ORIGINAL PAPER

MATHEMATICAL ASSESSMENT ON DYNAMICS OF GOVERNMENT EXPENDITURES AND GROSS DOMESTIC PRODUCT PER CAPITA, IN ROMANIA AND EUROPEAN UNION

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Abstract. *The research purpose represents the identification and mathematical definition of some models expressed by regression equations describing the GE per inhabitant according to the GDP per inhabitant. The study is customized at EU level and in seven states located in the Eastern-EU (RO, PL, GR, BG, SI, SK and HU) for the period 2009-2018. The research methodology is based on econometric modelling and testing of their viability. Relevant conclusions are also made regarding RO's position in the European Union in terms of government spending. The research provides useful information to substantiate micro and macroeconomic decisions designed to ensure a dynamic of GE's sustainable growth on education, health, general public services, defense, public order and safety. Based on the developed econometric models, values of endogenous variables (GE per capita) can be estimated depending on the variants of predictable scenarios for the size of the GDP per capita.*

Keywords: *government expenditures; gross domestic product; the Durbin-Watson statistical coefficient; the Jarque-Bera statistical coefficient; Theil Inequality Coefficient.*

1. INTRODUCTION

Following the economic situation created at the national level, we raised the question regarding the evolution of government expenditures (GE) both at the level of Romania (RO) and at the European Union (EU27). Total and structured GE is directly dependent on both the public and private sectors' economic potential, on the administrative management and political decisions [1, 2]. Existing studies have shown that government spending has steadily increased over the years, especially at the federal level. It is well known that these expenditures serve purposes of vital human existence, economic stabilization, provision of public goods, to meet the needs of society, etc. [3-5]. Evaluating existing policies or developing the new systems involves new macroeconomic indicators, which will indicate the

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place of a community or what it should do to progress [6]. A country's economic performance is generally measured by the Gross Domestic Product (GDP). GDP is considered the indicator that synthetically expresses a state' economic potential and synthesizes economic growth when its evolution is characterized by positive rhythms [7, 8]. By increasing the total GDP and per capita, the material and financial basis necessary for the fulfillment of the objectives of existence and sustainable development of all fields of economic and social life is ensured [9, 10]. Internationally, several specialized studies have sought to explain the systemic relationship between public debt, growth, and inflation [11] or explore the impact of public debt on economic growth [12-14]. Generally, Government debt as a percent of GDP is used by investors to measure a country's ability to make future payments on its debt, thus affecting the country borrowing costs and government bond yields [15]. Regarding the current state of research, many studies have focused on the process of revenue convergence towards macroeconomic imbalances [16] or the relationship between economic growth and the level of GE [4, 17-19]. Mathematical models based on the simple regression equation were used in social science fields [20, 21] interpreting the relationships between: the GDP and the final consumption [8, 22, 23], local public expenditures and local GDP growth rates [24], GDP, education and degree of civilization [14], e-commerce and influencing factors [25], in evaluating employee performance [26], companies financial performance [27] or to identify the correlations between the number of employees and the financial performance indicators [28]. In regression applications, independent variables are often intercorrelated, in the form of multicollinearity. The more predictive they are within the model, the greater the potential for multicollinearity or an association between variables [29, 30].

The research purpose represents the identification and mathematical definition of some models expressed by regression equations describing the GE per inhabitant according to the GDP per inhabitant. The study is customized at EU level and in seven states located in the Eastern-EU (RO, PL, GR, BG, SI, SK and HU) for the period 2009-2018. The research provides useful information to substantiate micro and macroeconomic decisions designed to ensure a dynamic of GE's sustainable growth on education, health, general public services, defense, public order and safety.

2. DATA COLLECTION AND VARIABLE DESCRIPTION

The methodology used for data modeling has the established structure, customized to analyze the five systems of interdependent variables (GE per capita - on five categories of expenditures - and GDP per capita) by simultaneous regression equations. Three alternative explanations are used to describe the relationship between the dynamics of GE on the period 2009-2018, and are subject to analysis by developing and attesting the viability of econometric models that refer to: (1) Econometric analysis with simultaneous equations of the dynamics of GE per capita, by types of expenditures, depending on the dynamics of the GDP per capita of RO; (2) Analysis of the dynamics of GE per capita, by types of expenditures, depending on the dynamics of GDP per capita for EU27; (3) Comparative analysis regarding GE per capita, by types of expenditures, in the period 2009-2018 in seven states in the Eastern-EU (RO, Poland (PL), Greece (GR), Bulgaria (BG), Slovenia (SI), Slovakia (SK) and Hungary (HU)). The statistical data that is used for the elaboration of econometric models is presented in Table 1, for RO, and in Table 2 for the EU27.

Table 1. GE by types of expenditures (RO, 2009-2018).

Year	GE on education		GE on health		GE for general public services		GE on defense		GE on public order and safely		G.D.P. current prices euro per capita
	Proportion in GDP (%)	Euro per capita y_1	Proportion in GDP (%)	Euro per capita y_2	Proportion in GDP (%)	Euro per capita y_3	Proportion in GDP (%)	Euro per capita y_4	Proportion in GDP (%)	Euro per capita y_5	x
2009	3.8	233.70	4.0	246.00	4.2	258.30	1.4	86.100	2.0	123.00	6,150
2010	3.3	204.27	4.2	259.98	4.6	284.74	1.5	92.850	2.4	148.56	6,190
2011	4.1	268.55	4.2	275.10	4.9	320.95	0.8	52.400	2.2	144.10	6,550
2012	3.0	199.20	3.8	252.32	4.9	325.36	0.7	46.480	2.2	146.08	6,640
2013	2.8	201.32	4.0	287.60	4.9	352.31	0.7	50.330	2.2	158.18	7,190
2014	3.0	226.50	4.0	302.00	4.7	354.85	0.7	52.850	2.1	158.55	7,550
2015	3.1	250.79	4.2	339.78	4.8	388.32	0.9	72.810	2.3	186.07	8,090
2016	3.3	285.45	4.0	346.00	4.4	380.60	1.7	147.05	2.0	173.00	8,650
2017	2.8	268.24	4.3	411.94	4.2	402.36	1.8	172.44	2.0	191.60	9,580
2018	2.2	231.22	4.7	493.97	4.6	483.46	1.7	178.67	2.2	231.22	10,510

Note: General public order and public order services meet general public needs and their cost is borne by society as a whole, mainly at the expense of budgetary resources. General public authorities include: Institutions of power and public administration (general public services) which include: Presidential institution; Institutions of central and local legislature (parliaments, unicameral or bicameral; councils or local authorities); Institutions of the judiciary; Central and local executive institutions (government, ministries, prefectures, town halls and other institutions); Public order institutions (public order and safely), include: The police; Gendarmerie; Information services; Special security and protection services.

Table 2. Total GE by types of expenditures (EU27, 2009-2018).

Year	GE on education		GE on health		GE for general public services		GE on defense		GE on public order and safely		GDP. current prices euro per capita
	Proportion in GDP (%)	Euro per capita y_1	Proportion in GDP (%)	Euro per capita y_2	Proportion in GDP (%)	Euro per capita y_3	Proportion in GDP (%)	Euro per capita y_4	Proportion in GDP (%)	Euro per capita y_5	x
2009	5.1	1,187.53	7.3	1,699.80	7.2	1,676.52	1.4	325.99	1.8	419.13	23,285
2010	5.0	1,245.00	7.2	1,792.80	7.1	1,767.90	1.3	323.70	1.8	448.20	24,900
2011	4.9	1,256.36	7.1	1,820.44	7.2	1,846.08	1.3	333.32	1.7	435.88	25,640
2012	4.9	1,261.75	7.1	1,828.25	7.4	1,905.50	1.3	334.75	1.7	437.75	25,750
2013	4.9	1,274.00	7.1	1,846.00	7.2	1,872.00	1.2	312.00	1.7	442.00	26,000
2014	4.9	1,300.95	7.1	1,885.05	7.0	1,858.50	1.2	318.60	1.7	451.35	26,550
2015	4.8	1,318.08	7.1	1,949.66	6.6	1,812.36	1.2	329.52	1.7	466.82	27,460
2016	4.7	1,323.52	7.0	1,971.20	6.3	1,774.08	1.2	337.92	1.7	478.72	28,160
2017	4.6	1,344.58	7.0	2,046.10	6.1	1,783.03	1.2	350.76	1.6	467.68	29,230
2018	4.6	1,387.36	7.0	2,111.20	6.0	1,809.60	1.2	361.92	1.7	512.72	30,160

3. RESULTS AND DISCUSSION

3.1. RO'S POSITION IN THE EU THROUGH THE DYNAMICS OF GE, BY TYPES OF EXPENDITURES AND GDP PER CAPITA

The situation presented in Table 3 allows locating RO's position in the general context of the EU, both in terms of GE on average per capita and GDP per capita, recorded between 2009 and 2018. The increase of the GDP per inhabitant of RO was marked by an average annual growth rate of 6.13%, higher than the general European rate of 2.92%. There is an average advance coefficient of +3.12% per year, but the average annual absolute increase in

RO is at a much lower level, 484.444 euros compared to 763.889 euros. Government spending on average education per capita was at an average annual rate of decrease of 0.12% compared to the average annual change in the EU which was positive, +1.74%. It is a situation that may explain some of the shortcomings identified in the field of education. Government spending on health per capita on average increased by an average annual rate of +8.05% which is ahead by an average of 5.48% the average rate of the EU positioned at +2.44% but the absolute average annual growth in RO, is at a much lower level, 27.552 euros compared to 45.711 euros. Government spending on general public services on average per capita increased at an average annual rate of +7.21%, a rate higher than the average recorded by the EU27 which were at a minimum below 1%, +0.85%. Government spending on defense per capita on average also has a marked evolution of significant relative increases, +8.45% annually while in the EU the average annual growth was +1.17%. The absolute average annual increase of +10.286 euros recorded by RO is 2.58 times higher than in the EU. Government spending on public order and safety on average per capita is positioned at an average annual growth rate of +7.26% with a size higher than the overall European pace which was +2.26%. The absolute average annual increase of +12,024 euros that RO registers are higher by 15.63% than at the level of the EU which carries forward +10.399 euros.

