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OCENA ALTERNATYW DLA WSPARCIA FINANSOWEGO PRZEMYSŁU EDUKACYJNEGO UKRAINY

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Streszczenie. Artykuł konstruuje statystycznie istotne i wystarczające regresji ekonomiczno-matematyczne liniowy modeli relacji wydatków skonsolidowanych pod względem sektorów edukacji, produktu krajowego brutto według rodzajów działalności „Edukacja", która charakteryzuje końcowy rezultat działalności produkcyjnej miejscowych jednostek gospodarczych w edukacji. W rezultacie prognozowana wartość PKB według rodzaju działalności „Edukacja" pod względem sektorów.

Słowa kluczowe: gospodarka narodowa, edukacja, sektory edukacji, wsparcie finansowe, rozwój, wydatki skonsolidowane, produkt krajowy brutto, modele liniowe regresji ekonomicznej i matematycznej.

ASSESSMENT OF THE ALTERNATIVES OF THE FINANCIAL PROVISION FOR THE DEVELOPMENT OF THE EDUCATION BRANCH OF UKRAINE

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Abstract. The article builds statistically significant and adequate economic and mathematical regression linear models of the relationship of consolidated expenditures in education sector, on gross domestic product by the type of activity "Education", which characterizes the end result of economic activity of resident units in the field of educational services. The analysis showed that the consolidated expenditures for education by the sectors grow during the period of 2012 – 2018. To study the connection between the volume of the consolidated expenditures by the sectors of the education branch and GDP, the correlation field between the consolidated expenditures for the education by the sectors of the education branch and GDP of the education branch was constructed and it was determined that the linear dependence can exist between the volume of the consolidated expenditures of the sectors of the education branch and GDP. We calculated the parameters of the econometric model dependence of GDP of the education branch on the consolidated expenditures by the sectors of the education branch, the obtained results were substituted in the econometric model and we got the following formulas of GDP dependence on the consolidated expenditures of the education branch. The suggested models are adequate and correctly describe the dependence between the volume of the consolidated expenditures for education and GDP of the education branch. The obtained economic-mathematical regression linear models allow to determine the forecast value of

the dependent variable (GDP of educational branch) by means of substitution in the equation the corresponding value of independent variable (consolidated expenditures for education of the corresponding sector). As a result, the forecast value of GDP by the type of activity "Education" by sector is obtained.

Keywords: national economy, education branch, sectors of education, financial provision, development, consolidated expenditures, gross domestic product, economic and mathematical regression linear models.

ОЦІНЮВАННЯ АЛЬТЕРНАТИВ ФІНАНСОВОГО ЗАБЕЗПЕЧЕННЯ РОЗВИТКУ ОСВІТНЬОЇ ГАЛУЗІ УКРАЇНИ

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Анотація. У статті побудовано статистично значимі та адекватні економіко-математичні регресійні лінійні моделі взаємозв'язку зведених видатків в розрізі секторів освіти, на валовий внутрішній продукт за видом діяльності «Освіта», який характеризує кінцевий результат виробничої діяльності економічних одиниць-резидентів у сфері послуг освітньої галузі. У результаті отримано прогнозне значення ВВП за видом діяльності «Освіта» у розрізі секторів.

Ключові слова: національна економіка, освітня галузь, сектори освіти, фінансове забезпечення, розвиток, зведені видатки, валовий внутрішній продукт, економіко-математичні регресійні лінійні моделі.

Problem set-up and its significance. The important factor of the education branch development is the provision of the financial fundamentals for the operation of the market of education services in Ukraine, the indicator of the education branch development and its compatibility is the dynamics of the funding index – overall education costs. In Ukraine the expenditures for education are included in the State Budget and are distributed for the needs of all the sectors of the education sphere: higher education, technical and vocational education, general secondary education and preschool education. Education reform envisages the following changes in these sectors of education: provision of the quality of higher education and creation of new system of management and funding of science, upgrading of the technical and vocational education, provision of qualitative, modern and affordable general secondary education ("New Ukrainian School"). Qualitative changes of all the sectors of education require core funding. That is why, the task of our research is to calculate the forecast value of the consolidated expenditure for each sector of education; construct the forecast value of GDP of the education branch; determine the trends of the volumes of the consolidated expenditures for education.

Analysis of the recent research of the problem. Ukrainian scholars who studied the problems of functioning and development of the educational sphere of Ukraine are D. Yu. Vilman *(Vilman D. Yu., Gevlych L. L., 2019),* L. L. Gelvlych *(Vilman D. Yu., Gevlych L. L., 2019),* V. M. Gracheva *(Diachenko N. K., Hrachova V. M., 2018),* N. K. Diachenko *(Diachenko N. K., Hrachova V. M., 2018),* V. G. Kremin *(Entsyklopediia*

osvity, 2008), V. O. Ogneviuk *(Ohneviuk V. O., 2003),* M. S. Pashkevych *(Pashkevych M. S., Kharchenko M. O., 2015),* N. B. Savina *(Savina N.B., Doroshchuk N.I., 2009),* K. S. Semeniuk *(Shevchenko V. L., Semeniuk K. S., 2009),* A. O. Trufen *(Trufina Zh. S., Trufen A. O., 2012),* Zh. S. Trufina *(Trufina Zh. S., Trufen A. O., 2012),* M. O. Kharchenko *(Pashkevych M. S., Kharchenko M. O., 2015),* V. L. Shevchenko *(Shevchenko V. L., Semeniuk K. S., 2009)* and others.

