Underachievement in education, children at risk of poverty and social expenditures of local budgets: Empirical analysis of the EU countries

Jurij Klapkiv
University of Lodz
ORCID: 0000-0002-9771-5357,e-mail: jurij.klapkiv@uni.lodz.pl

Bohdan Malyniak
PhD (Economics), Associate Professor, West Ukrainian National Economic University
ORCID: 0000-0001-6965-393X, e-mail: b.malyniak@wunu.edu.ua

Olesia Martyniuk
West Ukrainian National Economic University
ORCID: 0000-0002-8931-991X, e-mail: o.martyniuk@wunu.edu.ua

DOI: 10.14595/CP/02/025

Abstract: The implementation of important sustainable development goals is closely linked to budget-financed provision of public goods. Numerous scientific studies prove the importance of quality education for the development of up-to-date competences and encouragement of a frugal attitude towards natural environment. This is the reason why the level of underachievement in reading, maths or science is included in the system of indicators used to assess the progress made in the attainment of sustainable development goals. The acquisition of education is a multi-faceted complex process, which is affected by a range of social factors. The unassailable fact is that low level of household well-being produces a negative impact on the capabilities of children to acquire proper education.

The goal of this study is to reveal the nature of the relationship between the level of underachievement in reading, maths or science and the percentage of children at risk of poverty or social exclusion, on the one hand, and social expenditures of budgets, on the other. Thus, by applying panel data analysis on a set of empirical data for 28 countries of the European Union over the period from 2007 to 2018, we studied the impact of budget expenditures, including expenditures of local budgets on pre-primary and primary education, secondary education and social protection of families with children, on the outcome variables. The findings revealed that larger expenditures on secondary education allocated from both local budgets (the coefficient of dependence equal to (–4.87)) and state and regional budgets (the coefficients of dependence equal to (–3.34)) produce an inverse impact on the level of underachievement in reading, maths or science. Besides, we find that the level of underachievement in reading, maths or science decreases as a result of increases in local budget expenditures on pre-primary and primary education (the coefficient of dependence equal to (–2.11)) and increases in local budget expenditures on social protection of families and children (–1.9). The study also finds support for the inverse impact of local budget expenditures on social protection of families and children (the coefficient of dependence equal to (–4.38)) and pre-primary and primary education (the coefficient of dependence equal to (–2.16)) on the percentage of children at risk of poverty or social exclusion. The findings of this research can be used for planning and implementing measures aimed at the realization of SDG objectives, as well as for modelling effective budget policies.

Key words: local budgets, budget expenditures, budget expenditures on education, budget expenditures on social protection, underachievement in education, risk of poverty, risk of social exclusion.

JEL: H72; H75; C13; I21; D30.

Introduction

In searching for ways to produce goods and improve people's well-being, human activities often give rise to many risks. Recent research testifies to aggravation of such problems in the environmental sphere, in particular. The Global Risks Perception Survey 2020 identifies the following major groups of risk by likelihood of occurrence: 1) extreme weather; 2) climate action failure; 3) human environmental damage; 4) infectious diseases; 5) biodiversity loss; 6) digital power concentration; and 7) digital inequality [World Economic Forum 2021]. Comprehension of the nature of global problems and understanding of the logical connections between existing risks and consequences of human activity encourage the mankind to undertake coordinated measures in order to remedy the situation. As a result, the paradigm of sustainable development emerged as a blueprint for achieving a better and more sustainable future for all of us.

In September 2015, the UN General Assembly approved a new Agenda for Sustainable Development. This document outlines 17 Sustainable Development Goals and 169 targets which are to be achieved [Resolution 2015]. In particular, the document assigns an important role to assurance of quality education at all levels and of social well-being. These specific spheres fall within competencies of local self-governments. Thus, now local budgets are not only being considered as a means for community development, but also serve as a key lever in achieving major goals of assuring sustainable development.

Theoretical premises

Aggravation of the global threats, which create powerful challenges for mankind, could not have escaped the interest of leading researchers. The issue of the significance of education for the achievement of Sustainable Development Goals (SDGs) by different societies has been actively discussed in scientific literature. R. J. Didham and P. Ofei-Manu suggest that integrating main SDG concepts into the study process could help citizens better comprehend global problems [Didham & Ofei-Manu, 2015]. In the same context, C. Buckler and H. Creech conclude that education enhances the sense of responsibility among individuals as global citizens and helps them to prepare better for the world that they will inherit [Buckler & H. Creech, 2014]. A recent study titled "Decade of Education for Sustainable Development (2005-2014)" performed by UNESCO, the world's leading international organization in the

sphere of education, shows that governments of many countries incorporate Sustainable Development Goals into the education process in order to prepare their citizens to address the problems of sustainability in the years to come. The findings of the empirical investigation carried out in 18 countries also corroborate the existence of a positive relationship between the inclusion of SDG concepts into the study process and the quality of education [Laurie, Nonoyama-Tarumi, McKeown & Hopkins, 2016]. In view of the positive impact of education on mitigation of adverse climatic changes and improvement of overall human behaviour, it has become one of the main SDG objectives to ensure inclusive and fair high-quality education, as well as to create opportunities for life-long learning for all [Rieckmann, Mindt & Gardiner, 2017]. E. Striessnig, W. Lutz and A. G. Patt place special emphasis on the positive effects of investments into primary and secondary education for overcoming the existing global insecurities [Striessnig, Lutz & Patt, 2013]. The understanding of the significance of primary and secondary education for SDGs resulted in that many primary and secondary schools around the world have been implementing a broad and diverse set of initiatives on sustainable development education since 2005, whereas the scope, volume and depth of sustainable development issues covered in school curricula have significantly grown [Buckler & Creech, 2013; Benavot, 2014]. P. Ofei-Manu and R. J. Didham substantiate that in order to solve the systemic objectives of sustainable development, more attention will have to be paid to accessibility of education and quality of education services in the future [Ofei-Manu & Didham, 2014]. The performed research corroborates the positive role of education in realizing the tasks of sustainable development and casts light onto the mechanism of such impact, which consists in the ability of high-quality education to change human activity so that people pay more respect to natural environment.

