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THE JUSTIFICATION OF THE EFFICIENCY OF FINANCIAL SUPPORT OF EDUCATION IN THE CONTEXT OF THE NATIONAL ECONOMY DEVELOPMENT

Abstract. In the conditions of formation of post-industrial social relations, there is a qualitative transformation of basic principles of functioning of both leading national economies and the world economy as a whole. In particular, under intensive scientific and technical progress, as well as the growth of labour productivity, knowledge, technologies and innovations became the basis for building a competitive national economy. Education, as one of the leading industries that produce these factors, becomes one of the highest priorities of state regulation.

In this regard, this article is devoted to the justification of effectiveness of financial support of education in the context of development and transformation of the national economy. To fulfil this task, at the first stage the authors formed a set of statistical data covering 14 countries of Central and Eastern Europe for the period 2006—2016, calculations were performed using the STATA 11 complex, a regression analysis with fixed effects and a distribution-lag modelling were selected as the study methods. Government expenditures on education were dependent variables and the leading indicators of the national economy (e.g., GDP, GNI, industry, production, services and agriculture as value added, imports and exports of goods and services, FDI, etc.) were as independent variables. In the second stage, a correlation analysis was performed to justify the need for the use of lag and determine its value. As a result of the study, the authors of the work revealed the current and long-term relationship between macroeconomic parameters that characterize sectoral and technological changes in the structure of the national economy and state financing of education. At the same time, a direct relationship was found for the main macroeconomic indicators (GDP, GNI, the participation of industry, production, services and agriculture in value added, exports and imports of goods and services), and long-term relationship (with a lag of 3—7 years) was found for FDI, current and financial balance of payments (direct dependence), exports of high-tech ICT goods and services, as well as tax revenues (inverse dependence).

Keywords: financial support of education, national economy, state financing of education, regression analysis, distribution-lag modelling, Central and Eastern Europe countries.

JEL Classification I22, I28, H52, E20

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ОБҐРУНТУВАННЯ ДІЄВОСТІ ІНСТРУМЕНТІВ ФІНАНСОВОГО ЗАБЕЗПЕЧЕННЯ ОСВІТИ В КОНТЕКСТІ РОЗВИТКУ НАЦІОНАЛЬНОЇ ЕКОНОМІКИ

Анотація. В умовах становлення постіндустріальних суспільних відносин відбувається якісна трансформація базових принципів функціонування як провідних національних економік, так і світового господарства в цілому. Зокрема, в умовах інтенсивного науково-технічного прогресу, а також зростання продуктивності праці основою побудови конкурентоспроможного національного господарства стали знання, технології та інновації. Освіта як одна із основних галузей, що продукує ці фактори, стає одним із найпріоритетніших завдань державного регулювання.

Присвячено обґрунтуванню дієвості фінансового забезпечення освіти в контексті розвитку і трансформації структури національної економіки. Для виконання поставленого завдання на першому етапі сформовано масив статистичних даних, що охоплював 14 країн Центральної та Східної Європи за часовий проміжок 2006—2016 рр., розрахунки здійснювалися за допомогою комплексу STATA 11, методом дослідження обрано регресійний аналіз із фіксованими ефектами і дистрибутивно-лагове моделювання. Залежними змінними виступали державні витрати на фінансування освіти як незалежні — основні показники стану розвитку національної економіки (наприклад, ВВП, ВНД, промисловість, виробництво, послуги і сільське господарство як додана вартість, імпорт та експорт товарів і послуг, ПІІ тощо). На другому етапі було проведено кореляційний аналіз для обґрунтування необхідності застосування лагу і визначення його величини. У результаті проведеного аналізу авторами роботи виявлено поточний і довгостроковий зв'язок між макроекономічними параметрами, які характеризують галузеві й технологічні зміни у структурі національної економіки, і державними витратами на фінансування освіти. При цьому для основних макроекономічних показників (ВВП, ВНД, участь промисловості, виробництва, послуг і сільського господарства у створенні доданої вартості, експорт та імпорт товарів і послуг) виявлено прямий зв'язок, а для ПІІ, стану поточного та фінансового рахунків балансу платежів (пряма залежність), експорту високотехнологічних товарів і послуг ІКТ, а також податкових надходжень (обернена залежність) — довгостроковий (з лагом 3—7 років).

Ключові слова: фінансове забезпечення освіти, національна економіка, державне фінансування освіти, регресійний аналіз, дистрибутивно-лагове моделювання, країни Центральної та Східної Європи.