Aim of the research – develop the approach to the selection of the alternatives to funding the education sectors, based on the forecast values of the consolidated expenditures.

Main material statement. The possible effect as a result of the growth of the education branch funding by its various sectors will be evaluated. For this purpose economic-mathematical regression linear models of the relations of the factors – consolidated expenditures for higher education, technical vocational education, general secondary education and preschool education on the index of the economic development – gross domestic product (GDP) of the education branch will be constructed.

Statistical data regarding the consolidated volume of the expenditures for education by the sectors of the education branch and GDP of the education branch for the period 2012 – 2018 will be considered (Table 1).

The analysis showed that the consolidated expenditures for education by the sectors grow during the period of 2012 – 2018. To study the connection between the volume of the consolidated expenditures by the sectors of the education branch and GDP, the correlation field between the consolidated expenditures for the education by the sectors of the education branch and GDP of the education branch was constructed and it was determined that the linear dependence can exist between the volume of the consolidated expenditures of the sectors of the education branch and GDP.

Table 1

Statistical data of the consolidated expenditures for the education and GDP of the education branch in 2012 - 2018

Years	Consolidated expenditures for higher education, mil. hrs.	Consolidated expenditures for technical and vocational education, mil. hrs.	Consolidated expenditures for general secondary education, mil. hrs.	Consolidated expenditures for preschool education, mil. hrs.	GDP of the education branch, mil. hrs.
2012	29 335,9	6 034,0	42 459,1	42 459,1	71 771,0
2013	30 003,1	6 359,8	44 233,2	44 233,2	77 986,0
2014	28 343,8	5 885,2	42 421,4	42 421,4	76 068,0
2015	30 981,8	6 171,2	49 668,3	49 668,3	82 778,0
2016	35 233,6	6 182,3	56 532,0	56 532,0	88 996,0
2017	38 838,2	8 278,9	84 346,3	84 346,3	133 213,0
2018	44 243,6	10 004,0	101 690,6	101 690,6	156 864,0

Source: developed by the author on the base of the sources (Derzhavna sluzhba statystyky Ukrainy. URL: http://www.ukrstat.gov.ua)

For the construction and analysis of the general linear econometric model of the considered data the apparatus of the matrix algebra will be used. For the given economic process the sample model will be presented in the matrix form:

$$Y = XB + e \quad (1)$$

where:

$$Y = \begin{pmatrix} y_1 \\ y_2 \\ \cdots \\ y_n \end{pmatrix}, \dim Y = n \times 1$$

– vector of observations over the dependent variable of the model;

$$X = \begin{pmatrix} 1 & x_{11} & x_{21} & \cdots & x_{m1} \\ 1 & x_{12} & x_{22} & \cdots & x_{m2} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ 1 & x_{1n} & x_{2n} & \cdots & x_{mn} \end{pmatrix}, \dim X = n \times k$$

– matrix of observations over the explanatory variables of the model;

$$B = \begin{pmatrix} b_0 \\ b_1 \\ b_2 \\ \cdots \\ b_m \end{pmatrix}, \dim B = k \times 1$$

– vector of parameters of the sampling model;

$$e = \begin{pmatrix} e_1 \\ e_2 \\ \cdots \\ e_n \end{pmatrix}, \dim e = n \times 1$$

– vector of model residuals;

n – number of observations in the statistical sample;

m – number of the independent (explanatory) variables of the model;

k = m + 1 – number of the model parameters.

In case of two-factor model we have:

Y	X1	X2	X3	X3
71 771	29 335,9	6 034,0	42 459,1	14 627,7
77 986	30 003,1	6 359,8	44 233,2	15 662,4
76 068	28 343,8	5 885,2	42 421,4	15 186,4
82 778	30 981,8	6 171,2	49 668,3	18 142,2
88 996	35 233,6	6 182,3	56 532,0	20 115,5
133 213	38 838,2	8 278,9	84 346,3	28 210,1
156 864	44 243,6	10 004,0	101 690,6	31 786,3

where: Y – GDP of the education branch, X1 – consolidated expenditures for higher education, X2 – consolidated expenditures for technical-vocational education, X3

– consolidated expenditures for general secondary education, X4 – consolidated expenditures for the preschool education.