Usually, the nature of any social phenomenon can hardly be explained by the influence of only one factor. Thus, it is no surprise that such a complex social property of people as education depends on a broad spectrum of various factors. However, the fact that there is a complicated system of linkages between the level of an individual's education and other factors does not mean that the results of schooling do not depend on the quality of education services and their accessibility for every child. These are the main objectives of public education provided at the expense of budget funds.

Thus, scientists often link the overall level of education in a society to operational efficiency of its public education system. This is particularly important in the context

of realizing SDG objectives because a significant share of acquired competences in the modern education systems is necessary for production of global public goods, not only for generation of private benefits. B. Tessa, P. John and G. Stoker point to the existence of positive consequences of government initiatives aimed at achieving progress in education. However, they also admit that the cause and effect relationships are often rather complex [Tessa, John & Stoker, 2006]. The empirical study of children's school achievement carried out by S., Habibullah and J., Ashraf determined that higher academic achievement depends on better school conditions [Habibullah & Ashraf, 2013]. An empirical study performed by E. Striessnig, W. Lutz and A. G. Patt based on data for 125 countries supports the thesis that investments into general primary and secondary education are the world's most effective strategy of preparation for resolving uncertain threats of future climate changes [Striessnig, Lutz & Patt, 2013] and the quality of education has an impact on the environment [Koziuk, et al., 2019]. R. J. Didham and P. Ofei-Manu corroborate the positive impact of high-quality education on realization of SDGs, paying attention to positive effects of integration between the measures aimed at education development for purposes of realising SDG [Didham & Ofei-Manu, 2015] and other sustainable development objectives [Glonti et al., 2020]. When comparing the effectiveness of adaptation investments into education and physical infrastructure for increasing the adaptive capacity of countries to climate change, W. Lutz, R. Muttarak and E. Striessnig assert that adaptation investments into education can be more effective, especially in situations when the consequences of climate change remain highly uncertain [Lutz, Muttarak & Striessnig, 2014]. Their findings point to the dependency between the quality of education and school conditions. Scientific research also proves the direct positive impact of investment in education upon the success of SDG objectives. Thus, it is possible to trace a link between the volume of resources invested into the education sphere and quality of education and the achievements in realising SDG objectives. Among the potential sources of education financing, scientists place emphasis on the importance of budget resources of local governments. I. de C. Filho and S. Litschig proved that an increase in transfers to local governments in Brazil produced a long-term increase in the level of literacy and education among children of school age [Filho & Litschig, 2020].

Student achievement in education is often associated with the social stance of the families raising them. R. Cassen and G. Kingdon conclude in their study that student underachievement is caused by a set of factors related primarily to social characteristics

of the students and their families. The researchers found that achievement in school was negatively affected by being male students, having special education needs, and/or having low well-being and receiving social support by their families [Cassen & Kingdon, 2007]. F. Demie further elaborates on the impact of social factors on student achievement. Based on the example of migrant schooling in England, the researcher found support for the impact of economic well-being on students' academic achievement [Demie, 2019]. B. P. Ackerman, E. D. Brown and C. E. Izard point to the existence of a link between the level of academic achievement and the level of students' poverty placing emphasis on the complex nature of such relationship [Ackerman, Brown & Izard, 2004]. A. Nyangarika and Z. J. Ngasa develop convincing arguments with respect to the relationship between the level of underachievement in school and the children's stay in orphanages, as well as the influence of a range of social and demographic factors [Nyangarika & Ngasa, 2020]. Therefore, social support of families with children is instrumental for attaining better results in education. It is also important to emphasize that social support of families with children not only contributes to attainment of better results in education, but also realizes another main function – protection of households with children from poverty.

The provision of quality education and minimization of child poverty risks represent an urgent task for governments in the context of attaining SDGs. Financial aspects play a significant role in the realization of these tasks. L. Boeskens, G. Lima, D. Nusche, T. Radinger and C. Shewbridge arrived at a conclusion that a well thought-out policy of school financing is critical for achieving the objectives of assuring equitable and effective quality education in schools [Boeskens et al., 2017]. The scientists explain that this dependence exists because the financing of education plays a key role in the allocation of resources. For many years now, the conclusions drawn by G. Psacharopoulos remain convincing with respect to the fact that among all education levels, primary education generates the largest benefits and plays a major role in forming the overall education level [Psacharopoulos, 1973]. In developed countries, the key role in education financing is played by local budgets. Under the influence of decentralization processes, the bodies of local self-government usually act as intermediaries that distribute central budget financing among schools, as well as use their own revenues to increase the amount of financing available [Boeskens, Lima, Nusche, Radinger & Shewbridge, 2017]. By providing public goods at the expense of local budgets, local governments assure the attainment of sustainable development goals.