Table 3. Dynamics of GE and GDP per capita, by synthetic statistical indicators (EU27 and RO).

GE and GDP	Territorial area	Average annual growth rate (decrease)	Annual average absolute increase (decrease) (euro)	Absolute increase (decrease) 2018 compared to 2009 (euro)	Relative increase (decrease) 2018 compared to 2009
GE for **education** per capita	27 *states –EU*	+1.74%	+22.203	+199.825	+16.83%
	RO	**-0.12%**	**-0.276**	**-2.480**	**-1.06%**
GE for **health** per capita	27 *states –EU*	+2.44%	+45.711	+411.395	24.20%
	RO	**+8.05%**	**+27.552**	**+247.970**	**+100.80%**
GE for **general public services** per capita	27 *states –EU*	+0.85%	+14.787	+133.080	+7.94%
	RO	**+7.21%**	**+25.018**	**+225.160**	**+87.17%**
GE for **defense** per capita	27 *states –EU*	+1.17%	+3.992	+35.930	+11.02%
	RO	**+8.45%**	**+10.286**	**+92.570**	**+107.51%**
GE for **public order and safely** per capita	27 *states –EU*	+2.26%	+10.399	+93.590	+22.33%
	RO	**+7.26%**	**+12.024**	**+108.220**	**+87.98%**
G.D.P. current prices per capita	27 *states –EU*	+2.92%	+763.889	+6875	+29.53%
	RO	**+6.13%**	**+484.444**	**+4360**	**+70.89%**

In the context of this analysis, it is worth noting the concerns and governmental decisions of RO to increase the expenditures for the priority support of the fields: defense, public order, and safety, general public services, and health. Suppose it is necessary to know the number of years after which the levels of GDP per capita registered in RO and the EU is equalized. In that case, the following calculation relation is applied, under the conditions of maintaining the average annual growth indices from the years 2010-2018 [31]:

$$\sqrt[n]{\frac{X_A}{X_B}} = \frac{\bar{I}_B}{\bar{I}_A};\quad n = \frac{\log_{10} X_A - \log_{10} X_B}{\log_{10} \bar{I}_B - \log_{10} \bar{I}_A}, \tag{1}$$

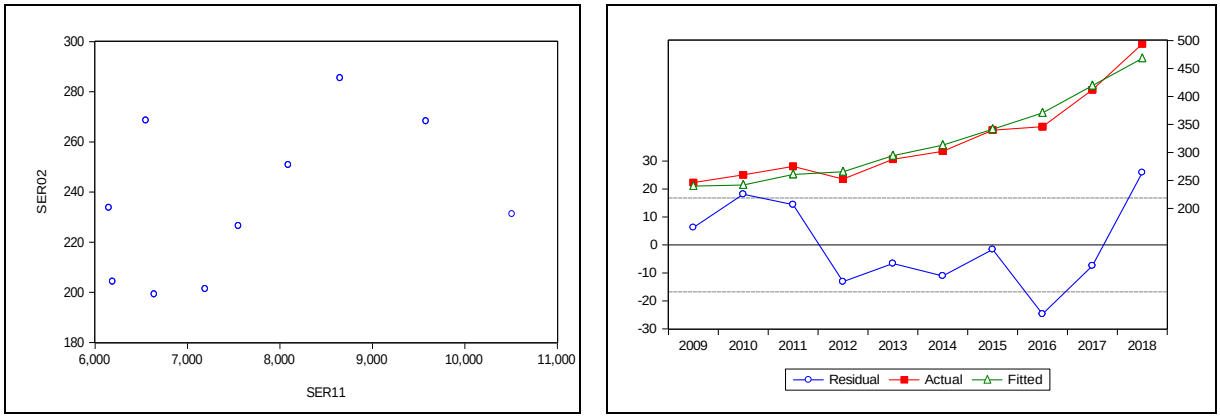
$$\sqrt[n]{\frac{X_{EU}}{X_R}} = \frac{\bar{I}_R}{\bar{I}_{EU}} \rightarrow \sqrt[n]{\frac{30160}{10510}} = \frac{1.06}{1.03} \rightarrow\quad n = \frac{\log_{10} 30160 - \log_{10} 10510}{\log_{10} 1.06 - \log_{10} 1.03} \tag{2}$$

$$n= \frac{4.47943-4.02160}{0.02530- 0.01283} = \frac{0.45783}{0.01247} = 36.71 = 37 \text{ years} \quad (3)$$

In which, X_{EU}=30,160 euro, XR=10,510 euro are the levels of GDP per capita in 2018 related to the EU27 and RO respectively, $\bar{I}_{EU}$=1.03, $\bar{I}_R = 1.06$ are the average annual growth indices of the GDP per capita (estimated as simple geometric averages) for the EU and for RO, respectively. The result obtained can signal the need for and application of economic growth scenarios to reduce the calculated gap estimate: 37 years.

3.2. ECONOMETRIC ANALYSIS WITH SIMULTANEOUS EQUATIONS OF THE DYNAMICS OF GE PER CAPITA, BY TYPES OF EXPENDITURES, DEPENDING ON THE DYNAMICS OF THE GDP PER INHABITANT OF RO

In the case of GE on average education per capita, no viable model of correlation with GDP per capita is identified. The graphical representation of this interdependence relationship is sufficiently edifying. The "point cloud" has a disposition that does not outline a certain statistical legitimacy, Figure 1. Between 2009 and 2018, the governmental decisions regarding the execution of this category of expenditures were based on priority considerations of a political nature, limited to a logic that can be considered subjective [32]. The lowest value is found in 2012, 199.20 euros, and the highest in 2016, 285.45 euros. Based on the communicated statistical data, the last three years of the analyzed period are also identified with successive decreases from 285.45 euros in 2016, expenses for education per inhabitant to 231.22 euros in 2018.



(a) **(b)**

Figure 1. Graphical representation (a) of the dynamics of expenditures for education per capita - SER02, (euro) depending on the dynamics of the gross domestic product, per capita - SER11, (euro) in RO (b) of residues (Residual), basic calculation levels (Actual) and levels estimates of the dynamics of GE for health on average per capita according to the dynamics of the GDP per capita (Fitted) (Linear one-factor econometric model).

The mathematical form of the model and the indicators of econometric representation are shown in Table 4. In Fig. 1b., are graphically represented the residues, the basic calculation levels, and the estimated levels of dynamics of GE for health on average per capita according to the dynamics of GDP per capita.

Table 4. Synoptic table of the system of indicators of econometric representation forth one-factor linear model of the dynamics of government expenditures for health on average per capita depending on the dynamics of the gross domestic product per capita (2009-2018, Romania).

Dependent Variable: SER04 = y_2 = ***Government expenditures for health on average per capita (euro)***				
Method: Least Squares				
Sample: 2009 - 2018; Included observations: 10				
$\hat{y}_2$ = a+b*x →$\hat{y}_2$ = -82.29521+0.052369*x				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
$SER11 = x$ = G.D.P. current prices euro per capita "*b*"	0.052369	0.003760	13.92916	0.0000
C "*a*"	-82.29521	29.46807	-2.792691	0.0235
R-squared	0.960400	Mean dependent var		321.4690
Adjusted *R*-squared	0.955450	S.D. dependent var		79.45155
S.E. of regression	16.76969	Jarque-Bera		0.475159
Sum squared resid	2249.779	Prob. (*J-B*)		78.8534%
R	0.98000	Hannan-Quinn criter.		8.587492
F-statistic	194.0214	Durbin-Watson stat.		1.335608
Prob. (*F*-statistic)	0.000001	Theil Inequality Coefficient		2.2725%
Heteroskedasticity Test: White	*F*-statistic = 1.854847; Prob. *F* (2; 7)			0.2257
	Chi-Square, $\chi^2 = 3.463866$; Prob. Chi-Square (2)			0.1769

The model of the dynamics of GE for health on average per capita depending on the dynamics of the GDP per capita for 2009-2018, it has the following mathematical form:

$$\hat{y}_2=a+b*x \rightarrow \hat{y}_2=-82.29521+0.052369*x \quad (4)$$

The model has the necessary statistical support to assess that it is fully viable and can be used to substantiate macroeconomic decisions regarding the financing of the health field in terms of the following indicators of econometric representation [33]: (1) The correlation ratio R=0.98 is statistically confirmed as significantly different from zero (therefore the correlation is real and strong). (2) Based on the coefficient of determination, R2 finds that 96.04% of the change in government spending on average health per capita is explained by the change in GDP per capita. (3) The size of the coefficient "b" is statistically confirmed as significantly different from zero (it allows us to appreciate that at an increase of 100 euros of GDP per capita, government spending on health on average per capita increases by 5.2369 euros). (4) The residual variable is distributed asymptotically normally according to the probability of 78.8534% associated with the Jarque-Bera statistical coefficient that follows a distribution law $\chi 2$ with 2 degrees of freedom. (5) The model is homoscedastic, the dispersion of the error term is constant, it does not correlate with the exogenous variable (GDP per capita), according to the results provided by both Criterion F and Criterion Chi-Square. (6) The Durbin-Watson statistical coefficient by its size, (DW=1.335608), confirms that the residual variable does not auto correlate, based on the Durbin-Watson statistical distribution, as follows: $d2=1.320<DW=1.335608<(4-d2)=2.680$, for a significance threshold of 5% and $n = 10$. (6) Theil Inequality Coefficient has a size below the threshold of 5% (Th=2.2725%), and in these conditions supports the option of predicting government health spending on average per capita depending on the increase predictable GDP per capita. The evolution of the health expenditures, the anticipation of future health expenditures, and the source of that funding are considered vital for effective health policy [34].