For the assessment of the sampling model parameters various methods are used, such as: moments method, least square method, method of maximum likelihood and others. Widely known least square method is referred to the simplest and most frequently used methods, which forms the base of the regression analysis. The fundamental of the least square method is the criterion according to which «the best » among all possibly is considered to be the regression function with such parameters, for which the sum of square errors is minimal. In mathematical expression this criterion has the following form:

$$\sum_{i=1}^{n} e_i^2 \to \min \tag{2}$$

Using this criterion the parameters of the sampling linear model are determined. The equation (1) is given in the form: $e = Y - XB$. Then the sum of square errors can be written in the following way:

$$\sum_{i=1}^{n} e_i^2 = e'e = (Y - XB)'(Y - XB) = Y'Y - 2B'X'Y + B'X'XB \tag{3}$$

For the minimization of the sum of square errors we will take the derivative from the expression by the vector of the parameters B assessment and equate the derivatives to zero:

$$\frac{\partial \sum_{i=1}^{n} e_i^2}{\partial B} = \frac{\partial (e'e)}{\partial B} = -2X'Y + 2X'XB = 0 \tag{4}$$

Finally we have:

$$X'XB = X'Y \tag{5}$$

This expression represents the matrix form of the system of normal equations recording. Having solved it with respect to the assessment vector B the assessment of the model parameters is obtained. For this purpose both parts of the expression are multiplied by the inverse matrix $(X'X)^{-1}$ and we obtain:

$$B = (X'X)^{-1}X'Y \tag{6}$$

Thus, having formed on the base of the statistic sample the observation vector over the dependent variable of the model Y and matrix of observations over the independent variables of the model X, the vector of the assessment of the model B parameters can be calculated applying the formula 6.

For the sake of convenience of using the formula (6) the matrices $(X'X)$ and $X'Y$ will be presented in the explicit form:

$$(X'X) = \begin{pmatrix} n & \sum_{i=1}^{n} x_{1i} & \sum_{i=1}^{n} x_{2i} & \cdots & \sum_{i=1}^{n} x_{mi} \\ \sum_{i=1}^{n} x_{1i} & \sum_{i=1}^{n} x_{1i}^2 & \sum_{i=1}^{n} x_{1i}x_{2i} & \cdots & \sum_{i=1}^{n} x_{1i}x_{mi} \\ \sum_{i=1}^{n} x_{2i} & \sum_{i=1}^{n} x_{2i}x_{1i} & \sum_{i=1}^{n} x_{2i}^2 & \cdots & \sum_{i=1}^{n} x_{2i}x_{mi} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ \sum_{i=1}^{n} x_{mi} & \sum_{i=1}^{n} x_{mi}x_{1i} & \sum_{i=1}^{n} x_{mi}x_{2i} & \cdots & \sum_{i=1}^{n} x_{mi}^2 \end{pmatrix}, \dim(X'X) = k \times k \quad (7)$$

$$X'Y = \begin{pmatrix} \sum_{i=1}^{n} y_i \\ \sum_{i=1}^{n} y_i x_{1i} \\ \sum_{i=1}^{n} y_i x_{2i} \\ \cdots \\ \sum_{i=1}^{n} y_i x_{mi} \end{pmatrix}, \dim X'Y = k \times 1 \quad (8)$$

We calculated the parameters of the econometric model dependence of GDP of the education branch on the consolidated expenditures by the sectors of the education branch, the obtained results were substituted in the econometric model and we got the following formulas of GDP dependence on the consolidated expenditures of the education branch (Table 2).

Table 2

Econometric models of GDP of the education branch dependence on the consolidated expenditures for education

Denomination	Econometric model	
Bond model of GDP of the education branch and consolidated expenditures for high education connection	$Y = 5{,}4416 * X_1 - 85981$	Y – GDP of education branch, X1 – consolidated expenditures for higher education
Bond model of GDP of education branch and the consolidated expenditures for technical-vocational education	$Y = 20{,}8536 * X_2 - 47483$	Y – GDP of education branch, X_2 – consolidated expenditures for technical-vocational education
Bond model of GDP of education branch and the consolidated expenditures for general secondary education	$Y = 1{,}4061 * X_3 + 13602$	Y – GDP of education branch, X_3 – consolidated expenditures for general secondary education

Bond model of GDP of education branch and the consolidated expenditures for preschool education	$Y = 4{,}8181 * X_4 - 689$	Y – GDP of education branch, X_4 – consolidated expenditures for preschool education

Source: author- developed

Models, presorted in Table 2 must be verified by means of quality indices of the model and check their statistic significance. Main quality indices of the constructed sampling model include correlation factor and determination coefficient.

Correlation factor is a quantitative measure of the density of the linear correlation between variables of the model and general case represents the coefficient of multiple correlation, calculated by such dependence:

$$R = \frac{\sum_{i=1}^{n}(y_i - \bar{y})(\hat{y}_i - \bar{\hat{y}})}{\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}\sqrt{\sum_{i=1}^{n}(\hat{y}_i - \bar{\hat{y}})^2}}, \quad (9)$$

where: y_i – actual (statistical) values of the dependent variable, $\hat{y}_i$ – calculated values.