Thus, scientific literature corroborates the positive impact of education on the attainment of sustainable development goals. Moreover, it has been found that the level of education among individuals depends, in particular, on the well-being of households. The process of decentralization in public finance resulted in the assignment of authority for provision of education and social support of family and children to local governments. Therefore, scientific research substantiates the logical implications of social budget expenditures for realization of sustainable development goals. However, we have not found any studies that would cast light onto the dependence between the underachievement in education, children at risk of poverty and social exclusion and the social expenditures of local budgets.

Methodology

The level of underachievement in education depends on the availability of equal access to high-quality education in the country, in particular pre-primary, primary and secondary education, which is ensured by allocation of certain amounts of budget financing. Budget-financed measures of social support provided to children and families lead to reduction in the level of underachievement in education. Larger opportunities with respect to providing equal access to pre-primary, primary and secondary education, as well as family and child support, are important for realizing yet another objective of sustainable development – reduction of child poverty. In what concerns the realization of sustainable development goals, local budget expenditures play the largest role within the system of budget spending on pre-primary, primary and secondary education, and support for children and families.

The subjects of the study include 28 countries, with data on different factors for each of the countries shown in Table 1. In cases when no data is available, the mean arithmetic value of the previous value and the subsequent value of the property in the sample is used. The time period under study covers the years from 2008 to 2018.

Table 1. Description of input data

Variable	Economic meaning	Unit
ChRPSEx	Children at risk of poverty or social exclusion	Percentage of gross domestic product
UrSt	Underachievement in reading, maths or science	Percentage of total population in the same age group
LBPPEd	Local budgets expenditure on pre-primary and primary education	Percentage of gross domestic product
OBPPEd	Other budgets expenditure on pre-primary and primary education	Percentage of gross domestic product
LBSEd	Local budgets expenditure on secondary education	Percentage of gross domestic product
OBSEd	Other budgets expenditure on secondary education	Percentage of gross domestic product
LBFC	Local budgets expenditure on social protection of family and children	Percentage of gross domestic product
OBFC	Other budgets expenditure on social protection of family and children	Percentage of gross domestic product

Source: own work

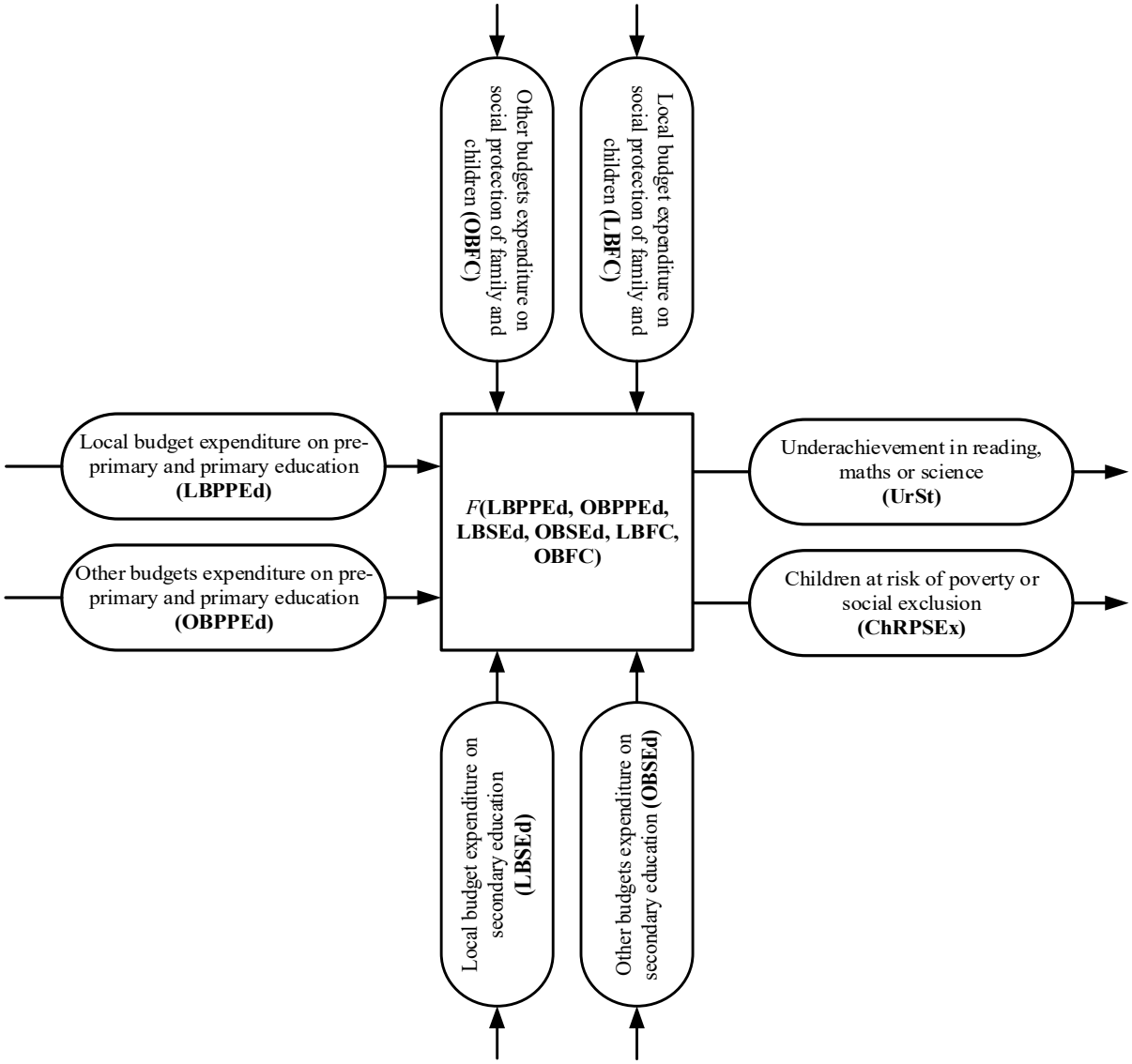
In order to reach the goal of the article, we used the data of the European Statistical Office on SDG attainment and the data on budget expenditures. As outcome indicators, we used the data on the level of underachievement in reading, maths or science and the data on the percentage of children at risk of poverty or social exclusion. The data on underachievement in reading, maths or science measures the share of 15-year-old students failing to reach level 2 ('basic skills level') on the PISA scale for the three core school subjects of reading, mathematics and science. The data stems from the Programme for International Student Assessment (PISA), which is a triennial international survey aiming to evaluate education systems by testing the skills and knowledge of 15-year-old students [Underachievement]. The percentage of children at risk of poverty or social exclusion is defined as the sum of children (0-17) who are at-risk-of-poverty or severely materially deprived or living in (quasi-)jobless households (i.e. households with very low work intensity (below 20%)) as a share of the total population in the same age group [Children].