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Introduction. The level of the national economy development defines the country's place in the international space, its competitiveness, level and quality of life. The quality of these processes is significantly determined by the national characteristics that have emerged as a result of the specifics of geographical and geopolitical position, long-term historical, cultural and social development of society and the formation of its economic system. The state of public relations

development in the country also has its impact on the structure of the national economy, which differs in sectoral, technological, territorial and other characteristics.

The field of education is an essential and integral element of the national economic system, and therefore it is in unity, and more precisely in the interdependence and interaction with its other areas (industrial and non-industrial) and industries. In particular, education prepares a skilled workforce, as well as provides constant updating of knowledge and skills of employees and their comprehensive personal development. In this regard, the state regulation of education and its financial support is a significant area of activity in the transition to a post-industrial type of development, which has a direct impact on the formation of sectoral and technological structure of the national economy.

Literature review and the problem statement. The peculiarities of national economic development and their transformation in the conditions of post-industrial society formation are the subject of numerous research of domestic and foreign scientists. In particular, the issue of a detailed study of economic activity of some Central and Eastern European countries (through GDP per capita and labour market indicators) and their impact on the country's prosperity is the basis of works of Kirikkaleli and Ozun [16]. The features of their economic situation [17] and the problem with public debt are depicted in the works of Noga et al. [26]. The impact on the state of social and economic development of fiscal decentralization [6; 27], public spendings [19], foreign direct investments [23], fiscal transparency [9], general financial services transparency [21], labour market indicators, including immigration [31] is proved. Quite interesting is the view of scholars [10; 13], who study the relationship between a country's economic competitiveness and a rate of its economic growth. The effect of economic indicators (interest rate, inflation rate and human development index) on supply chain performance is considered in the work of Sinaga et al. [35]. In studying the state of national economic development, it is essential to consider the numerous socio-economic challenges [11; 25] and macroeconomic imbalance [7] facing the government. Also, Boiarchuk et al. [4] consider the impact of the main manifestations of globalization processes on the state of national economies. Industrial cooperation is discovered in the work of Fomina et al. [8].

The state of national economic development is characterised by numerous factors, not only economic but also social [3; 43]. Thus, in their study, Palienko and Lyulyov [27] empirically proved the influence of social factors (through the prism of human capital indicators) on macroeconomic stability, and Bondar and Paszkowski [5] demonstrated the impact of intellectual capital indicators on the state of cooperation between countries. Luchko et al. [22] investigated the formation of the optimal potential of human resources for the national economy and the relationship with a gross domestic product, business innovations [33]. Pitoňáková [30] studied the impact of economic and demographic factors on the personal saving rate in the Euro area.

In the conditions of a post-industrial or information society formation, there is a change of the basic approaches to understanding the education system and measures of its management and regulation [32; 34; 39]. Numerous studies have focused on the specifics of educational standards and in particular the state regulation of education in Europe [1; 12], Russia [36], Ukraine [24]. Kohnová et al. [18] examined the changes in the technological and production structure of the national economy with the transition to Industry 4.0, which requires a partnership with the education sector to increase the innovation of its activities. Vorontsova et al. [44] proposed an expenditure optimization model for education to make more rational use of financial resources; financial flows in education, both formal and non-formal, was suggested by Kowalska I. [20]. Numerous works are devoted to the positive impact of the educational component or its results on the social and economic development of the country [14; 42].

However, despite numerous studies on the national economic development, the financial support of education and its transformation in the post-industrial society, in our opinion, the issue of comprehensive justification of the impact of state regulation of education on the national economy, considering time factors.

Based on this, *the purpose of this work* is to justify the effectiveness of financial support of education in the context of development and transformation of the national economic structure.

Research results. Most domestic and foreign scholars [2; 29; 37; 38; 40], while studying the main signs of society's transition to new forms of post-industrial relations, note the corresponding transformations in the structure of the national economy. In particular, there is a growth and services expansion along with the production of goods, increasing the value of information and knowledge, as well as innovation and research.

Such activities as financial intermediation, real estate, rent and business activities, public administration and defense, social sphere (education, health care, etc.), other types of public, social and personal services, which are combined in the group «Other activities» (subsections 65—95 ISIC) dominate in the structure of the services sector. This economic structure as a whole in the world is entirely consistent with the assertion of the transition to a post-industrial or information type of social relations.