In case of linear regression with one regressor the density of linear correlation relationship between the dependent variable y and independent variable x is evaluated by means of the known coefficient of pair correlation:

$$r_{yx} = \frac{\mathrm{cov}(x, y)}{\sqrt{\mathrm{var}(x)}\sqrt{\mathrm{var}(y)}}, \quad (10)$$

where, $\mathrm{cov}(x, y) = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$ – sample covariance coefficient,

$\mathrm{var}(x) = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2$ – sample dispersion of the explanatory variable model,

$\mathrm{var}(y) = \frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})^2$ – sample dispersion of the dependent variable model.

Determination coefficient is used as the adequacy (fitting) criterion of the model to statistical data, as it is a measure of the explainable force of the independent variables and shows, what part of the variation of the dependent variable is explained by the variation (change) of the independent variables and not by other random factors, accumulated in the stochastic component of the model. In other words, the determination coefficient shows how significant is the impact of the explanatory variables of the model on the dependent variable. If this impact is considerable, then the constructed model really describes linear dependence between the corresponding economic indices and this dependence is important. If this impact is minor then the model is inadequate to the statistic data and linear regression dependence between the

economic indices in the model is rather questionable and of bad quality. Determination coefficient is denoted by R2 and is calculated by the following dependence:

$$R^2 = 1 - \frac{\sum_{i=1}^{n} e_i^2}{\sum_{i=1}^{n} (y_i - \bar{y})^2} \quad (11)$$

It should be noted that the determination coefficient can be calculated, applying other formulas. It is proved in mathematical statistic that the determination coefficient and the coefficient of multiple correlation are connected by the following relation: $R^2 = (R)^2$ (for multiple regression), $R^2 = (r_{yx})^2$ (for pair regression). Thus, in practical calculations it is sufficient to calculate only the correlation coefficient. The greater is the value of the determination coefficient (the closer it is to unit) the more significant and systematic is the impact of the explicative variables on the dependent and there are more reasons to state that the change of the values of the explicative variables the change of the value of the dependent variable model is explained and not by other random and unaccounted in the model factors. In other words, high, close to 1 value of the determination coefficient shows the high level of adequacy of the evaluated model to the statistical values. Correlation factor is calculated by the formula:

$$r_{yx} = \frac{\operatorname{cov}(x, y)}{\sqrt{\operatorname{var}(x)}\sqrt{\operatorname{var}(y)}}$$

Correlation coefficients of the constructed models are calculated, the following results are obtained:

1) Bond model of the GDP of the education branch and consolidated expenditures for higher education: determination coefficient: $R^2 = 0.937$. That is, 6.3% of the change of the index values (GDP of the education branch) is explained by the random factors. In accordance with Chaddock scale the relation between the studied factors, characterized by the correlation coefficient, is very strong (Ohneviuk V. O., 2003. p. 12);

2) Bond model of GDP of the education branch and the consolidated expenditures for technical-vocational education: $R^2 = 0.964$. That is, 3.6% of the index value change (GDP of the education branch) is explained by the random factors. The relation between the studied factors, characterized by the correlation coefficient is very strong;

3) Bond model of GDP of the education branch and consolidated expenditures for general secondary education: $R^2 = 0.994$. That is, 0.6% of index value change (GDP of education branch) is explained by the random factors. Relation between the studied factors, characterized by the correlation coefficient, is very strong;

4) Bond model of GDP of the education branch and consolidated expenditures for preschool education: $R^2 = 0.982$. That is, 1.8% of index value change (GDP of education branch) is explained by the random factors. Relation between the studied factors, characterized by the correlation coefficient is very strong.

Regression model, be more precise, regression equation, can be considered to be statistically significant («valid») if it really reflects linear dependence between economic indices in this equation. It is possible if the determination coefficient R2 is rather close to unit. If this coefficient equals zero or slightly differs from zero the dependence between the variables of the model is missing and the obtained sample equation of

regression does not reproduce the real situation. Verification of the statistic significance of the model on the whole is reduced to the verification of the determination coefficient, i.e., verification of its real value differs greatly from zero. For this purpose two hypotheses are put forward:

$$H_0 : R^2 = 0,$$

$$H_1 : R^2 \neq 0.$$

The first, zero hypothesis, states that the evaluated sample regression equation does not explain the change of the dependent variable under the impact of the explicative variables. Second, alternative hypothesis, on the contrary, states that the variation by the dependent variable is explained by the impact of the explicative variables. For the verification of the hypotheses the following F-test statistic (F-Fisher's criteria) is used:

$$F = \frac{R^2}{1-R^2} \cdot \frac{n-k}{m}, \quad (13)$$

which, if zero-hypothesis is correct, has F-distribution with the degrees of freedom $\nu_1 = m$ i $\nu_2 = n-k$. Verification of the statistic significance of the model on the whole will be performed by the next on the base of the value of the sample coefficient of determination R2, that calculates the calculation value of Fisher's criteria: bond model of GDP of the education branch and consolidated expenditures for high education:

