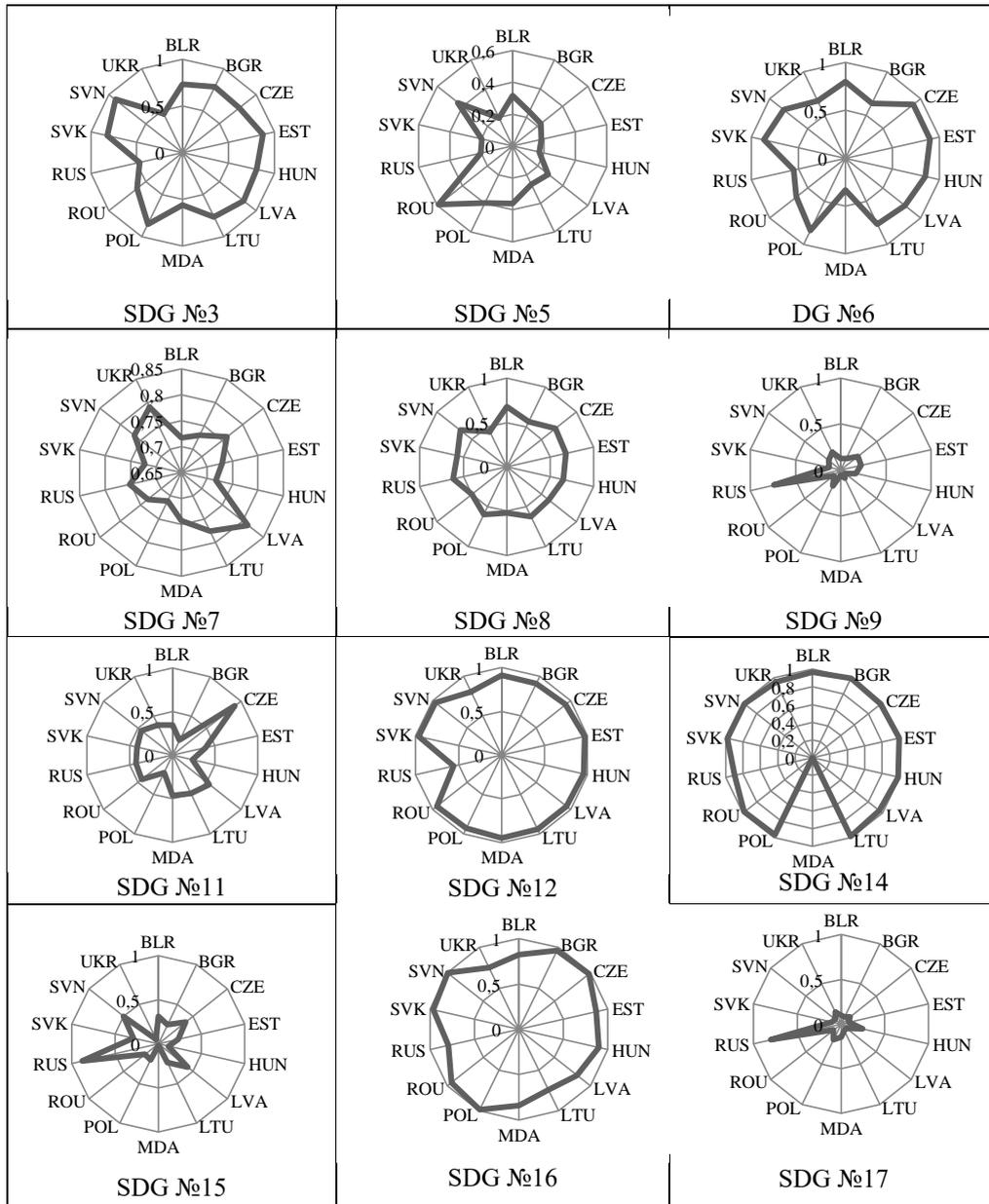
We propose to use separate indicators, which describe the state regulation of the education sector in this or that country, as independent variables (X). Based on the general theoretical facts about education policy, its state regulation main areas include the formation of:

- a general strategy of the country’s education sector development and its operational tasks and directions;
- the only legal field, which complies with the international standards and lets to achieve the fixed goal at various levels;
- the effective and modern infrastructure of the education sector, considered as a net of the educational providers to perform the educational activities;
- a system of the staffing support for the education sector,
- a financial provision system of the education sector.

The most general indicators, which describe the education policy of this or that country are the duration of compulsory education (years) and gross enrolment ratio from primary to tertiary (%).

In order to analyze the staffing support of the state regulation in the education sector, one proposed to use such indicators as the student-teacher ratio at different education levels (pre-primary, primary, secondary and tertiary education), which shows in average how many students are given to one lecturer. The most direct method of the state regulation in the education sector is its financial provision, which is proposed to be used by means of the following indicators – government expenditure on education (PPP\$, millions).

Figure 3. Integral indicators by SDGs for 2016



(Source: Authors' calculations)

First of all, we propose to investigate the selected indicators with the help of the Descriptive statistics module (Table 2).

Table 2. Descriptive statistics for the set of independent variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
x1	84	18258.56	32012.14	857.67	139931.90
x2	84	9.88	1.12	9.00	13.00
x3	84	89.14	8.03	69.00	100.43
x4	84	11.59	3.53	5.67	19.30
x5	84	14.85	3.00	9.32	20.62
x6	84	9.84	1.77	6.72	13.23
x7	84	15.52	5.19	8.38	33.06

where x1 – government expenditure on education, PPP\$ (millions); x2 – compulsory education, duration (years); x3 – gross enrolment ratio, primary and secondary, both sexes (%); x4 – student-teacher ratio in pre-primary education (headcount basis); x5 – student-teacher ratio in primary education (headcount basis); x6 – student-teacher ratio in secondary education (headcount basis); x7 – student-teacher ratio in tertiary education (headcount basis)

(Source: Authors' calculations)

Based on the initial and obtained data, we can define that the Russian Federation had more expenditure for education in absolute terms (although in the percentage terms its share varies within 4% as % from GDP). Moldova had the lowest share for education in the absolute terms (although its share from GDP was 7-8%). People, who study, have to spend from 9 years (Bulgaria, Belarus, Estonia Lithuania, Moldova, Slovenia for 2016) to 13 years in Hungary for education. Gross enrolment ratio also varies, its lowest value was observed in Moldova in 2010 (68.99%), which slightly increased to 70.41% in 2016; the highest – Belarus. The student-teacher ratio at different levels also varies and it influences the education process quality in a certain way. The lowest values were in Estonia (2010) in the pre-school education, Poland (2010) in the primary education, Ukraine (2010) in the secondary education and Estonia (2012) in the higher education.

Having analyzed the incoming data let us start the regression analysis, the aim of which consists in the detecting of dependencies between separate indicators of the state regulation in the education sector and sustainable development goals. Let us notice that the 4th goal forms the state regulation of education. That is why it as excluded from the research.

As a result of the single-factor regression dependencies construction, it was found that government funding has the most significant influence on the sustainable development goals achievement. According to the obtained results, the direct essential link with the following goals was proved (Table 3):

- Goal 6. To ensure availability and sustainable management of water and sanitation for all (Y6);
- Goal 8. To promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (Y8);
- Goal 9. To build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (Y9);
- Goal 12. To ensure sustainable consumption and production patterns (Y12);
- Goal 14. To conserve and sustainably to use the oceans, seas and marine resources for sustainable development (Y14);
- Goal 16. To promote peaceful and inclusive societies for sustainable development, to provide access to justice for all and build effective, accountable and inclusive institutions at all levels (Y16);
- Goal 17. To strengthen the means of implementation and to revitalize the Global Partnership for Sustainable Development (Y17).

**Table 3. Results of the regression analysis by the indicator x1
(government expenditure on education)**

Variable	Coefficient of x	Standard error	t	P> t 	R-sq
Y6	0.380	0.093	4.070	0.000	0.593
Y8	0.523	0.201	2.600	0.011	0.521
Y9	0.251	0.049	5.140	0.000	0.844
Y12	0.452	0.099	4.580	0.000	0.785
Y14	0.499	0.045	11.180	0.000	0.936
Y16	0.498	0.185	2.680	0.009	0.521
Y17	0.169	0.063	2.670	0.010	0.897

(Source: Authors' calculations)

As for the other indicators of the state regulation of education, distinguished by us earlier, the weak and relevant link with the following directions was proved (Table 4):

Table 4. Confirmed adequate relationships according to the results of the regression analysis

Indicator (independent variable)	SDGs (dependent variables)
Gross enrolment ratio from primary to tertiary (%).	Goal 2. To end hunger, to achieve food security and improved nutrition and to promote sustainable agriculture Goal 3. To ensure healthy lives and to promote well-being for all at all ages Goal 6. To ensure availability and sustainable management of water and sanitation for all Goal 8. To promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all Goal 12. To ensure sustainable consumption and production patterns Goal 14. To conserve and sustainably use the oceans, seas and marine resources for sustainable development Goal 16. To promote peaceful and inclusive societies for sustainable development, to provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Student – teacher ratio in pre-primary education	Goal 1. To end poverty in all its forms everywhere Goal 16. To promote peaceful and inclusive societies for sustainable development, to provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Student – teacher ratio in primary education	Goal 9. To build resilient infrastructure, to promote inclusive and sustainable industrialization and foster innovation Goal 14. To conserve and sustainably use the oceans, seas and marine resources for sustainable development Goal 16. To promote peaceful and inclusive societies for sustainable development, to provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Student – teacher ratio in secondary education	Goal 6. To ensure availability and sustainable management of water and sanitation for all Goal 7. To ensure access to affordable, reliable, sustainable and modern energy for all Goal 15. To protect, restore and to promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Indicator (independent variable)	SDGs (dependent variables)
Student – teacher ratio in tertiary education	Goal 2. To end hunger, achieve food security and improved nutrition and promote sustainable agriculture Goal 3. To ensure healthy lives and promote well-being for all at all ages Goal 6. To ensure availability and sustainable management of water and sanitation for all Goal 8. To promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all Goal 12. To ensure sustainable consumption and production patterns Goal 15. To protect, restore and to promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Duration of compulsory education	Goal 8. To promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

(Source: Authors' calculations)

4. Conclusions

Concluding the above research, one can confirm that the state activities in the education sector have a great influence on the achievement of sustainable development goals. It is caused not only by the fact that the goal №4 is “to provide inclusive and fair qualitative education and to encourage the opportunities to study during the whole life for everybody”, but also by understanding that only high educated nation will be able to have a rational lifestyle, which will promote the economic, ecological and social prosperity and development.

The empiric results of the carried out research additionally confirm it. They prove that the most effective instrument within the state regulating tools for the education sector is its funding, which helps to achieve the countries' economic (goal 8, goal 9, goal 12), ecological (goal 6, goal 14) and social (goal 16, goal 17) development. Less effective instruments and those which have the impact on the achievement of sustainable development goals are such tools, which are usually prescribed within the current education policy: gross enrolment ratio, duration of compulsory education ra student-teacher ratio.

Authors Contributions

The authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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