A comparative analysis of the national economy of Ukraine (UKR) and the countries of Central and Eastern Europe (CEE) is of interest, in particular Belarus (BLR), Bulgaria (BGR), the Czech Republic (CZE), Estonia (EST), Hungary (HUN), Latvia (LVA), Lithuania (LTU), Moldova (MDA), Poland (POL), Romania (ROU), the Russian Federation (RUS), Slovakia (SVK), Slovenia (SVN). These countries are united not only by a common geographical location but also by the peculiarities of historical and cultural development. Most of these countries belonged to the Union of Soviet Socialist Republics (USSR), which was characterized by a planned economy with a high level of centralization and typical mechanisms (mostly administrative-command) in various areas of economic activity. Also, the rest of the countries were the part of the Eastern (Soviet) bloc, which was enshrined in the Warsaw Pact on Cooperation and Mutual Assistance, and therefore had a common vector of development.

After the collapse of the communist regimes, these countries began a gradual transition to a market economy, using various paths that determine their current state of development. Some countries that are most successful in the context of such a transformation of national systems have joined the European Union (EU). As of 2004, Latvia, Lithuania, Estonia, Poland, Slovakia, Slovenia, Hungary and the Czech Republic joined the bloc; and Bulgaria and Romania in 2007.

As for the rest of the countries, they have chosen a different path of development. Thus, the Russian Federation, Belarus and Moldova are the members of the Commonwealth of Independent States (CIS). The Russian Federation is considered a country with a reasonably strong economy, significant reserves of natural resources (including energy) and a strong influence on most post-Soviet states, which has long determined and influenced the development of Ukrainian national economy.

Since 2014 Ukraine has been in the process of withdrawing from the organization due to the aggravation of the political situation and is officially considered a former member of the CIS. Besides, relations between Ukraine and the Russian Federation have deteriorated significantly, exacerbated by the annexation of the Autonomous Republic of Crimea and the military conflict in eastern Ukraine. Moldova and Ukraine have recognized the European integration vector of their development and are taking steps in this direction (association agreements have been signed, a visa-free regime to Ukraine has entered into force, etc.). It should be noted that relations between the Russian Federation and Belarus on the one hand and the European Union on the other have deteriorated, numerous sanctions are imposed, and economic ties are limited.

Examining the features of the national economic structure in the sample countries, we note that the share in the system of value added of GDP in agriculture is the largest for Moldova (14%), Ukraine (12%) and Belarus (9%). As for the industry, its share varies between 30—40% [mostly in the Czech Republic (37%) and Belarus (37%)]. The service sector in these countries is expected to be dominant in the structure of their national economies. As of 2017, Latvia (73%), Estonia (70%) and Lithuania (68%) were the leaders in the share of services in the system of value added of GDP.

In this regard, we consider it appropriate to justify the effectiveness of financial support of education in the context of the national economic development and the transformation of its main areas. To do this, authors selected and analyzed the leading indicators that describe the state of the national economic growth from the standpoint of its sectoral and technological structure, as well as correspond to the current state of social development.

After that, they will be used for empirical calculations by building a regression model with fixed effects and a distribution-lag model to confirm the existence of current and long-term relationships with the financial provision of education (primarily through the instrument of state financing of education).

The use of a distribution-lag model or a distributed lag model is since most phenomena and processes occurring in the economy are complex and interconnected, which defines the possibility of the effect of their implementation not only in the current time but also in the long run. This period of time is called the time lag, the presence of which is considered in the proposed model.

Given the fact that education is an essential component of the knowledge economy and its successful financial support stimulates social and economical, and most importantly innovative development of countries, we have studied and confirmed such relationships empirically. In generalized form, the methodological principles of justification of the impact of state financing of education on the transformation of the sectoral and technological structure of the national economy under the trends of post-industrial type of public relations will be as follows.

At the first stage, standard preparatory procedures for the collection, processing and initial analysis of statistical data were carried out. Given that financing is one of the most effective tools of state regulation of education, we used this indicator as a dependent variable. The leading indicators of the state of development of the national economy, given above, are chosen as independent variables (*Fig.*).