As factor indicators for purposes of this study we have chosen the shares of expenditures on primary and secondary education in GDP, in particular the expenditure on pre-primary level of education (ISCED 0 – Initial stage of organised instruction, designed primarily to introduce very young children to a school-type environment) and primary level of

education (ISCED 1 – Programmes normally designed to give students a sound basic education in reading, writing and mathematics) [Manual 2019]. Budget expenditures on secondary education comprise expenditures on the lower secondary level of education (ISCED 2 – The lower secondary level of education generally continues the basic programmes of the primary level, although teaching is typically more subject-focused, often employing more specialised teachers who conduct classes in their field of specialisation) and the upper secondary level of education (ISCED 3 – The final stage of secondary education in most countries. Instruction is often more organised along subject-matter lines than at ISCED level 2 and teachers typically need to have a higher level, or more subject-specific, qualification that at ISCED 2. There are substantial differences in the typical duration of ISCED 3 programmes both across and between countries, typically ranging from 2 to 5 years of schooling) [Manual 2019]. Budget expenditures on "Family and children" include the following: the provision of social protection in the form of cash benefits and benefits in kind to households with dependent children; administration, operation or support of such social protection schemes; cash benefits, such as maternity allowances, birth grants, parental leave benefits, family or child allowances, other periodic or lump-sum payments to support households and help them meet the costs of specific needs (for example, those of the lone parent families or families with handicapped children); benefits in kind, such as shelter and board provided to pre-school children during the day or part of the day, financial assistance towards payment of a nurse to look after children during the day, shelter and board provided to children and families on a permanent basis (orphanages, foster families, etc.), goods and services provided at home to children or to those who care for them, miscellaneous services and goods provided to families, young people or children (holiday and leisure centres) [Manual 2019].

The goal of this study is to determine the influence of all factors, as well as to analyse the contribution of each factor separately. This analysis will enable us to determine the significance of different factors for explaining the differences in the levels of underachievement in reading, maths or science and children at risk of poverty or social exclusion in different countries.

Figure 1. *The scheme of modelling the influence of social and economic factors of budget expenditures at different levels on the level of poverty risk*



Source: own work

The question of studying the influence of social and economic factors on the risk of poverty and underachievement in different countries is rather complex. Such important problems cannot be solved simply by describing the observed regularities. Econometric studies, which perform analysis of cross-sectional and time series data separately, can only describe the average behaviour of subjects. Such models often turn out insufficient for the study of economic phenomena. This problem can be avoided and factor heterogeneity can be studied by using panel data, which represents extended cross-sectional datasets, where each

separate subject is observed over a certain period of time. Panel datasets include both cross-sectional and longitudinal data, thus combining the advantages of both types of data.

Results

The descriptive statistics for variables in Table 2 shows that the distribution of variables is somewhat different from normal; some asymmetry is present – the values of the median and the mean are different, while asymmetry coefficients have non-zero values.

Table 2. Descriptive properties of variables used in this study

Indicators	Response variables		Factor variables					
	UrSt	ChRPSEx	LBPPEd	OBPPEd	LBSEd	OBSEd	LBFC	OBFC
Mean	23.84	26.29	1.13	0.57	0.84	0.92	0.51	1.37
Median	21.95	24.7	0.86	0.1	0.9	0.9	0.19	1.3
Minimum	6	11.9	0	0	0	0	0	0.2
Maximum	53.4	52.5	4.29	2.1	2.7	2.4	4.62	3.6
Std. Deviation	9.68	9.15	0.97	0.65	0.68	0.76	0.85	0.71
Coefficient of variation	0.41	0.35	0.86	1.15	0.81	0.82	1.66	0.51
Asymmetry	1.08	0.78	0.93	0.73	0.35	0.23	2.9	0.71
Excess kurtosis	1.01	0.32	0.36	–0.99	–0.92	–1.46	8.65	0.26

Source: based on data by Eurostat: https://ec.europa.eu/eurostat/data/database

The analysis of the properties in Table 2 shows that the indicators of local budget expenditures on secondary education (LBSEd), local budget expenditures on primary education (LBPPEd), expenditures of other budgets, which include the state budget and regional budgets, on social protection of family and children (OBFC), and expenditures of other budgets (state and regional budgets) on secondary education (OBSEd) have the largest mean values.