The mathematical form of the model and the indicators of econometric representation are presented in Table 5, and in Figure 2 are graphically represented the residues, the basic calculation levels, and the estimated levels of the dynamics of GE for general public services on average per capita according to GDP per capita dynamics.

Table 5. Synoptic table of the system of indicators of econometric representation for the linear one-factor model of the dynamics of government expenditures for public services general on average per capita depending on the dynamics of the gross domestic product per capita (2009-2018, Romania).

Dependent Variable: SER06 = y_3 = ***Government expenditures for general public services on average per capita (euro)***				
Method: Least Squares				
Sample: 2009 - 2018; Included observations: 10				
$\hat{y}_3$=a+b*x →$\hat{y}_3$=39.19008+0.040977*x				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
$SER11 = x$ = G.D.P. current prices euro per capita "*b*"	0.040977	0.004646	8.819654	0.0000
C "*a*"	39.19008	36.41622	1.076171	0.3132
R-squared	0.906745	Mean dependent var		355.1250
Adjusted *R*-squared	0.895088	S.D. dependent var		63.98169
S.E. of regression	20.72374	Jarque-Bera		1.278366
Sum squared resid	3435.786	Prob. (*J-B*)		52.7723%
R	0.95223	Hannan-Quinn criter.		9.010906
F-statistic	77.78630	Durbin-Watson stat		1.289169
Prob. (*F*-statistic)	0.000021	Theil Inequality Coefficient		2.5742%
Heteroskedasticity Test: White	*F*-statistic = 0.144712; Prob. *F* (2; 7) Chi-Square, , $\chi^2 = 0.397047$; Prob. Chi-Square (2)			0.8678 0.8199

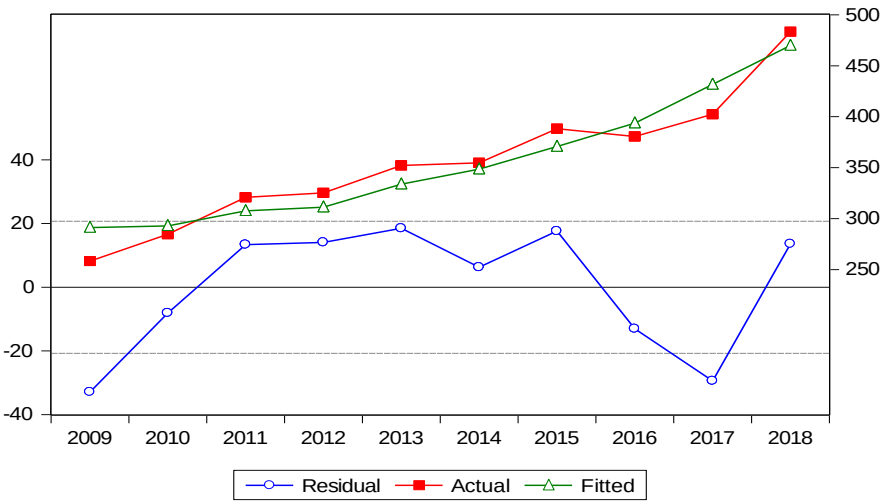


Figure 2. Graphical presentation of residues (Residual), basic calculation levels (Actual) and levels estimates of the dynamics of GE for general public services on average per capita according to the dynamics of the GDP per capita (Fitted) - (Linear one-factor econometric model)

The model of the dynamics of GE for general public services on average per capita depending on the dynamics of the GDP per capita regarding the period 2009-2018 has the following mathematical form:

$$\hat{y}_3=a+b*x \rightarrow \hat{y}_3=39.19008+0.040977*x \quad (5)$$

The model has the necessary statistical support to assess that it is fully viable and can be used to substantiate macroeconomic decisions on the financing of general public services in terms of the following indicators of econometric representation: (1) The correlation ratio R=0.95223 is statistically confirmed as significantly different from zero, and therefore the correlation is real and strong. (2) Based on the coefficient of determination, R2 finds that 90.6745% of the change in GE on general public services on average per capita is explained by the change in GDP per capita. (3) The size of the coefficient "b" is statistically confirmed

as significantly non-zero and allows us to appreciate that at an increase of 100 euros of GDP per capita, GE on general public services on average per capita increases by 4.0977 euros. (4) The residual variable does not have the necessary statistical support to estimate that it is distributed asymptotically normally according to the probability of 52.7723% associated with the statistical coefficient Jarque-Bera which, follows a distribution law $\chi 2$ with 2 degrees of freedom, because it is within the indecision range 50%-60%. (5) The model is homoscedastic, the dispersion of the error term is constant, it does not correlate with the exogenous variable (GDP per inhabitant), according to the results provided by both Criterion F and Criterion Chi-Square [35]. (6) The Durbin-Watson statistical coefficient by its size, (DW=1.289169), induces the conclusion of indecision because for a significance threshold of 5% and n=10, the residual variance is auto-correlated and for a significance threshold of 1%, and n=10, the residual variance is not auto correlated, based on the Durbin-Watson statistical distribution and under these conditions the null hypothesis is rejected. The model is thus marked by the existence of a state of vulnerability in terms of the correct assessment of the significance of the model's location estimators and the intensity of the interdependence between the system variables is higher than in reality. Similarly, Lee, formulate the Z test on Durbin-Watson (DW) statistics by publicly distributing the sample of DW statistics under the assumption of being a serial correlation [36]. (7) The Inequality Coefficient has a size below the 5% threshold (Th=2.5742%). In these conditions, it supports the option of predicting GE for general public services on average per capita of the foreseeable increase of the GDP per capita. The simulation model's credibility is validated by the classical method of Theil's inequality coefficient, although the consistency between the simulation and the reference output is analyzed [37]. The mathematical form of GE's dynamics for defense on average per capita depending on the dynamics of the GDP per capita, the model, and the indicators of econometric representation are shown in Table 6. Figure 3 graphically represented the residues, the basic calculation levels, and the estimated levels of dynamics of GE for defense on average per capita according to the dynamics of GDP per capita.

Table 6. Synoptic table of the system of indicators of econometric representation for the linear one-factor model of the dynamics of government expenditures for defence on average per capita depending on the dynamics of the gross domestic product per capita (2009-2018, Romania).

Dependent Variable: : SER08 $= y_4$ = ***Government expenditure for defense on average per capita (euro)***				
Method: Least Squares				
Sample: 2009 - 2018; Included observations: 10				
$\hat{y}_4$=a+b*x →$\hat{y}_4$=-124.9329+0.028551*x				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
$SER11 = x$ = G.D.P. current prices euro per capita "*b*"	0.028551	0.007092	4.025857	0.0038
C "*a*"	-124.9329	55.58676	-2.247529	0.0548
R-squared	0.669524	Mean dependent var		95.19800
Adjusted *R*-squared	0.628215	S.D. dependent var		51.87982
S.E. of regression	31.63330	Jarque-Bera		1.006340
Sum squared resid	8005.327	Prob. (*J-B*)		60.4611%
R	0.818244	Hannan-Quinn criter.		9.856767
F-statistic	16.20752	Durbin-Watson stat		0.837667
Prob. (*F*-statistic)	0.003810	Theil Inequality Coefficient		13.4390%
Heteroskedasticity Test: White	*F*-statistic = 1.247923; Prob. *F* (2; 7) Chi-Square, $\chi^2 = 2.628355$; Prob. Chi-Square (2)			0.3439 0.2687

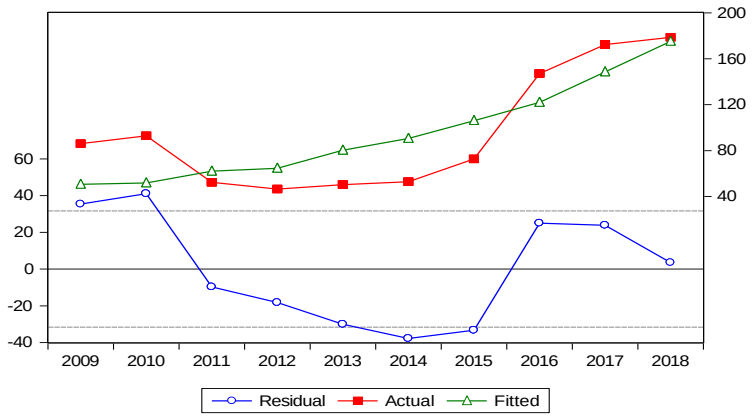


Figure 3. Graphical presentation of residues (Residual), basic calculation levels (Actual), and levels estimates of the GE for defense on average per capita according to the dynamics of the GDP per capita (Fitted) (Linear one-factor econometric model)