The formation of information base and the choice of methodical tools of research
<p>Research base: official statistics of the World Bank</p> <p>Objects of research: 14 countries of Central and Eastern Europe: Belarus, Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Slovakia, Slovenia, the Russian Federation, Ukraine.</p> <p>Time range: 2006–2016 years (available statistics for all indicators and countries).</p> <p>Research method: combination of regression analysis and distributive-lag modeling.</p> <p>Effective variables: development indicators are NOT: <i>GDP</i> – gross domestic product; <i>GNI</i> – gross national income; <i>Ind</i> – industry (including construction), value added; <i>Manuf</i> – production, value added; <i>Serv</i> – services, value added; <i>Agric</i> – agriculture, forestry and fishing, value added; <i>Exp</i> – export of goods and services; <i>Imp</i> – import of goods and services; <i>FDI</i> – foreign direct investment, net; <i>BoP_FA</i> – net financial account; <i>BoP_CurA</i> – current account balance; <i>HT_exp</i> – export of high-tech technologies; <i>ICT_exp</i> – export of ICT services; <i>TaxRev</i> – tax revenues.</p> <p>Dependent variable: government spending on education (<i>GE_Ed</i>).</p> <p>Measurement units of all parameters – in current prices, in US dollars</p>

Fig. A generalized presentation of the information base and the choice of methodological tools of the study

As a result, typical panel data were formed, the features of which were taken into account within our study. All calculations were performed using the software product STATA 11.

In the second stage, to substantiate the need for the use of lag and determine its value, a correlation analysis was performed, which allows establishing the direction of the dependent and independent variables, adjusted for a specific time lag. An indicator of the presence of lag is the largest value modulo. To do this, we use the correlation coefficient (r_τ):

$$r_\tau = \frac{(n - \tau) \sum_{t=1}^{n-\tau} y_t x_{t+\tau} - \sum_{t=1}^{n-\tau} y_t \sum_{t=1}^{n-\tau} x_{t+\tau}}{\sqrt{\left[(n - \tau) \sum_{t=1}^{n-\tau} y_t^2 - \left(\sum_{t=1}^{n-\tau} y_t \right)^2 \right] \left[(n - \tau) \sum_{t=1}^{n-\tau} x_{t+\tau}^2 - \left(\sum_{t=1}^{n-\tau} x_{t+\tau} \right)^2 \right]}}$$

The calculations suggest that for such indicators as GDP, GNI, the share of industry, production, agriculture, value added services, exports and imports of goods and services, the lag is considered, because there are quite strong connection in both current and past time intervals between state financing of education and them.

As a result, a conventional regression analysis was performed for these variables, for which a model with fixed effects (the most optimal according to the Hausman test) was used. The results of the regression analysis are given below (*Table 1*).

Table 1

The results of the regression analysis that define the effectiveness of state financing of education in the context of the national economy in the current period

Variable	Model coefficients	Standard error	<i>t</i>	<i>P</i> > <i>t</i>	<i>R-sq</i>
GDP	0.504	0.075	6,95	0.000	0.919
GNI	0.508	0.075	6,77	0.000	0.925
Ind	0.405	0.083	6,91	0.000	0.893
Manuf	0.463	0.077	6,01	0.000	0.868
Serv	0.601	0.079	7,56	0.000	0.901
Agric	0.399	0.089	4,47	0.000	0.929
Exp	0.804	0.091	8,86	0.000	0.821
Imp	0.602	0.084	7,09	0.000	0.842

The analysis of the obtained data shows that the model is adequate; the model parameters are statistically significant. There is a high coefficient of determination for all constructed models, which indicates a considerable dependence on performance indicators (indicators of national economic development) on the factor (government financing of education). At the same time, with the growth of public expenditure on education per unit:

- GDP will increase by 0.504 units;
- GNI will increase by 0.507 units;
- the share of industry in value added will increase by 0.405 units;
- the share of production in value added will increase by 0.463 units;
- the share of value added services will increase by 0.601 units;
- the share of agriculture in value added will increase by 0.399 units;
- export of goods and services will increase by 0.804 units;
- import of goods and services will increase by 0.602 units.

Thus, there is reason to believe that the effectiveness of financial support of education is reflected in numerous current changes in the sectoral and technological structure of the national economy (through the ratio of primary, secondary and tertiary sectors).

At the last stage there is a direct regression analysis and evaluation of the parameters in the obtained distribution-lag model. To do this, we used a sequential estimation approach, which involves the gradual (step-by-step) addition to the model of variables shifted by one period of time, doing so as long as the model parameters remain statistically significant and the model itself is adequate.

It includes other variables that describe the state of the national economic development, and for which the correlation analysis revealed the presence of lag periods in the model. The results of the parameters evaluation of the distribution-lag model by the method of sequential evaluation, which define the effectiveness of financial support of education in the context of the national economy in the long run, are given below (*Table 2*).