Panel data represents a two-dimensional dataset, in which one dimension is cross-sectional, featuring, in our case, countries ($1 < i < 28$), whereas the other one is longitudinal, covering a time period of eleven years ($2008 < t < 2018$). Thus, panel data has a double subscript (i, t).

A general fixed effects panel data model is expressed as an equation:

$$Y_{it} = \alpha_i + \beta X_{it} + u_{it},$$

where α_i denotes the individual-specific effect observed for subject *i*, β is the coefficient of the vector of common factor variables X_{it} observed for cross-sectional subject *i* over period *t*, errors u_{it} are independent and identically distributed random values (across countries and across time).

Fixed effects models allow to eliminate the impact of unobserved variables and to obtain unbiased estimates of the parameters, thence effects α_i represent fixed unobservable parameters of the model.

In our case, it would be feasible to use the fixed effects panel data model, since the entities under study are countries featuring individual attributes but assigned to the "same type", which means they cannot be considered random.

Analysis of the dependence between the level of student underachievement in reading, maths or science and the social expenditures of local budgets

The above-described approach was used to investigate the impact of selected variables on the level of underachievement in reading, maths or science. The study is based on the data for 28 cross-sectional subjects (countries) over 6 time periods (years 2003, 2006, 2009, 2012, 2015, and 2018). Model 1 (Table 3) indicates that the impact on response variable produced by expenditures from different types of budgets is inverse in nature, which means that the level of underachievement decreases when these budget expenditures increase.

Table 3. Model 1 "The relationship between the level of underachievement in reading, maths or science (UrSt) and factor variables" (weighted least squares method), R^2 =0.652

Variables	Coefficient	Std. deviation	*t*-Statistics	*p*-Value
Const	33.02	1.99	16.54	1.54e–08 ***
LBPPEd	–2.11	0.62	–3.38	0.009***
OBPPEd	0.57	1.22	0.46	0.63
LBSEd	–4.87	0.78	–6.26	3.28e–09 ***
OBSEd	–3.34	0.79	–4.23	3.92e–05 ***
LBFC	−1.6	0.41	–3.68	0.002 ***
OBFC	–0.09	0.53	–0.18	0.85

*Note: *** - the level of confidence for model parameters is at 99% level.*

Source: based on data by Eurostat: https://ec.europa.eu/eurostat/data/database

Based on the developed model (Table 3), we can now construct an equation describing the relationship between the level of underachievement in reading, maths or science and the amount of financing allocated to primary and secondary education and social support for families and children. It should be noted that in this equation, variables OBPPEd are OBFC are excluded due to their statistical insignificance and immaterial influence on the response variable:

$$UrSt = 33.02 - 2.11 \cdot LBPPEd - 4.87 \cdot LBSEd - 3.34 \cdot OBSEd - 1.9\, LBFC \quad (1)$$

Model (1) indicates that factor variables produced an inverse effect on the dependent variable (*UrSt*), which explains its decrease when respective budget expenditures increase. The findings of the study corroborate the hypothesis that larger budget expenditures on pre-primary and primary education and expenditures on secondary education lead to a reduction in underachievement in reading, maths or science. In view of the nature of the study process, a larger impact on underachievement in reading, maths or science is produced by budget expenditures on secondary education. Thus, the coefficient of the impact of local budget expenditures on secondary education (LBSEd) is the highest, equalling (-4.87), whereas that of the respective expenditures of other budgets (OBSEd) is (-3.34). A noticeable effect on the reduction in underachievement in reading, maths or science is also produced by budget expenditures on pre-primary and primary education. At that, it is necessary to pinpoint that the inverse effect on underachievement in reading, maths or science (which equals (-2.11)) is produced only by local budget expenditures on pre-primary and primary education (LBPPEd). This can be explained by the efficiency of local government spending and its better adaptability to customer needs. Such results generally support the conclusions drawn by R. Cassen and G. Kingdon that poor achievement in primary school usually becomes an important driver of underachievement in further study [Cassen & Kingdon, 2007].

In result of testing the hypothesis that larger budget expenditures on social support to families and children produce an additional impact on the reduction in the level of underachievement in reading, maths or science, we have found that such impact is quite noticeable. However, the statistically significant dependence of the level of underachievement in reading, math or science is only observed for expenditures of local budgets on social support to families with children (LBFC), which is reflected in the value of the coefficient (-1.9). At that, the statistically significant impact of similar expenditures from other types of budgets on the response variable is absent. This allows us to underscore that

for the reduction of underachievement in reading, maths or science, it is not only the impact of budget expenditures on secondary education that is highly significant, but also local budget expenditures on pre-primary and primary education and social support to families with children.

It should be noted that the factors under study explain only 65% of the level of underachievement in reading, maths or science. However, this, in our opinion, can be considered as rather high level of impact since the process of knowledge absorption is subject to influence of not only the amounts of expenditures from different budgets allocated to primary and secondary education and social support to families and children, but other variables as well, such as, for example, social and psychological factors that can rarely be measured quantitatively. As for the researched model, we can assert that nearly 30% of the level of underachievement in reading, maths or science is caused by non-financial indicators. Since the constant indicates the value of response variable when factor variables equal zero, we can assume, based on Model 1, that nearly 33% of the level of underachievement in education is preconditioned by certain starting conditions, such as social, psychological and other unobserved factors mentioned previously.