$$F^* = \frac{0,937}{1-0,937} * \frac{7-2}{1} = 74,4$$

Bond model of GDP of the education branch and consolidated expenditures for technical-vocational education:

$$F^* = \frac{0,964}{1-0,964} * \frac{7-2}{1} = 133,9$$

Bond model of GDP of the education branch and consolidated expenditures for general secondary education:

$$F^* = \frac{0,994}{1-0,994} * \frac{7-2}{1} = 828,3$$

Bond model of GDP of the education branch and consolidated expenditures for preschool education:

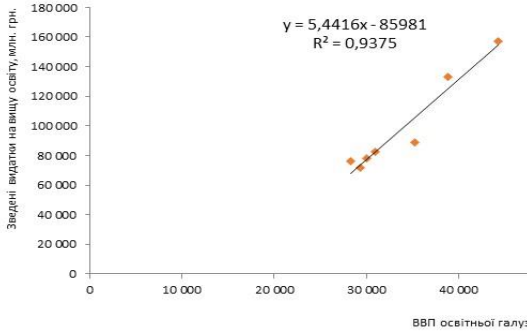
$$F^* = \frac{0,982}{1-0,982} * \frac{7-2}{1} = 272,8$$

Significance level is set α = 0,05. According to statistical tables of the critical points of Fisher-Snedecor F-distribution for the acceptable level of significance α and degrees of freedom $k_1 = m = 1$ and $k_2 = n-k = 5$ critical (table) value of Fisher's criterion = 6,6 is determined (Ohneviuk V. O., 2003. p. 18-19). As the condition

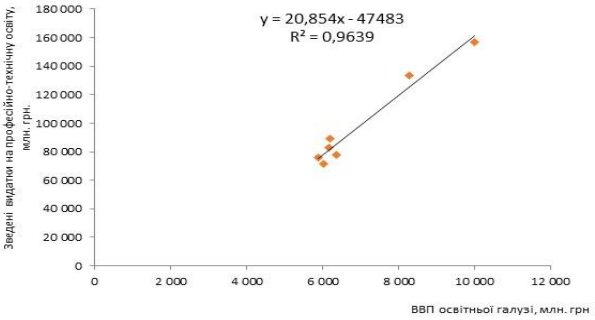
$F^* > F_{кр}$ is satisfied for all four models, then the zero hypotheses is discarded in favor of the alternative hypothesis, this implies the statistical significance of the constructed models on the whole and their adequacy.

Thus, the suggested models are adequate and correctly describe the dependence between the volume of the consolidated expenditures for education and GDP of the education branch (Fig. 1).

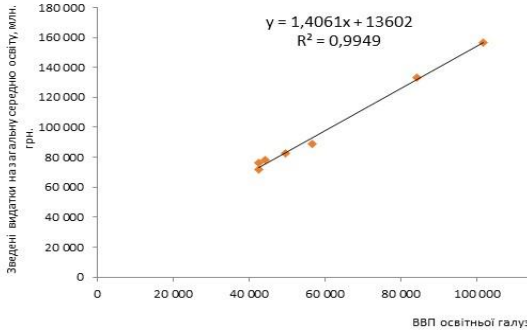
Model of the dependence between GDP of the education branch and consolidated expenditures for higher education.



Model of the dependence between GDP of the education branch and consolidated expenditures for technical-vocational education



Model of the dependence between GDP of the education branch and consolidated expenditures for general secondary education



Model of the dependence between GDP of the education branch and consolidated expenditures for preschool education

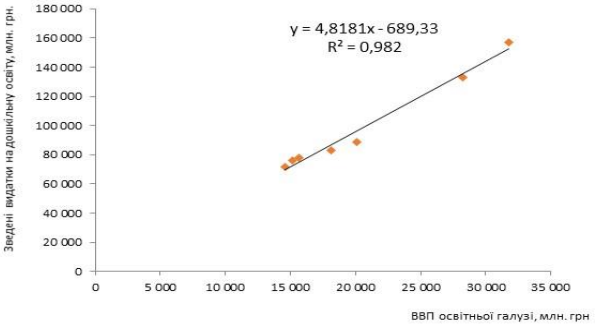


Fig. 1 Models of dependence between the volume of the consolidated expenditures for education and GDP of the education branch (constructed by the author)

The obtained economic-mathematical regression linear models allow to determine the forecast value of the dependent variable (GDP of educational branch) by means of substitution in the equation the corresponding value of independent variable (consolidated expenditures for education of the corresponding sector). The consolidated results of the forecast of GDP of education branch for 2019 by the determined models are presented in Table 3.

Table 3

Forecast of GDP of educational branch by the determined models

Designation	Econometric model		Forecast value of the independent variable (X)	Forecast value of the dependent variable (Y)
Bond model of GDP of the education branch and consolidated expenditures for higher education	$Y = 5,4416 * X_1 - 85981$	Y – GDP of education branch, X_1 – consolidated expenditures for higher education	X_1= 47379,7 mil. hrs. (+7,1% to 2018, Fig. 2)	Y_{x1}= 171839 mil. hrs. (+9,5% to 2018, Fig. 6)
Bond model of GDP of the education branch and consolidated expenditures for technical vocational education	$Y = 20,8536 * X_2 - 47483$	Y – GDP of education branch, X_2 – consolidated expenditures for technical-vocational education	X_2= 10883,5 mil. hrs. (+8,8% to 2018, Fig. 3)	Y_{x2}= 179476 mil. hrs. (+14,4% to 2018, Fig. 6)
Bond model of GDP of the education branch and consolidated expenditures for general secondary education	$Y = 1,4061 * X_3 + 13602$	Y – GDP of education branch, X_3 – consolidated expenditures for general secondary education	X_3= 117624,9 mil. hrs. (+15,7% to 2018, Fig. 4)	Y_{x3}= 178995 mil. hrs. (+14,1% to 2018, Fig. 6)
Bond model of GDP of the education branch and consolidated expenditures for preschool education	$Y = 4,8181 * X_4 - 689$	Y – GDP of education branch, X_4 – consolidated expenditures for preschool education	X_4= 36175,7 mil. hrs. (+13,8% to 2018, Fig. 5)	Y_{x4}= 173607 mil. hrs. (+10,7% to 2018, Fig. 6)

*Source: author- developed

Analysis of the Table 3 shows that the additional growth of the consolidated expenditures for education can provide the increase of GDP of Ukraine: growth of the consolidated expenditures for higher education by 7,1%, may lead to the increase of GDP of the education branch by 9,5% and increase of GDP of Ukraine by 0,42% (9,5%*4,4%, share of the volume of GDP of Ukraine in 2018); growth of the consolidated expenditures for technical vocational education by 8,8% may lead to the increase of GDP of the educational branch by 14,4% and increase of GDP of Ukraine by 0,64% (14,4%*4,4%); growth of the consolidated expenditures for general secondary education by 15,7% may lead to the increase of GDP of the educational branch by 14,1% and increase of GDP of Ukraine by 0,62% (14,1%*4,4%); growth of the consolidated expenditures for preschool education by 13,8% may lead to the increase of GDP of the education branch by 10,7% and increase of GDP of Ukraine by 0,47% (10,7*4,4%).

Dynamics of the consolidated expenditures by the sectors is shown in Fig. 2 – 5.

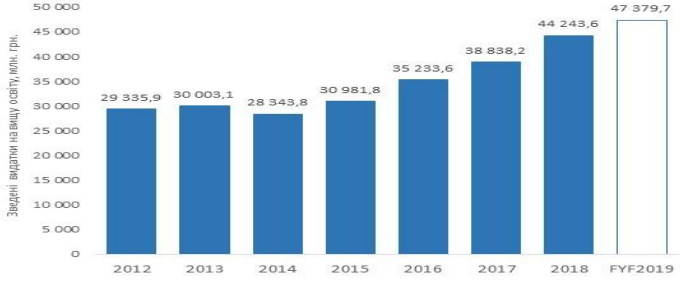


Fig. 2. Dynamics of the consolidated expenditures for higher education for 2012 – 2018 and forecast for 2019 (constructed by the author)

Growth of the consolidated expenditures for higher education for 2019 we adopt on the level of the growth rate of the consolidated expenditures for the period of 2012 – 2018:

$$T = 100 * \sqrt[6]{\frac{44243,6}{29335,9}} - 100 = 7,1\%$$

Thus, the forecast value of the volume of the consolidated expenditures for higher education for 2019 will be: 38838,2 * (1 + 0,071) = 48668,0 mil. UAH.

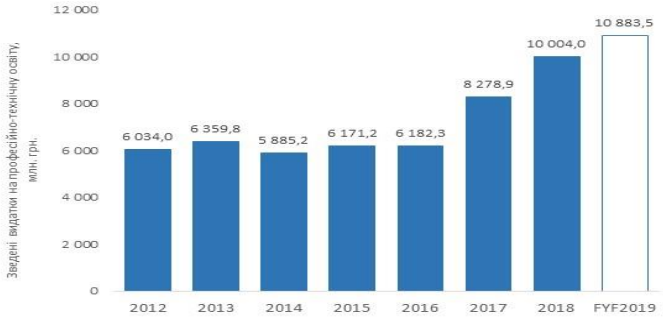


Fig. 3. Dynamics of the consolidated expenditures for technical-vocational education for 2012 – 2018 and the forecast for 2019 (constructed by the author)

The growth of the consolidated expenditures for technical-vocational education for 2019 we adopt on the level of the growth rate of the consolidated expenditures for the period of 2012 – 2018:

$$T = 100 * \sqrt[6]{\frac{10004,0}{6034,0}} - 100 = 8,8\%$$

Thus, the forecast value of the volume of the consolidated expenditures for technical-vocational education for 2019 will be: 10004,0*(1+0,088)=10883,5 mil. UAH.