The table shows statistically significant parameters of the models, which are reliable and adequate (the decision was made based on qualitative analysis of models). The average lag period is 5—6 years for most indicators, which is quite natural because this period of time is necessary to obtain a certain degree in most of the analyzed countries. The degree of effectiveness of financial support of education is not one-time but is quite long for most of the studied indicators.

Table 2

**The results of the regression analysis of the distribution-lag model that define
the effectiveness of financial support of education in the context
of national economic development in the long run**

Variable / lag period	Model coefficients	Standard error	<i>t</i>	<i>P</i> > <i>t</i>	<i>R</i> -sq
A	1	2	3	4	5
FDI					
0	-1,383	0.508	-2,72	0.000	0.471
1	-2,297	0.592	-3,88	0.000	0.475
2	-2,131	0.684	-3,11	0.002	0.493
3	-1,688	0.768	-2,20	0.030	0.509
4	-2,988	0.916	-3,26	0.002	0.489
BoP_FA					
0	-1,831	0.502	-3,65	0.000	0.474
1	-2,829	0.586	-4,83	0.000	0.472
2	-3,279	0.646	-5,07	0.000	0.491
3	-2,239	0.699	-3,21	0.002	0.542
4	-2,214	0.742	-2,98	0.004	0.604
5	-2,065	0.857	-2,41	0.019	0.613
BoP_CurA					
0	-1,965	0.505	-3,89	0.000	0.519
1	-2,867	0.586	-4,90	0.000	0.525
2	-3,313	0.623	-5,32	0.000	0.553
3	-1,632	0.683	-2,39	0.019	0.616
HT_exp					
0	1,427	0.146	9,77	0.000	0.439
1	1,505	0.155	9,72	0.000	0.436
2	1,483	0.154	9,61	0.000	0.431
3	1,475	0.169	8,72	0.000	0.429
4	0.732	0.188	3,90	0.000	0.428
ICT_exp					
0	1,648	0.181	9,14	0.000	0.665
1	1,672	0.176	9,49	0.000	0.694
2	1,637	0.174	9,41	0.000	0.711
3	1,745	0.167	10,45	0.000	0.727
4	1,479	0.178	8,30	0.000	0.749
5	1,078	0.182	5,94	0.000	0.771
6	0.781	0.174	4,46	0.000	0.790
TaxRev					
0	0.782	0.135	5,80	0.000	0.626
1	0.799	0.146	5,48	0.000	0.627
2	0.945	0.150	6,28	0.000	0.631
3	1,185	0.153	7,76	0.000	0.636
4	1,001	0.164	6,09	0.000	0.645
5	0.712	0.152	4,68	0.000	0.653
6	0.594	0.134	4,44	0.000	0.655
7	0.524	0.149	3,52	0.001	0.656

Proposing a methodological approach to justify the effectiveness of financial support of education in the context of the development of the national economy according to the distribution-lag model were put forward exactly those indicators that have the highest coefficients of determination. With the growth of state financing of education per unit, it helps to identify the following patterns:

- foreign direct investment will decrease by 1,688 units with a lag period of three years, with 47—49% of this inverse relationship will be observed for four consecutive years;
- the net financial account will decrease by about 2 units with a lag period from four to five years;
- the current account balance will decrease by 1,632 units with a lag period of three years;

- exports of high-tech technologies will increase by about 1.4—1.5 units with a lag period of 1—3 years;
- exports of ICT services will increase by 1,078 and 0.781 units with a lag period from five to six years;
- tax revenues will increase by 0.712 units with a lag period of five years, by 0.594 units with a lag period of six years, by 0.524 units with a lag period of seven years.

Conclusion. The effectiveness of financial support of education (in particular through the instrument of public expenditure) is reflected in numerous indicators of the state of the national economic development. In turn, it leads to increased financing opportunities for education and contributes to economic growth and welfare in society.

As a result of empirical calculations, the existence of current and long-term relationships between state financing of education and the formation of sectoral and technological structure of the national economy by building a regression model with fixed effects and distribution-lag models for a sample of Central and Eastern Europe and Ukraine is justified. Consequently, there is a current (excluding time lags) direct link between state financing of education and key macroeconomic indicators (GDP, GNI, the participation of industry, production, services and agriculture in value added, exports and imports of goods and services). At the same time, the following indicators revealed a long-term relationship (with a lag of 3—7 years) foreign direct investment, current and financial accounts of the balance of payments (direct dependence), exports of high-tech ICT goods and services, and tax revenues (inverse dependence).

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