However, public expenditures in various countries over different years can differ substantially. That is why, taking country-specific features into account, it is possible to identify latent factors across time periods and economic entities. At that, the model will take on the following form:

$$Y = \alpha + \beta X_{it} + d_t + f_i + \varepsilon_{it}, \ (i = 1, \ldots, 28; \ t = 1, \ldots, 11)$$

where α is a constant, β is the coefficient of the vector of common factor variables X_{it} observed for cross-sectional unit i over period t, i.e. the structure of variable $X = (x_{1.1}, x_{1.2}, \ldots, x_{1.11}, x_{2.1}, x_{2.2}, \ldots, x_{2.11}, \ldots, x_{28.1}, x_{28.2}, \ldots, x_{28.11})$, f_i expresses individual-specific time-invariant effects of economic entities; d_t denotes time effects that are constant for countries; errors ε_{it} represent independent and identically distributed random variables (across countries and across time). Dummy variables for each economic entity i are binary values, that is

$$z_{ij}^{f} = \begin{cases} 1, \ i = j, \\ 0, \ i \neq j. \end{cases}$$

Dummy variables for each time effect *t*:

$$z_{tr}^{d} = \begin{cases} 1, \, t = r, \\ 0, \, t \neq r. \end{cases}$$

Thus, in our case, the model of panel data with individual effects will take on the following form:

$$Y = \alpha + \beta X_{it} + \sum_{r=1}^{T} z_{tr}^{d} d_t + \sum_{j=1}^{N} z_{ij}^{f} f_i + \varepsilon_{it}, \ (T = 11, N = 28).$$

The fixed effects model is applied in order to take into account the unobserved factors, which are different for different moments in time. The fixed effect model is a model of linear regression, in which intercepts change across economic subjects *i*. This model has the same assumptions as in the regular linear regression model:

1. Factors X_{it} are independent from ε_{it} for all *i* and *t*.
2. Errors ε_{it} are independent and identically distributed random values with zero mathematical expectation and variance.

We can now construct a panel data model – the model with fixed individual-specific effects which represents the initial regression model modified in terms of deviations from time-mean variables. We can now estimate the regression model with fixed effects for the mentioned variables.

When constructing Model 2 with dummy variables, which enable us to account for individual effects, the coefficients of the model did not differ significantly from those used in Model 1, demonstrating the same nature of influence on the dependent variable. The latent variables of individual-specific effects across economic entities (countries) were abandoned due to their colinearity, whereas the impact of time effects was somewhat different in nature: Some reduction in the level of underachievement in reading, maths or science was observed in 2003 and 2006, while the maximum fixed time effect was observed in 2009 (d_{t3}).

Table 4. Values of time variables in Model 2 "The relationship between the level of underachievement in reading, maths or science (UrSt) and factor variables, taking into account individual effects»

Variables	d_{t1}	d_{t2}	d_{t3}	d_{t4}	d_{t5}
Years	2003	2006	2009	2012	2015
Coefficient of time effects	−0.20	−0.01	0.36	0.27	0.09

Source: based on data by Eurostat: https://ec.europa.eu/eurostat/data/database

Variable d_{t3} indicates that in 2009 a weakening could be observed in the relationship between the level of underachievement in reading, maths or science and the factor variables described in Model 1. A comparatively larger value of the time effects coefficient for this year can be explained by abnormal dynamics of public expenditures in 2009, caused by the world financial crisis. However, the return of the time effects coefficient to the pre-crisis levels after 2009 proves that the model is robust in explaining the persistent impact of the social expenditures of local budgets on underachievement in reading, maths or science.

Analysis of the dependence between the percentage of children at risk of poverty or social exclusion and the social expenditures of local budgets

Social budget expenditures usually produce a broad spectrum of effects on social relations. In view of the fact that underachievement in education is often connected with poor social conditions of households, as well as the fact that accessibility to education services often affects the life-activity of households in general, it is important to investigate the dependence between the risk of child poverty (*ChRPSEx*) and the budget expenditures on education.

It is necessary to note that we studied state budget expenditures on social protection of family and children as one of the factor variables. Although it was found that such expenditures lead to reduction in the level of underachievement in education, it is also important to analyze their impact on the reduction of the share of children at risk of poverty as an important determinant of the attainment of sustainable development goals.

In order to study the impact of factor variables on the level of children at risk of poverty or social exclusion indicator, we consider it feasible to develop a model with fixed individual-specific effects (Table 4) by taking the initial regression model and rewriting it in terms of deviation from time-mean values of variables. This will allow to fully take into account the dependence of the children at risk of poverty or social exclusion indicator on the time period and the country. In the developed model, due to collinearity, we excluded 29 dummy fixed unknown variables, f_i *(i = 1,…, 28)* denotes the effect of a separate country, and d_{11} represents the latent effect for the year 2018.

Table 5. Model 3 «The relationship between children at risk of poverty or social exclusion and factor variables, taking into account individual effects», $R^2 = 0.922$[18]

Variables	Coefficient	Std. Deviation	t-Statistics	p-Value
Const	25.75	2.89	8.883	1.69e-09 ***
LBPPEd	−2.16	1.93	−2.110	0.027**
OBPPEd	1.91	3.64	1.5233	0.06*
LBSEd	2.58	2.71	2.9515	0.03**
OBSEd	−1.46	1.08	−1.351	0.018**
LBFC	−4.38	1.62	−2.699	0.006***
OBFC	0.21	1.68	0.1223	0.9

Note: The table shows values for observed factors, whereas coefficients for latent variables are not shown.