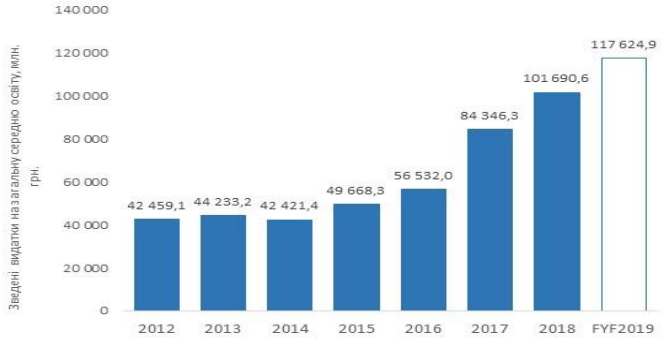


Fig. 4. Dynamics of the consolidated expenditures for general secondary education for the period 2012 – 2018 and forecast for 2019 (constructed by the author)

The growth of the consolidated expenditures for general secondary education for 2019 we adopt on the level of the growth rate of the consolidated expenditures for the period 2012 – 2018:

$$T = 100 * \sqrt[6]{\frac{101690,6}{42459,1}} - 100 = 15,7\%$$

Thus, the forecast value of the volume of the consolidated expenditures for the general secondary education for 2019 will be: 38838,2 * (1 + 0,157) = 117624,9 mil. UAH.

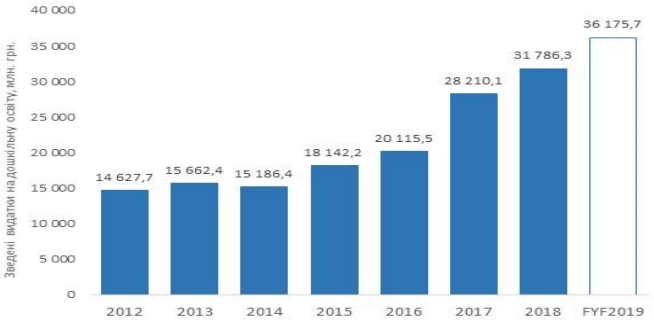


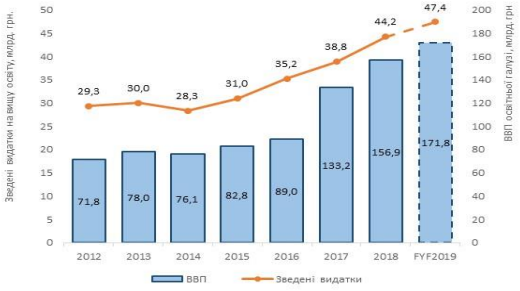
Fig. 5. Dynamics of the consolidated expenditures for the preschool education period of 2012 – 2018 and forecast for 2019 (constructed by the author)

The growth of the consolidated expenditures for the preschool education for 2019 we adopt on the level of the growth rate of the consolidated expenditures for the period 2012 – 2018:

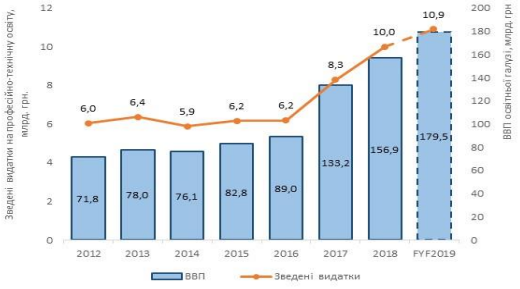
$$T = 100 * \sqrt[6]{\frac{31786,3}{14627,7}} - 100 = 13,8\%$$

Thus, the forecast value of the volume of the consolidated expenditures for the preschool education for 2019 will be: 31786,3 * (1 + 0,138) = 36175,7 mil. hrs. On the base of calculated forecast values of the volumes of the consolidated expenditures by the sectors of education, we can construct the forecast value of GDP of the whole education branch (Fig. 6).