The model of GE's dynamics for defense on average per capita depending on the dynamics of the GDP per capita for 2009-2018 has the following mathematical form:

$$\hat{y}_4=a+b*x \rightarrow \hat{y}_4=-124.9329+0.028551*x \quad (6)$$

The correlation ratio R=0.818244 is statistically confirmed as significantly different from zero, and therefore, the correlation is real and strong. Based on the coefficient of determination, R2 finds that the change in GDP per capita explains 66.9524% of GE's change for defense on average per capita. The difference up to 100% is the influence of other unspecified factors or the residual variable. The size of the coefficient "b" is statistically confirmed as significantly different from zero. It allows appreciating that at an increase of 100 euros of GDP per capita, GE for defense on average per capita increases by 2.8551 euros. The residual variable is distributed asymptotically normally according to the probability of 60.4611% associated with the Jarque-Bera statistical coefficient that follows a distribution law $\chi 2$ with 2 degrees of freedom, because it exceeds the limit of 60% as the null hypothesis exception threshold. The model is homoscedastic, the dispersion of the error term is constant, and it does not correlate with the exogenous variable (GDP per capita), according to the results provided by both Criterion F and Criterion $\chi 2$. The Durbin-Watson statistical coefficient by its size, (DW=0.837667), confirms the existence of a vulnerability state of the model because the residual variable is auto-correlated, based on the Durbin-Watson statistical distribution, (d2=1.320>DW=0. 837667<(4-d2) =2.680), for a significance threshold of 5% and n=10. Theil Inequality Coefficient (Theil Inequality Coefficient) has a size above the threshold considered as an acceptable limit of 5%, (Th=13.4390%). In these conditions, the option to predict GE for defense on average per capita in depending on the foreseeable increase of the GDP per capita may have a high degree of uncertainty respectively, the confidence interval of the prediction will have vast limits of confirmation of the value achieved. Also, a very high magnitude of the proportion of the estimation of the regression's standard error in the average value of the dependent variable, in percentage expression, which is 33.23% and thus supports the significance of the inequality coefficient Theil, is identified [38].

The mathematical form of the model and the indicators of econometric representation of GE's dynamics for public order and safety on average per capita according to the GDP per capita dynamics are shown in Table 7.

Table 7. Synoptic table of the system of indicators of econometric representation for the linear one-factor model of government expenditures dynamics for public order and safely on average per capita depending on the dynamics of the gross domestic product per capita (2009-2018, Romania).

Dependent Variable: $SER10 = y_5$ = ***Government expenditures for public order and safely on average per capita (euro)***				
Method: Least Squares				
Sample: 2009 - 2018; Included observations: 10				
$\hat{y}_5$=a+b*x →$\hat{y}_5$=14.79973+0.019616*x				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
$SER11 = x$ = G.D.P. current prices euro per capita "*b*"	0.019616	0.002313	8.478999	0.0000
C "*a*"	14.79973	18.13260	0.816194	0.4380
R-squared	0.899867	Mean dependent var		166.0360
Adjusted *R*-squared	0.887350	S.D. dependent var		30.74451
S.E. of regression	10.31890	Jarque-Bera		0.814738
Sum squared resid	851.8374	Prob. (*J-B*)		66.5399%
R	0.948613	Hannan-Quinn criter.		7.616301
F-statistic	71.89342	Durbin-Watson stat		2.483348
Prob. (*F*-statistic)	0.000029	Theil Inequality Coefficient		2.7395%
Heteroskedasticity Test: White	*F*-statistic = 0.364328; Prob. *F* (2; 7) Chi-Square, χ^2 = 0.942797; Prob. Chi-Square (2)			0.7071 0.6241

The model of GE'S dynamics for public order and safety on average per capita depending on the dynamics of the GDP per capita for 2009-2018 has the following mathematical form:

$$\hat{y}_5=a+b*x \rightarrow \hat{y}_5=14.79973+0.019616*x \quad (7)$$

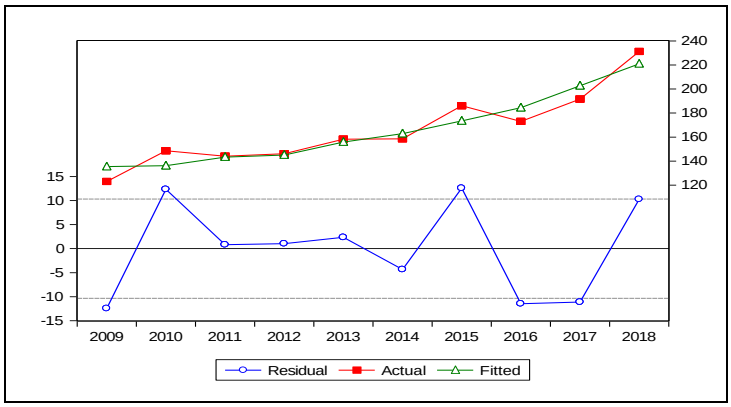


Figure 4. Graphical presentation of residues (Residual), basic calculation levels (Actual) and levels estimates of the dynamics of GE for public order and safety on average per capita according to the dynamics of the gross GDP per capita (Fitted) - (Linear one-factor econometric model)

The model has the necessary statistical support to assess that it is fully viable and can be used to substantiate macroeconomic decisions regarding the financing of public order and security conditions institutions in the light of the following indicators of econometric representation. The correlation ratio R=0.948613 is statistically confirmed as significantly different from zero, and therefore, the correlation is real and strong. Based on the coefficient of determination, R2 finds that 89.9867% of the change in GE on public order and safety on average per capita is explained by the change in GDP per capita. The size of the coefficient "b" is statistically confirmed as significantly non-zero and allows us to estimate that at an increase of 100 euros of GDP per capita, government spending on public order and average safety per capita are increases by 1.9616 euros. The residual variable is distributed

asymptotically normally according to the probability of 66.5399% associated with the statistical coefficient Jarque-Bera which follows a distribution law $\chi 2$ with 2 degrees of freedom. The model is homoscedastic, the dispersion of the error term is constant, it does not correlate with the exogenous variable (GDP per capita), according to the results provided by both Criterion F and Criterion $\chi 2$. The Durbin-Watson statistical coefficient by its size, (DW = 2.483348), it is confirmed that the residual variable does not auto correlate, based on the Durbin-Watson statistical distribution and thus supports the viability of the model, $d2 = 1.320 < DW = 2.483348 < (4 - d2) = 2.680$, for a significance threshold of 5% and $n = 10$. Theil Inequality Coefficient has a size below the 5% threshold (Th=2.7395%), and in these circumstances supports the option of predicting GE for public order and safety on average per capita according to the foreseeable increase of the GDP per capita.

3.3. ANALYSIS OF THE DYNAMICS OF GE PER CAPITA, BY TYPES OF EXPENDITURES, DEPENDING ON THE DYNAMICS OF THE GDP PER CAPITA FOR EU27

The analysis of GE's dynamics for education/heal/general public service/defense/public order and safety on average per capita, according to GDP's dynamics of the EU27 states, aims to define a mathematical model that summarizes the legitimacy of the trend of this relationship with statistically recognized viability valences. The graphical representation of GE's dynamics for these five categories on average per capita according to the GDP's dynamics per capita (Figure 4) provides sufficiently edifying information, through the arrangement of the point cloud, on the form in which took place the relationship between the two variables during the analyzed period, (2009-2018). The most basic regression relationship is a simple linear regression [39]. In these dynamic series conditions, it is considered suitable to opt for a linear regression equation, $\hat{y}_n = a + b * x$, for the estimated level series. The real levels are represented by the equation: $\hat{y}_n = a + b * x + u$, where "Yn" is the endogenous variable (Y1 average GE on education per capita; Y2 average GE on health per capita; Y3 average GE for general public service per capita; Y4 average GE for defense per capita; Y5 average GE for public order and safety per capita) "x" is the exogenous variable (GDP per capita) and "u" is the residual variable. The analytical form of the model and the indicators of econometric representation are shown in Table 8. Figure 5 graphically represents residues, baseline levels, and estimated GE dynamics levels for the five categories of expenditures on average per capita depending on the dynamics of the GDP per capita. The econometric model of GE dynamics for education on average per capita depending on the dynamics of GDP per capita has the following mathematical form for the analyzed period:

$$\hat{y}_1 = a + b*x \rightarrow \hat{y}_1 = -562.9922 + 0.27212*x \quad (8)$$

The model has the necessary statistical support to assess that it is fully viable and can be used to inform and substantiate the decisions of EU states regarding GE, for education per capita in terms of the following indicators of econometric representation: The correlation ratio, R=0.988360 is statistically confirmed as significantly different from zero, and therefore, the correlation is real and very strong. Based on the coefficient of determination, R2 finds that the change in GDP per capita explains 97.6855% of the change in GE for education on average per capita, the difference up to 100% is due to other influencing factors not included in the model or of the residual variable.

Table 8. Synoptic table of the system of indicators of econometric representation for the linear one-factor model of the dynamics of government expenditures for education per capita depending to the dynamics of the gross domestic product per capita (27 countries - EU).

Dependent Variable: y_1 = ***Government expenditures for education on average per capita (euro)***				
Method: Least Squares				
Sample: 2009 – 2018; Included observations: 10				
$\hat{y}_1$=a+b*x →$\hat{y}_1$=-562.9922+0.27212*x				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
x = G.D.P. current prices euro per capita „*b*”	0.027212	0.001481	18.37502	0.0000
C “*a*”	562.9922	39.66693	14.19299	0.0000
R-squared	0.976855	Mean dependent var		1289.914
Adjusted *R*-squared	0.973961	S.D. dependent var		56.95967
S.E. of regression	9.191278	Jarque - Bera		0.211229
Sum squared resid	675.8368	Prob. (*J-B*)		89.9771%
R	0.988360	Hannan-Quinn criter.		7.384857
F-statistic	337.6413	Durbin-Watson stat		1.557248
Prob. (*F*-statistic)	0.000000	Theil Inequality Coefficient		0.3184%
Heteroskedasticity Test: White	*F*-statistic = 0.085874; Prob. *F* (2; 7) Chi-Square, , χ^2 = 0.239480; Prob. Chi-Square (2)			0.9187 0.8872

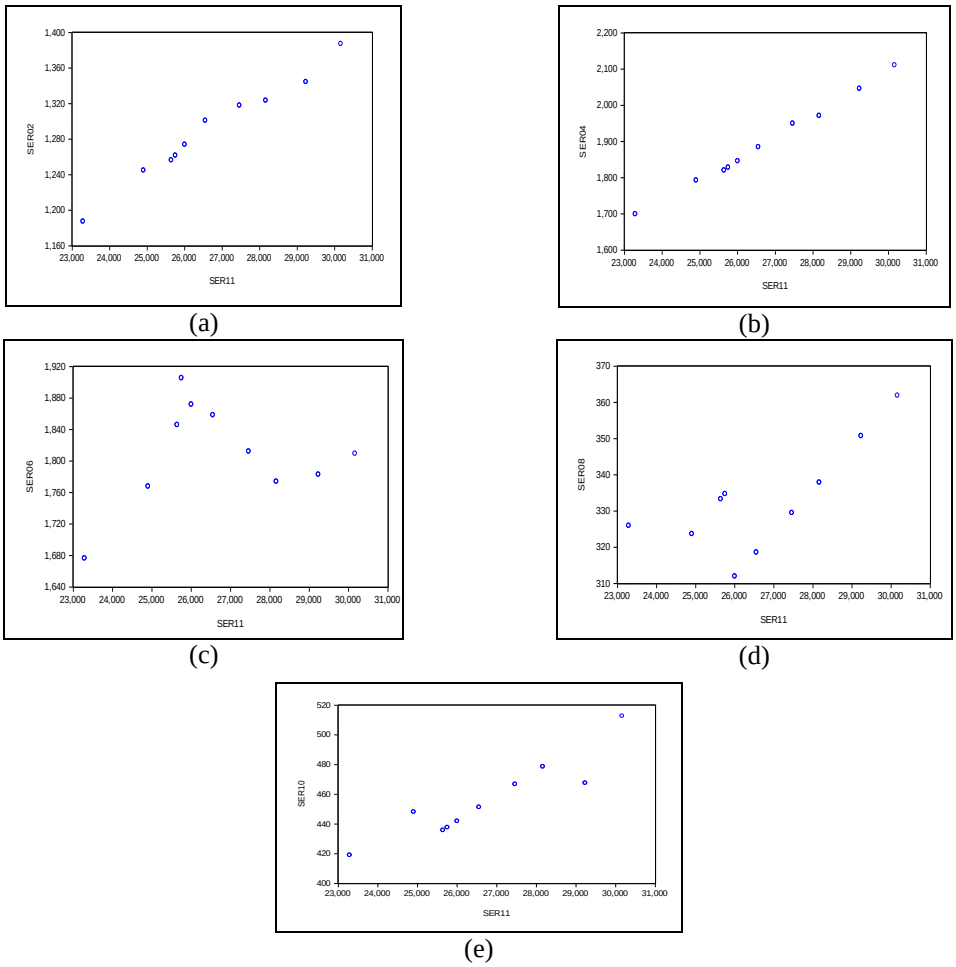


Figure 5. Graphical representation of the correlation between the dynamics of GE (a) for education (b) for health (c) for general public service (d) for defense (e) for public order and safety on average per capita with the dynamics of the GDP per capita

Note: SER02 = y1; SER04 = y2; SER06 = y3; SER08 = y4; SER10 = y5; SER11 = x

The size of the coefficient "b" is statistically confirmed as significantly different from zero. It allows us to appreciate that at an increase of 100 euros of GDP per capita, GE for education on average per capita for the 27 states of the EU is increased by 2,7212 euros during the research period. The residual variable is distributed asymptotically normally, according to the probability of 89.9771% associated with the Jarque-Bera statistical coefficient following a distribution law $\chi 2$ with 2 degrees of freedom, being positioned above the agreed limit of 60%.

This statistical finding supports the efficiency and safety of the attestation model. The model is homoscedastic, the dispersion of the error term is constant, and it does not correlate with the exogenous variable (GDP per capita), according to the results provided by both Criterion F and Criterion $\chi 2$. The Durbin-Watson statistical coefficient by its size (DW=1.557248) confirms that the residual variable does not auto-correlated based on the Durbin-Watson statistical distribution. This statistical test provides safety information in establishing and assessing the viability of the model. Theil Inequality Coefficient has a size below the 5% threshold (Th=0.3184%). These conditions support the option of predicting GE for education on average per capita based on the foreseeable increase in GDP per capita.

The model of GE dynamics for health on average per capita, depending on the dynamics of the GDP per capita, regarding the period 2009-2018, it has the following mathematical form:

$$\hat{y}_2=a+b*x \rightarrow \hat{y}_2=291.7764+0.060017*x \quad (9)$$

The model has the necessary statistical support to assess that it is viable and can be used to inform and substantiate EU countries' decisions regarding GE for health per capita, in terms of the following indicators of econometric representation. The correlation ratio R=0.997582 is statistically confirmed as significantly different from zero, and therefore, the correlation is real and very strong (Table 9). Based on the coefficient of determination, R2 finds that the change in GDP per capita explains 99.5169% of the change in government expenditure for health on average per capita, the difference up to 100% is due to other influencing factors not included in the model, or of the residual variable.

The size of the coefficient "b" is statistically confirmed as significantly non-zero. It allows estimating that at a 100 euros increase in GDP per capita, government expenditure for health on average per capita for the 27 states of the EU is increased by 6.0017 euros during the research period. The residual variable does not have the necessary statistical support to estimate that it is distributed asymptotically normally according to the probability of 57.8277% associated with the statistical coefficient Jarque-Bera, which follows a distribution law $\chi 2$ with 2 degrees of freedom, because it is in the range of indecision 50%-60%. The model is homoscedastic, the dispersion of the error term is constant, and it does not correlate with the exogenous variable (GDP per inhabitant), according to the results provided by both Criterion F and Criterion $\chi 2$. The Durbin-Watson statistical coefficient by its size (DW=1.575884), confirms that the residual variable does not auto-correlate based on the Durbin-Watson statistical distribution. This statistical test provides safety information in establishing and assessing the viability of the model. Theil Inequality Coefficient has a size below the 5% threshold (Th=0.2161%). These conditions support the option of predicting the government expenditure for health on average per capita based on the foreseeable increase in GDP per capita.

Table 9. Synoptic table of the system of indicators of econometric representation for the one-factor linear model of the dynamics of government expenditures for health on average per capita depending on the dynamics of the gross domestic product per capita (27 countries - EU).

Dependent Variable: y_2 = ***Government expenditures for health on average per capita (euro)***				
Method: Least Squares				
Sample: 2009 – 2018; Included observations: 10				
$\hat{y}_2$=a+b*x →$\hat{y}_2$=291.7764+0.060017*x				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
x = G.D.P. current prices euro per capita „*b*”	0.060017	0.001478	40.59376	0.0000
C „*a*”	291.7764	39.60204	7.367713	0.0001
R-squared	0.995169	Mean dependent var		1895.051
Adjusted *R*-squared	0.994565	S.D. dependent var		124.4671
S.E. of regression	9.176241	Jarque - Bera		1.095404
Sum squared resid	673.6272	Prob. (*J-B*)		57.8277%
R	0.997582	Hannan-Quinn criter.		7.381582
F-statistic	1647.853	Durbin-Watson stat		1.575884
Prob. (*F*-statistic)	0.000000	Theil Inequality Coefficient		0.2161%
Heteroskedasticity Test: White	*F*-statistic = 0.331690; Prob. *F* (2; 7) Chi-Square, , χ^2 = 0.865649; Prob. Chi-Square (2)			0.7284 0.6487

The graphical representation of the dynamics of GE for general public services on average per capita according to the dynamics of GDP per capita (Figure 5c.) provides sufficiently useful information, through the arrangement of the "point cloud", on the form in which the relationship between the two variables took place during the analyzed period (2009-2018). In the first three years of the period (2010-2012) the expenses increase, and then, in the years 2013-2016, they decrease up to 1,774.080 euros. In the last two years, 2017-2018 there are successive increases to 1,783.030 euros, and 1,809.600 euros, respectively.

The correlation ratio R=0.883500 is statistically confirmed as significantly different from zero, and therefore, the correlation of the two variables included in the model is real and strong (Table 10). Based on the coefficient of determination, R2 finds that the change in GDP per capita explains 78.0572% of the change in GE for general public services on average per capita, the difference up to 100% is due to other influencing factors not included in the model or residual variable. The model parameters are statistically confirmed as significantly different from zero by significance thresholds below the 5% threshold. Following this test performed using Criterion t, which is based on the Student distribution law, it is concluded that the model has a correct mathematical form.

The residual variable has the necessary statistical support to estimate that it is distributed asymptotically normally according to the probability of 65.0335% associated with the statistical coefficient Jarque-Bera, which follows a distribution law $\chi 2$ with 2 degrees of freedom, because it is above the limit of 60%. The model is homoscedastic, the dispersion of the error term is constant, and it does not correlate with the exogenous variable (GDP per capita), according to the results provided by both Criterion F and Criterion $\chi 2$. The Durbin-Watson statistical coefficient by its size, (DW=1.850278), confirms that the residual variable does not auto correlate based on the Durbin-Watson statistical distribution. This statistical test provides safety information in establishing and assessing the viability of the model. Theil Inequality Coefficient has a size below the threshold of 5% (Th=0.7994%), and in these conditions supports the option of predicting GE for general public services on average per capita depending on the increase predictable GDP per capita.

Table 10. Synoptic table of the system of indicators of econometric representation for the one-factor polynomial of the 3rd degree model of the dynamics of government expenditures for public services general on average per capita depending on the dynamics of the gross domestic product per capita (27 states - EU).

Dependent Variable: SER06 = y_3 = ***Government expenditures for general public services on average per capita (euro)***				
Independent Variable: x = G.D.P. current prices euro per capita				
Method: Least Squares				
Sample: 2009 – 2018; Included observations: 10				
$\hat{y}_3$=a+b*x+c* x^2+d* x^3→$\hat{y}_3$=77,730.49+8.741435*x-0.000319* x^2+(3.87E-09)* x^3				
SER06 =C(1)+C(2)*SER11+C(3)*SER11^2+C(4)*SER11^3				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C(1) „*a*”	-77,730.49	28025.79	-2.773534	0.0323
C(2) „*b*”	8.741435	3.179387	2.749409	0.0333
C(3) „*c*”	-0.000319	0.000120	-2.662727	0.0374
C(4) „*d*”	(3.87E-09)	(1.50E-09)	2.578586	0.0418
R-squared	0.780572	Mean dependent var		1,810.557
Adjusted *R*-squared	0.670858	S.D. dependent var		65.17314
S.E. of regression	37.39039	Jarque - Bera		0.860535
Sum squared resid	8,388.248	Prob. (*J-B*)		65.0335%
R	0.883500	Hannan-Quinn criter.		10.23710
F-statistic	7.114618	Durbin-Watson stat		1.850278
Prob. (*F*-statistic)	0.021117	Theil Inequality Coefficient		0.7994%
Heteroskedasticity Test: White	*F*-statistic = 1.970862; Prob. *F* (2; 7)			0.2374
	Chi-Square, χ^2 = 6.119052; Prob. Chi-Square (2)			0.1904

The model has the necessary statistical support to assess that it is sufficiently viable and can be used to inform and substantiate EU countries' decisions regarding GE for defense per capita, in terms of the following indicators of econometric representation. The correlation ratio R=0.743560 is statistically confirmed as significantly different from zero, and therefore, the correlation is real and relatively strong (Table 11). Based on the coefficient of determination, R2 finds that the change in GDP per capita explains 55.2882% of the change in GE for defense on average per capita, the difference up to 100% is due to other influencing factors not included in the model, or of the residual variable.

Table 11. Synoptic table of the system of indicators of econometric representation for the linear one-factor model of the dynamics of government expenditures for defense on average per capita depending on the dynamics of the gross domestic product per capita (27 countries - EU).

Dependent Variable: y_4 = *Government expenditures for defense on average per capita (euro)*				
Method: Least Squares				
Sample: 2009 – 2018; Included observations: 10				
$\hat{y}_4$=a+b*x →$\hat{y}_4$=190.6197+0.005324*x				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
x = G.D.P. current prices euro per capita „*b*”	0.005324	0.001693	3.145212	0.0137
C “*a*”	190.6197	45.34247	4.203998	0.0030
R-squared	0.552882	Mean dependent var		332.8480
Adjusted *R*-squared	0.496992	S.D. dependent var		14.81375
S.E. of regression	10.50636	Jarque - Bera		0.901677
Sum squared resid	883.0696	Prob. (*J-B*)		63.7094%
R	0.743560	Hannan-Quinn criter.		7.652309
F-statistic	9.892359	Durbin-Watson stat.		1.011503
Prob. (*F*-statistic)	0.013697	Theil Inequality Coefficient		1.4107%
Heteroskedasticity Test: White	*F*-statistic = 0.092230; Prob. *F* (2; 7)			0.9130
	Chi-Square, χ^2 = 0.256748; Prob. Chi-Square (2)			0.8795

The size of the coefficient "b" is statistically confirmed as significantly non-zero. It allows estimating that at an increase of 100 euros of GDP per capita, GE for defense on average per capita for the EU27 states, is increased by 0.5324 euros, during the period included in the research. The residual variable is distributed asymptotically normally, according to the probability of 63.7094% associated with the Jarque-Bera statistical coefficient following a distribution law $\chi 2$ with 2 degrees of freedom, being positioned above the agreed limit of 60%. This statistical finding supports the efficiency and safety of attestation model. The model is homoscedastic, the dispersion of the error term is constant, and it does not correlate with the exogenous variable (GDP per capita), according to the results provided by both Criterion F and Criterion $\chi 2$. The Durbin-Watson statistical coefficient by its size (DW=1.011503), confirms that the residual variable is auto-correlated based on the Durbin-Watson statistical distribution. This statistical test, provides information that the significance of the estimators "a" and "b" is distorted. Theil Inequality Coefficient has a size below the 5% threshold (Th=1.4107%), and in these conditions supports the option of predicting GE for defense on average per capita, based on the foreseeable increase in GDP per capita.

The model has the necessary statistical support to assess that it is fully viable and can be used to inform and substantiate the decisions of EU states regarding GE for public order and safety per capita in terms of the following indicators of econometric representation. The correlation ratio R=0.921705 is statistically confirmed as significantly different from zero, and therefore, the correlation is real and very strong (Table 12).

Table 12. Synoptic table of the system of indicators of econometric representation for the linear one-factor model of the dynamics of government expenditures for public order and safely on average per capita depending on the dynamics of the gross domestic product per capita (27 states - EU).

Dependent Variable: y_5 = ***Government expenditure on public order and safely per capita (euro)***				
Method: Least Squares				
Sample: 2009 – 2018; Included observations: 10				
$\hat{y}_5$=a+b*x →$\hat{y}_5$=139.5841+0.011846*x				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
x = G.D.P. current prices euro per capita „*b*”	0.011846	0.001763	6.720921	0.0001
C “*a*”	139.5841	47.20988	2.956671	0.0182
R-squared	0.849541	Mean dependent var		456.0250
Adjusted *R*-squared	0.830734	S.D. dependent var		26.58860
S.E. of regression	10.93906	Jarque - Bera		0.182855
Sum squared resid	957.3051	Prob. (*J-B*)		91.2627%
R	0.921705	Hannan-Quinn criter.		7.733027
F-statistic	45.17078	Durbin-Watson stat		2.411383
Prob. (*F*-statistic)	0.000149	Theil Inequality Coefficient		1.0713%
Heteroskedasticity Test: White	*F*-statistic = 3.424890; Prob. *F* (2; 7) Chi-Square, χ^2= 4.945768; Prob. Chi-Square (2)			0.0918 0.0843

Based on the coefficient of determination, R2 finds that 84.9541% of the change in GE for public order and safety on average per capita is explained by the change in GDP per capita. The difference up to 100% is due to other factors influence, not included in the model or the residual variable. The size of the coefficient "b" is statistically confirmed to be significantly different from zero. It allows estimating that at an increase of 100 euros of GDP per capita, GE for public order and safety on average per capita, for the EU27 states, it increases by 1.1846 euros, during the research period. The residual variable is distributed asymptotically normally, according to the probability of 91.2627% associated with the Jarque-Bera statistical coefficient following a distribution law $\chi 2$ with 2 degrees of freedom,

being positioned above the agreed limit of 60%. This statistical finding supports the efficiency of estimators and certainty of the model. The model is homoscedastic, the dispersion of the error term is constant, and it does not correlate with the exogenous variable (GDP per capita), according to the results provided by both Criterion F and Criterion $\chi 2$. The Durbin-Watson statistical coefficient by its size (DW=1.011503), confirms that the residual variable is auto-correlated based on the Durbin-Watson statistical distribution. This statistical test provides information that the significance of the estimators "a" and "b" is distorted. Theil Inequality Coefficient has a size below the threshold of 5% (Th=1.0713%), and in these conditions supports the option of predicting GE for public order and safety on average per capita in depending on the foreseeable increase in GDP per capita.

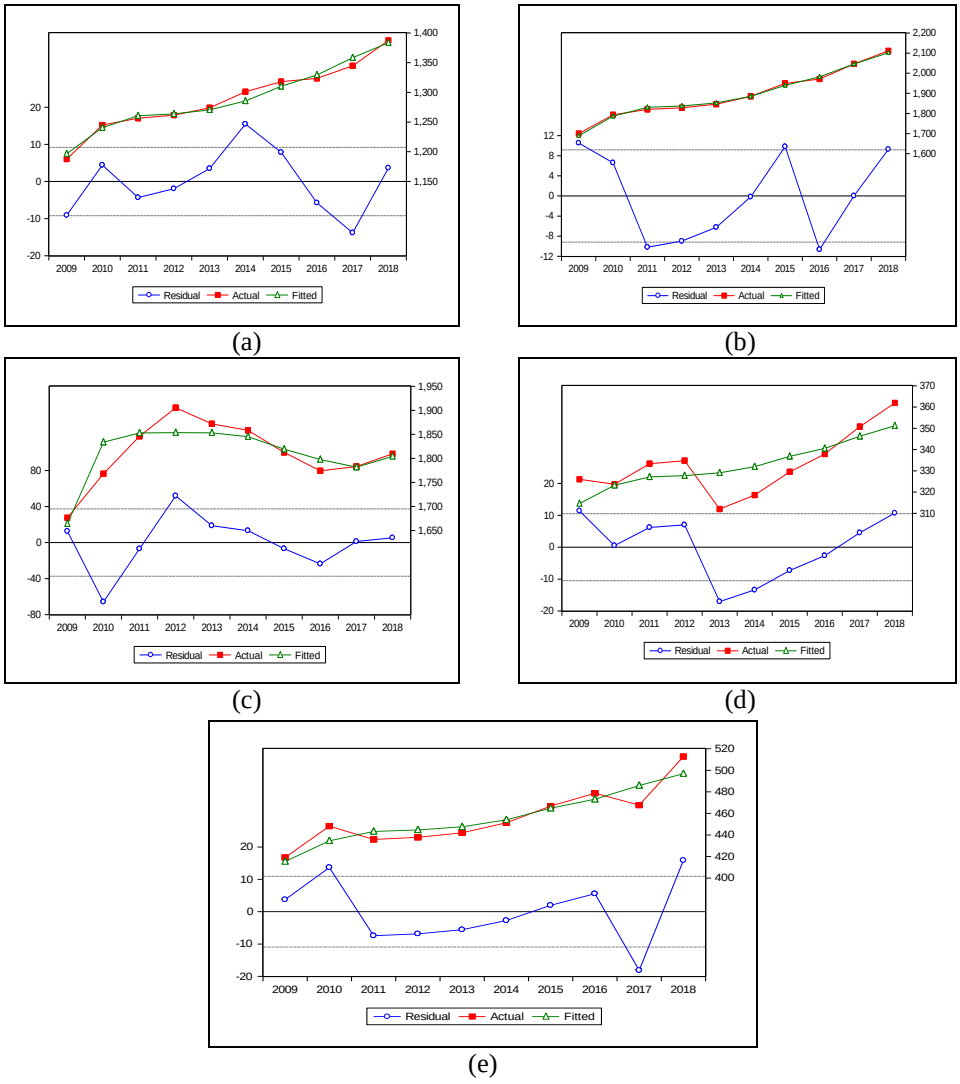


Figure 6. Graphical presentation of residues (Residual), basic calculation levels (Actual) and level estimates of the dynamics of GE for (a) education (b) health (c) general public service (d) defense (e) public order and safety public on average per capita depending on the dynamics of the GDP per capita (Fitted) - (Linear one-factor econometric model)

3.4. COMPARATIVE RESULTS REGARDING THE DEVELOPED MODELS, ON TYPES OF EXPENSES, IN THE PERIOD 2009-2018 BETWEEN RO AND THE EU

The results obtained and the analysis performed based on the econometric methodology confirm and discuss the existence of important discrepancies between RO and the EU27 regarding the amount of GE made on a structure of five categories of expenditures. Table 13 presents the results related to GE made between 2009- 2018 by RO and EU27.

Table 13. Comparative results regarding the econometric models of the dynamics of GE per capita depending on the dynamics of the GDP per capita in the period 2009-2018.

Indicators of government expenditure per capita depending on the GDP per capita	RO	EU(27)
a. Education - linear model		
b = regression coefficient	no viable model	0.027212
R^2 = coefficient of determination	is identified	0.976855
The level of expenditure per capita (euro):		
- in the year 2018	231.220	1387.360
- annual average during the period 2009-2018	236.924	1289.914
b. Health - linear model		
b = regression coefficient	0.052369	0.060017
R^2 = coefficient of determination	0.960400	0.995169
The level of expenditure per capita (euro):		
- in the year 2018	493.970	2111.200
- annual average during the period 2009-2018	321.469	1895.051
c. General public services - linear model		
b = regression coefficient	0.040977	- Polynomial gr.3 model
R^2 = coefficient of determination	0.906745	0.780572
The level of expenditure per capita (euro):		
- in the year 2018	483.460	1809.600
- annual average during the period 2009-2018	355.125	1810.557
d. Defense - linear model		
b = regression coefficient	0.028551	0.005324
R^2 = coefficient of determination	0.669524	0.552882
The level of expenditure per capita (euro):		
- in the year 2018	178.670	361.920
- annual average during the period 2009-2018	95.198	332.848
e. Public order and safely - linear model		
b = regression coefficient	0.019616	0.011846
R^2 = coefficient of determination	0.899867	0.849541
The level of expenditure per capita (euro):		
- in the year 2018	231.220	512.720
- annual average during the period 2009-2018	166.036	456.025

In the period for which the study was carried out, 2009-2018, the following aspects are noted: the average annual level of GE for education per capita is 5.44 times higher in the EU compared to the situation in RO, and in 2018 the gap is in favor of the EU (6.00 times higher). If we refer to the average annual level of GE for health per capita, they are 5.89 times higher in the EU than the situation in RO. In 2018 the gap was in favor of the EU (4.27 times higher). GE for general public services per capita on average for one year of the period we are referring to is 5.10 times higher in the EU than the situation in RO, and in 2018 the gap is in favor of the EU (3.74 times bigger). According to GE's level for defense per capita, the gap is significantly lower in 2018, 2.03 times higher in the EU compared to RO. Compared to RO, the annual average registered in the reference period is higher than 3.50 times in the EU.

The average annual level of GE for public order and safety per capita is 2.75 times higher in the EU compared to the situation in RO and in 2018 the gap is in favor of the EU

2.22 times higher. The results show the lower possibilities of RO to make government spending because there is a significant gap in terms of economic potential expressed by GDP per capita which in 2018 is 30,160 euros in the EU compared to 10,510 euros reported RO.

3.5. COMPARATIVE ANALYSIS REGARDING GE, BY TYPES OF EXPENDITURES, IN SEVEN STATES IN THE EASTERN-EU (RO, PL, GR, BG, SI, SK AND HU)

In the context of identifying RO's European positioning information, a customized study is added that targets seven states from the Eastern-EU that are comparable in terms of space, historical, political and economic traditions. It is noted that the study refers specifically to econometric analysis with simultaneous equations of the dynamics of GE per capita according to the dynamics of GDP per capita for these seven countries.

The results obtained, and the analysis performed by applying the econometric methodology confirm and discuss the existence of discrepancies between the analyzed states regarding the amount of GE incurred on average per inhabitant, on a structure of five categories of expenditures. Table 14 presents the results related to GE made between 2009-2018 by the states included in the study.

Table 14. Comparative results regarding the econometric models of the dynamics of GE per capita (y) depending on the dynamics GDP per capita (x) in the period 2009-2018.

Indicators of government expenditure per capita (y) depending on the GDP per capita (x)	RO	PL	GR	BG	SI	SK	HU
a. Education							
- linear model: $y_1 = a + bx$	no viable				no viable		
a = the constant of the model	model is	146.4522	6.407691	40.79832	model is	222.3474	18.04466
b = regression coefficient	identified	0.038475	0.041239	0.029729	identified	0.025136	0.049334
R^2 = coefficient of determination		0.937937	0.745655	0.775925		0.735410	0.873778
The level of expenditure per capita (euro):	231.220	646.000	671.190	279.300	1,192.320	658.800	698.190
- in the year 2018	236.924	553.899	737.449	223.932	1,132.567	575.760	561.956
- annual average during the period 2009-2018							
b. Health							
- linear model: $y_2 = a + bx$							
a = the constant of the model	-82.29521	41.19740	-	-108.8345	254.1898	-	141.5425
b = regression coefficient	0.052369	0.043333	1498.035	0.065497	0.054039	24.21555	0.036594
R^2 = coefficient of determination	0.960400	0.946395	0.141034	0.872762	0.929925	0.073627	0.927531
The level of expenditure per capita (euro):	493.970	620.160	0.958901	399.000	1,457.280	0.932040	643.430
- in the year 2018	321.469	500.098	860.500	294.628	1,272.881	1,202.310	544.987
- annual average during the period 2009-2018			1,002.082			1,010.976	
c. General public services							
- linear model: $y_3 = a + bx$		no viable		no viable	no viable		
a = the constant of the model	39.19008	model is	-	model is	model is	46.77021	609.7865
b = regression coefficient	0.040977	identified	2318.424	identified	identified	0.049048	0.035258
R^2 = coefficient of determination	0.906745		0.235616			0.575504	0.479541
The level of expenditure per capita (euro):	483.460	568.480	0.835034	263.340	1170.240	823.500	1,136.270
- in the year 2018	355.125	539.924	1,428.430	227.219	1136.741	736.384	998.510
- annual average during the period 2009-2018			1,858.334				

Table 14.(*continued*)

d. Defense							
- linear model: $y_4 = a + bx$				no viable model is identified	no viable model is identified		no viable model is identified
a = the constant of the model	- 124.9329	- 25.88108	-541.7368 0.055510			- 45.80379	
b = regression coefficient	0.028551	0.018381	0.808209			0.012585	
R^2 = coefficient of determination	0.669524	0.926303	344.200	87.780 75.536	220.800 203.884	0.910426	123.210
The level of expenditure per capita (euro):	178.670	206.720	442.287			164.700	96.052
- in the year 2018	95.198	168.779				131.148	
- annual average during the period 2009-2018							
e. Public order and safely							
- linear model: $y_5 = a + bx$	14.79973	82.32652	no viable model is identified	11.80280	no viable model is identified	121.1922	-163.9850
a = the constant of the model	0.019616	0.014511		0.023133		0.015204	0.035369
b = regression coefficient	0.899867	0.963617	361.410	0.804563	331.200	0.515902	0.961044
R^2 = coefficient of determination	231.220 166.036	271.320 235.995	345.540	199.500 154.305	319.153	362.340 334.959	314.870 225.960
The level of expenditure per capita (euro):							
- in the year 2018							
- annual average during the period 2009-2018							

4. CONCLUSIONS

This study is useful information support for the scientific coordination and substantiation of economic and budgetary-fiscal policies at the EU27. Concerning the period 2009 - 2018, the following classifications can be made: (a) Ranking of the seven Eastern European states, in descending order, by: average annual level of GE for education per capita: 1-SI, 2-GR, 3-SK, 4-HU, 5-PL, 6-RO and 7-BG; average annual level of GE for health per capita: 1-SI, 2-SK, 3-GR, 4-HU, 5-PL, 6-RO and 7-BG; average annual level of GE for general public services per capita: 1-GR, 2-SI, 3-HU, 4-SK, 5-PL, 6-RO and 7-BG; average annual level of GE for defense per capita: 1-GR, 2-SI, 3-PL, 4-SK, 5-HU, 6-RO and 7-BG; average annual level of GE for public order and safety per capita: 1-GR, 2-SK, 3-SI, 4-PL, 5-HU, 6-RO and 7-BG. In the case of the five categories of GE made per capita as an annual average, during the ten years for which the study was conducted, RO invariably occupies the penultimate place, a finding that requires a reconsideration of decisions in developing and implementing budgetary policy for next time. (b) Ranking of the seven Eastern-EU states, in descending order, by: the amount of GE for education made in 2018, per capita: 1-SI, 2-HU, 3-GR, 4-SK, 5-PL, 6-BG and 7-RO; the amount of GE for health made in 2018, per capita: 1-SI, 2-SK, 3-GR, 4-HU, 5-PL, 6-RO and 7-BG; the amount of GE for general public services made in 2018, per inhabitant: 1-GR, 2-SI, 3-HU, 4-SK, 5-PL, 6-RO and 7-BG; the amount of GE for defense made in 2018, per capita: 1-GR, 2-SI, 3-PL, 4-RO, 5-SK, 6-HU and 7-BG; the amount of GE for public order and safety made in 2018, per capita: 1-SK, 2-GR, 3-SI, 4-HU, 5-PL, 6-RO and 7-BG. If we refer exclusively to the situation registered in 2018, RO is also positioned on the last places except for the GE for defense made on an inhabitant when it occupies the 4th place. (c) Ranking of the seven Eastern-EU states by: the amount of GE made for education per capita when the GDP per capita increases by 100 euros: 1-HU, 2-GR, 3-PL, 4-BG, 5-SK; the amount of GE made for health per capita when the GDP per capita increases by 100 euros: 1-GR, 2-SK, 3-BG, 4-SI, 5-RO, 6-PL and 7-HU; the amount of GE made for general public services per capita when the GDP per capita increases by 100 euros: 1-GR, 2-SK, 3-RO, 4-HU; the amount of GE made for defense per capita when the GDP per inhabitant increases by 100 euros: 1-GR, 2-RO, 3-PL and 4-SK; the amount of GE made for

public order and safety per capita when the GDP per capita is increased by 100 euros: 1-HU, 2-BG, 3-RO, 4-SK, 5-PL.

Compared to the previous rankings, a different situation refers to the models with a statistically confirmed viability power by the size of the regression coefficient ("b"), which positions RO on a median place or close to the median one. In the case of SI, there is a particular conclusion that the influence of the political decision-maker, with different conjectural values from one year to the next, predominates in establishing and carrying out GE except those for health where dependence on GDP is identified as a priority factor. Based on the developed econometric models, values of endogenous variables (GE per capita) can be estimated depending on the variants of predictable scenarios for the size of the GDP per capita.

There is an obvious finding of discrepancies between states and the need to approximate the volume of GE per capita on the structure of the five categories of spending analyzed. It is clear that the existence of important differences between the states of the EU and the achievement of the desire to approximate the size of government spending per capita is under the significant influence of the historical tradition that marked each country, the different conditions in which it developed, the natural resources disposed of and how to capitalize on them. The research's results confirm the volume of GE per capita that can be considered a target to be achieved based on GDP per capita, configured as a level of economic development, and the number of years in which it can be achieved can be estimated, under certain conditions.

REFERENCES

[1] Afonso, A., *Applied Economics Letters*, **17**(2), 105, 2010.
[2] Khan A. *Fundamentals of Public Budgeting and Finance*. Palgrave Macmillan: Cham, 2019.
[3] Georgescu, G., *Procedia Economics and Finance*, **8**, 353, 2014.
[4] Glomm, G., Ravikumar, B., *Journal of Economic Dynamics and Control*, **21**(1), 183. 1997.
[5] Bruno, M., *Crisis, stabilization, and economic reform: Therapy by consensus*. Clarendon Press: Oxford, 1993.
[6] Rotar, L.J., Krsnik, S., *Society and Economy*, **42**,2020.
[7] Goossens, Y., Mäkipää, A., Schepelmann, P., Van de Sand, I., Kuhndt, M., & Herrndorf, M. *Conference Proceedings Beyond GDP Measuring progress, true wealth, and the well-being of nations*, European Parliament: Brussels, 305, 2007.
[8] Anghelache, C., Anghel, M.G., Capusneanu, S., Topor, D.I., *Economic Computation & Economic Cybernetics Studies & Research*, **53**(1), 2019.
[9] Gómez-Puig, M., Sosvilla-Rivero, S., *Acta Oeconomica*, **68**(2), 209, 2018.
[10] Alfaro, J., Lopez, V., Nevado, D., *Acta Oeconomica*, **61**(3), 293, 2011.
[11] Reinhart, C.M., Rogoff, K. S., *American economic review*, **100**(2), 573, 2010.
[12] Presbitero, A., *Eur J Dev Res 24*, 606, 2012. https://doi.org/10.1057/ejdr.2011.62
[13] Kumar, M., Woo, J., *IMF working papers*, 1, 2010.
[14] Weisz, J., *Quaestus*, (9), 101, 2016.
[15] Brady, G.L., Magazzino, C., *Journal of Quantitative Economics*, **17**(2), 361, 2019.
[16] Miron, D., Alexe, I., *Procedia Economics and Finance*, **8**, 25, 2014.
[17] Blankenau, W.F., Simpson, N.B., *Journal of development economics*, **73**(2), 583, 2004.
[18] Ponzetto, G.A., Troiano, U., *NBER Working Papers*, 24533, 2018.

[19] Tanninen, H., *Applied Economics*, **31**(9), 1109, 1999.
[20] Nathans, L.L., Oswald, F.L., Nimon, K., *Practical Assessment, Research, and Evaluation*, **17**(1), 9, 2012.
[21] Hendry, D.F., Doornik, J.A., *Empirical model discovery and theory evaluation: automatic selection methods in econometrics*. MIT Press: Cambridge, 2014.
[22] Hopkins, W.G., A new view of statistics, Internet Society for Sport Science: http://www.sportsci.org/resource/stats/, 2000
[23] Greene, E., *Econometrie*, Pearson Education Publishing: Paris, 2011.
[24] Bilan, I., Oprea, F., Cigu, E., Toderascu, C.S., *Transformations in Business & Economics*, **15**(3C), 352, 2016.
[25] Duica, M.C., Florea, N.V., Duica, A., Toplicianu, V., *Journal of Science and Arts*, **17**(3), 503, 2017.
[26] Florea, N.V., Mihai, D.C., *Journal of Science and Arts*, **17**(1), 81, 2017.
[27] Danila, A., Horga, M.G., Coman, D.M., Coman, M.D., Stanescu, S.G., Journal *of Science and Arts*, **17**(4), 761, 2017.
[28] Stanescu, S.G., Danila, A., Horga, M.G., *Journal of Science and Arts*, **18**(1), 159, 2018.
[29] Pedhazur, E.J. *Multiple regression in behavioral research: Explanation and prediction* (3rd ed.). CT: Thompson Learning: Stamford, 1997.
[30] Zientek, L.R., Thompson, B. *Journal of Early Intervention*, **28**(4), 299, 2006.
[31] Pastor, J.M., Peraita, C., Serrano, L., Soler, Á., *European Planning Studies*, **26**(8), 1616, 2018.
[32] Macris, A., Macris, M., *Annals of the University of Petrosani, Economics*, **10**(4), 181, 2010.
[33] Washington, S., Karlaftis, M.G., Mannering, F., Anastasopoulos, P., *Statistical and econometric methods for transportation data analysis*, 3rd Edition, CRC press, 2020.
[34] Dieleman, J.L., Campbell, M., Chapin, A., Eldrenkamp, E., Fan, V.Y., Haakenstad, A., Reynolds, A., *The Lancet*, **389**(10083), 2005, 2017.
[35] Lee, M.Y., *Expert Journal of Economics*, **2**(3), 85,2014.
[36] Lee, M.Y., *International Journal of Computational Economics and Econometrics*, **6**(1), 114, 2016.
[37] Song, J., Wei, L., Ming, Y., *A method for simulation model validation based on Theil's inequality coefficient and principal component analysis.* In Asian Simulation Conference (pp. 126-135). Springer: Berlin, Heidelberg, 2013.
[38] Maleki, M., Barkhordar, Z., Khodadadi, Z., Wraith, D., *Journal of Statistical Computation and Simulation*, **89**(14), 2765, 2019.
[39] Altman, N., Krzywinski, M., *Nat Methods*, **12**(11), 999, 2015.