Source: based on data by Eurostat: https://ec.europa.eu/eurostat/data/database

The R^2 value indicates that the obtained model describes 92% of the response property after individual-specific fixed time effects have been taken into account. Since all indicators of the model vary in time, we estimated the coefficients for each of them. That is, the impact of the factors on the response variable is time-invariant. The coefficients for all indicators except OBFC are statistically significant and, according to the results of the fixed effect model, these factors produce an effect on the level of children at risk of poverty indicator:

$$(3) \quad ChRPSEx = 25.75 - 2.16 \cdot LBPPEd + 1.91 \cdot OBPPEd + 2.58 \cdot LBSEd - 1.46 \cdot OBSEd - 4.38 \cdot LBFC$$

Among the studied impacts of factor variables on the children at risk of poverty or social exclusion indicator, we can single out the adverse impact of local budget expenditures on social protection of families and children (LBFC), estimated to equal (-4.38). This is explained primarily by the direct purpose of such expenditures which consists in preventing the poverty of households. At that, we can observe the absence of a statistically significant relationship between the state budget expenditures on social protection of families and children and the percentage of children at risk of poverty or social exclusion. This is preconditioned by the fact that households usually do not receive their social support directly from the state and regional budgets; these resources are mainly used to finance measures, the participation in which can hardly be differentiated based on the beneficiaries having particular poverty characteristics. A much higher impact of local budget expenditures

[18] The number of observations was 308. The number of cross-sectional units is 28. Length of the time series is 11 years.

on the reduction of the percentage of children at risk of poverty or social exclusion reflects the high level of local budget resources allocation to social protection of families and children.

In Model (3), we can observe that the impact of budget expenditures on the percentage of children at risk of poverty or social exclusion is non-homogeneous. This is caused primarily by the fact that the main task of public education financing is to ensure equal access to quality education services for all children. At that, worth acknowledging is the positive role of local budget expenditures on pre-primary and primary education (LBPPEd) and of the state and regional budget expenditures on secondary education (OBSEd) for reducing the share of children at risk of poverty or social exclusion. Therefore, we find only partial support for the hypothesis that larger public expenditures on pre-primary and primary education, secondary education and social support of families and children have a significant effect for decreasing the risk of child poverty.

The Fisher criterion shows that the coefficients are non-zero in all the models. The Fisher criterion for effects also shows that they are other than zero. The *t*-criterion above 1.96 (at 95% confidence level) for all statistically significant coefficients indicates that respective variables are relevant.

It should be noted that the Fixed Effects Model 3 also involves the determination of the effects of specific time points: By introducing dummy variables for each time point, we managed to estimate the influence of each time period on the level of child poverty and the degree of significance of the processes taking place during separate time periods (Table 6).

Table 6. Values of the time variables in Model 3 "The relationship between the level of children at risk of poverty or social exclusion and factor variables, taking into account individual effects"

Variables	d_{t1}	d_{t2}	d_{t3}	d_{t4}	d_{t5}	d_{t6}	d_{t7}	d_{t8}	d_{t9}	d_{t10}
Years	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Time effect coefficient	1.81	2.99	3.81	4.16	4.75	4.81	4.01	3.44	2.66	1.07

Note: All estimates d_{ti} were statistically significant at the 1% level.

Source: based on data by Eurostat: https://ec.europa.eu/eurostat/data/database

The obtained values for d_{t6} and d_{t5} are the largest and positive, which allows us to conclude that the magnitude of the time effect was the largest during the years 2012 and

2013; at that, an increase in the level of child poverty during these years was larger compared to other years.

Conclusions

The performed empirical research based on the official data for 28 countries of the European Union, encompassing the period from 2007 until 2018, allowed to determine the dependence between students' underachievement in reading, maths or science and social expenditures of the budgets. We found that countries with larger expenditures of both local budgets and state and regional budgets on secondary education face less problems with underachievement in reading, maths or science (the coefficients of dependence equalled (–4.87) and (–3.34) respectively). The additional negative effect on the decrease in this phenomenon is produced by expenditures of local budgets on pre-primary and primary education (the coefficient of dependence equal to (-2.11)) and expenditures of local budgets on social protection of families and children (-1.9)). The obtained results were statistically significant, which is proved by the 99% confidence level for model parameters.

In the countries of the European Union that had larger expenditures of local budgets on social protection of families and children, the level of children at risk of poverty or social exclusion indicator was lower (coefficient of dependence equal to (-4.38)). Expenditures of different types of budgets on education produced mixed impact on the response variable. Negative impact on the children at risk of poverty or social exclusion indicator was produced by expenditures of local budgets on pre-primary and primary education (coefficient of dependence equal to (-2.16)), as well as expenditures of the state and regional budgets on secondary education (coefficient of dependence equal to (-1.46)). This supports the thesis that local budget expenditures on social protection of families and children play an important role in the reduction of underachievement in reading, maths or science, as well as in the reduction of the percentage of children at risk of poverty or social exclusion.