Forecast of GDP of the education branch by the consolidated expenditures for higher education



Forecast of GDP of the education branch by the consolidated expenditures for technical-vocational education



Forecast of GDP of the education branch by the consolidated expenditures for general secondary education

Forecast of GDP of the education branch by the consolidated expenditures for preschool education

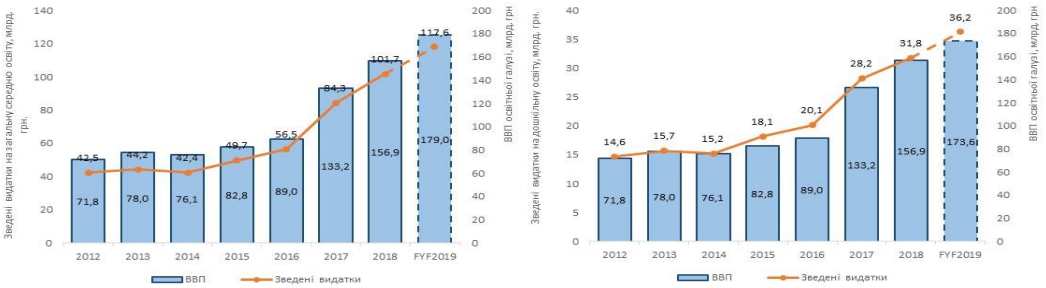


Fig. 6. Forecast value of GDP of the education branch by the volume of the consolidated expenditures (constructed by the author)

Calculated forecast values of the volumes of the consolidated expenditures by the sectors of education enabled to construct the forecast value of GDP of the education branch and prove that the growth of the volume of the consolidated expenditures for education is a necessary condition to provide the development of the educational branch and national economy.

Conclusions. The statistically significant and adequate economic-mathematical regression models of the interconnection of the consolidated expenditures by education sectors by gross domestic product (GDP) by the type of activity «Education», are constructed. As a result, the forecast value of GDP by the type of activity «Education» by the sectors is obtained: forecast value of the volume of the consolidated expenditures for higher-education – 48668.0 mil. hrs.; forecast value of the volume of the consolidated expenditures for technical-vocational education – 10883.5 mil. hrs.; forecast value of the volume of the consolidated expenditures for general secondary education – 117624.9 mil. hrs.; forecast value of the volume of the consolidated expenditures for the preschool education – 36175.7 mil. hrs.

That is, maximum growth of the GDP of Ukraine by the type of economic activity «Education», on the condition of maintaining the existing trends of the consolidated expenditures in different sectors of education, gives technical-vocational education: increase by 1% of the consolidated expenditures gives +1.64 % of GDP growth as compared with higher education (+1.34%), general secondary education (+0.90%) and preschool education (+0.78%).

Reference:

1. Vilman D. Yu., Hevlych L. L. (2019) Finansuvannia vitchyznianoi osvitnoi haluzi v period reformuvannia. Visnyk studentskoho naukovoho tovarystva Donetskoho natsionalnoho universytetu imeni Vasylia Stusa. 2019. Vyp. 11. T 1. S. 176-179.
2. Diachenko N. K., Hrachova V. M. (2018) Deiaki aspekty podalshoho rozvytku vyshchoi osvity v Ukraini. Osvita i nauka v umovakh hlobalnykh transformatsii : mater. II Vseukr. nauk. konferentsii (26-27 zhovtnia 2018 r., m. Dnipro). Dnipro : SPD «Okhotnik», 2018. S. 8-10. URL: http://dspace.dsau.dp.ua/jspui/handle/123456789/1088 (data zvernennia 12.04.2020).
3. Entsyklopediia osvity (2008) / vidp. red. V. H. Kremen. Kyiv : Yurinkom Inter, 2008. 1040 s.
4. Pashkevych M. S., Kharchenko M. O. (2015) Analiz efektyvnosti zakladiv zahalnoi serednoi osvity u rehionakh Ukrainy yak skladovoi efektyvnykh osvitnikh okruhiv. Stalyi rozvytok ekonomiky. 2015. № 2. S. 13-21. URL: http://nbuv.gov.ua/UJRN/sre_2015_2_3 (data zvernennia 12.04.2020).

5. Savina N.B., Doroshchuk N.I. (2009) Tendentsii finansovoho zabezpechennia osvitnoi haluzi natsionalnoi ekonomiky. Visnyk Natsionalnoho universytetu vodnoho hospodarstva ta pryrodokorystuvannia. Ekonomichni nauky. 2019. Vypusk 2(86). S. 82–90.
6. Shevchenko V. L., Semeniuk K. S. (2009) Bolonskyi protsess: sostoianye y problemы vыssheho obrazovanyia Ukraynы. Visnyk. 2009. Vyp. №1(10). S.30-34.
7. Trufina Zh. S., Trufen A. O. (2012) Finansove zabezpechennia vyshchoi osvity v Ukraini, stan ta shliakhy udoskonalennia. Ekonomika. Upravlinnia. Innovatsii. Ser. Ekonomichni nauky : elektron. nauk. fakh. vyd. Zhytomyr, 2012. № 1. URL: http://nbuv.gov.ua/UJRN/eui_2012_1_59 (data zvernennia 12.04.2020).
8. Ohneviuk V. O. (2003) Osvita v systemi tsinnostei staloho liudskoho rozvytku (svitohliadno-metodolohichnyi aspekt) : avtoref. dys. … dokt. filos. nauk : 09.00.03. Kyiv, 2003. 35 s.
9. Derzhavna sluzhba statystyky Ukrainy. URL: http://www.ukrstat.gov.ua.