The performed study of the dependence of students' underachievement in education and the percentage of children at risk of poverty on social expenditures of local budgets based on panel data for the EU countries generally proves the existence of the positive impact of local budget expenditures on the attainment of sustainable development objectives. The prospects for future research in this direction consist, in our opinion, in performing a more

detailed investigation into the connection between budget expenditures and the progress in SDG attainment. In view of the above, it is worth to focus on detailed analysis of the dependence between the results of public goods provision and the volume of public financing. For that, the researchers can apply experiments, in the process of which the participants will be modelling the behaviour of economic subjects, in particular the process of public goods provision. This will allow to study the nature of the influence of budget financing on the public goods provision and the implementation of SDG objectives.

References

Ackerman, B. P., Brown, E. D., Izard, C. E., (2004). The relations between persistent poverty and contextual risk and children's behaviour in elementary school. Developmental Psychology, 40, 367–377.

Benavot, A., (2014) Education for Sustainable Development in Primary and Secondary Education, Paris.

BOESKENS, L., LIMA, G., NUSCHE, D., RADINGER, T. AND SHEWBRIDGE, C., (2017). The Funding of School Education. Connecting Resources and Learning. OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264276147-en

Buckler, C., Creech, H., (2014). Shaping the Future We Want: UN Decade of Education for Sustainable Development (2005-2014). Final Report, UNESCO, Paris, 2014. 202 p.

Cassen, R., Kingdon, G., (2007). Tackling Low Educational Achievement. York: Joseph Rowntree Foundation. 79 p.

Children at risk of poverty or social exclusion. https://ec.europa.eu/eurostat/databrowser/product/view/ILC_PEPS01

Demie, F., (2019). Educational attainment of Eastern European pupils in primary schools in England: Implications for policy and practice. London Review of Education, 17 (2): 159–177. DOI https://doi.org/10.18546/LRE.17.2.05

Didham R. J., Ofei-Manu P., (2015). The role of education in the sustainable development agenda: empowering a learning society for sustainability through quality education, in: Achieving the Sustainable Development Goals: from Agenda to Action; Institute for Global Environmental Strategies, Institute for Global Environmental Strategies, Hayama, pp. 95–133.

Filho, I. de C., Litschig, S., (2020). Long-run Impacts of Intergovernmental Transfers. Journal of Human Resources. https://doi:10.3368/jhr.57.3.0917-9064R2.

GLONTI, V., TRYNCHUK, V., KHOVRAK, I., MOKHONKO, G., SHKROBOT, M., MANVELIDZE L. (2020). Socialization of organization sustainable development based on the principles of corporate social responsibility, Montenegrin Journal of Economics, 16(1), 169-182. DOI: 10.14254/1800-5845/2020.16-1.11

Habibullah, S., Ashraf, J., (2013). Factors Affecting Academic Performance of Primary School Children. Pakistan Journal of Medical Research. Vol. 52. 47–52.

KOZIUK, V., DLUHOPOLSKYI, O., HAYDA, Y., KLAPKIV, Y. (2019). Does educational quality drive ecological performance? Case of high and low developed countries. Global Journal of Environmental Science and Management (GJESM), 5(SI): 22-32. DOI: 10.22034/gjesm.2019.SI.03

Laurie, R., Nonoyama-Tarumi, Y., McKeown, R., Hopkins, C.A., (2016). Contributions of education for sustainable development (ESD) to quality education: a synthesis of research, J. Econ. Sustain, Journal of Education for Sustainable Development. Vol. 10, issue: 2. 226-242. https://doi.org/10.1177/0973408216661442

Lutz, W., Muttarak, R., Striessnig, E., (2014). Environment and development. Universal education is key to enhanced climate adaptation. Science, Vol. 346(6213), pp. 1061–1062. doi:10.1126/science.1257975.

Manual on sources and methods for the compilation of COFOG statistics Classification of the Functions of Government (COFOG). 2019 edition. Luxembourg: Publications Office of the European Union, 2019, 232 p. URL: https://ec.europa.eu/eurostat/documents/3859598/10142242/KS-GQ-19-010-EN-N.pdf.

Nyangarika, A., Ngasa, Z. J., (2020). Factors Influencing Academic Performance of Primary School's Orphans in Tanzania. International Journal Of Advance Research And Innovative Ideas In Education. Vol. 6. 398–406.

Ofei-Manu, P., Didham, R.J. (2014). Quality Education for Sustainable Development: A Priority in Achieving Sustainability and Well-Being for All, IGES Policy Brief, No. 28. P. 1–12.

Psacharopoulos, G., (1973). Returns to Education: An International Comparison (Jossey-Bass, Elsevier).

Resolution adopted by the General Assembly on 25 September 2015. 70/1. Transforming our world: the 2030 Agenda for Sustainable Development. URL: https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

Rieckmann. M., Mindt, L., Gardiner, S., (2017). Education for Sustainable Development Goals: Learning Objectives, Paris, UNESCO, 2017. 63 p.

Striessnig, E., Lutz, W., Patt, A. G., (2013). Effects of Educational Attainment on Climate Risk Vulnerability, Ecology and Society, Vol. 18. DOI: http://dx.doi.org/10.5751/ES-05252-180116

Underachievement in reading, maths or science (source: OECD) (sdg_04_40). ESMS Indicator Profile (ESMS-IP). Compiling agency: Eurostat, the statistical office of the European Union. https://ec.europa.eu/eurostat/cache/metadata/en/sdg_04_40_esmsip2.htm

WORLD ECONOMIC FORUM (2021). The Global Risks Report 2021. 16th edition. Insight report. URL: http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf