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EXPLORING THE NEXUS BETWEEN TAX REVENUE TRENDS AND SOCIAL CONTRIBUTIONS DEVELOPMENT IN EUROPEAN UNION COUNTRIES

Abstract. The purpose of the research: to analyze the main tendencies of the tax revenue and social contributions in EU countries, to study the hypothesis concerning convergence of the annual growth rates of the total tax revenue (including social contributions) to the GDP in European Union countries during the last decade and to build the predicted values for the total tax revenue (including social contributions) as GDP percentage in EU countries. The research was conducted based on the time serious analysis) and forecasting method to predict data values of the total revenue to the GDP. The analysis presented in the research has shown that tax revenues in the main tax categories displayed a corresponding pattern, with a differing fiscal lag for direct taxes, indirect taxes and social contributions. Correlation analysis has shown that many countries of EU essentially correlate ratio of the total tax revenues to the GDP. Using the presented models for the time series of the total revenue to the GDP in Eiropenean Union counties, the predicted values were obtained. The research has shown that some countries have common characters of the total revenue, and some gruop of countries has varies. Regardless of the declaration of the common economic policy in EU, as well as levy system in EU, the research has noticed some differences in the total revenues concerning the GDP trends. The impact of possible convergence in tax burden policy in EU countries explains these differences.

In order to harmonize tax policy and to increase the fiscal role of taxation in the EU countries, such measures are proposed: application of unified procedures and conditions of administration of taxes and other budget revenues; differentiation of tax rates and establishment of the upper limit of their size; introduction of a unified tax base; differentiation of objects of taxation with the purpose of increase of tax revenues to the budget and avoiding increase of tax burden for population and others.

Keywords: tax burden, tax revenue, EU-countries, time serious analysis, forecasting.
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ДОСЛІДЖЕННЯ ЗВ'ЯЗКІВ МІЖ ТЕНДЕНЦІЯМИ ПОДАТКОВИХ НАДХОДЖЕНЬ І РОЗВИТКОМ СОЦІАЛЬНИХ ВНЕСКІВ У КРАЇНАХ ЄВРОПЕЙСЬКОГО СОЮЗУ

Анотація. Мета дослідження — проаналізувати основні тенденції податкових надходжень і соціальних внесків у країнах ЄС, вивчити гіпотезу щодо збіжності річних темпів зростання загальних податкових надходжень (у тому числі соціальних внесків) до ВВП країн Європейського Союзу протягом останнього десятиліття і побудувати прогнозні значення частки загальних податкових надходжень (включаючи соціальні внески) у ВВП у країнах ЄС. Дослідження проводилося на основі аналізу часових рядів і методів прогнозування для прогнозування відношення цих видів податкових надходжень до ВВП. Аналіз, представлений у дослідженні, показав, що податкові надходження відображають відповідну картину з різним фіскальним відставанням для прямих податків, непрямих податків і соціальних внесків. Кореляційний аналіз показав, що для багатьох країн ЄС існує суттєвий зв'язок між відношенням показника загальних податкових надходжень до ВВП. За допомогою представлених моделей для часових рядів показника відношення загальних податкових надходжень до ВВП у країнах Європейського Союзу отримано прогнозовані значення. Результати прогнозування показали, що деякі країни мають спільні характеристики формування податкових надходжень, а інші країни мають різний характер їх формування. Незважаючи на декларацію єдиної економічної політики в країнах-ЄС, а також систему оподаткування на території ЄС, дослідження визначило деякі відмінності в тенденціях відношення сукупних податкових надходжень до ВВП. Ці відмінності пояснюються впливом можливої конвергенції у політиці щодо податкового навантаження в країнах ЄС. З метою гармонізації податкової політики та підвищення фіскальної ролі податків у країнах ЄС запропоновано заходи: застосування єдиних процедур і умов адміністрування податкових та інших надходжень до бюджету, диференціація податкових ставок і встановлення верхньої межі їхнього розміру, запровадження єдиної податкової бази; диференціація об'єктів оподаткування з метою збільшення податкових надходжень до бюджету та уникнення збільшення податкового навантаження для населення та інші.

Ключові слова: податкове навантаження, податкові надходження, країни ЄС, аналіз часових рядів, прогнозування.

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ИЗУЧЕНИЕ ВЗАИМОСВЯЗИ МЕЖДУ ТЕНДЕНЦИЯМИ НАЛОГОВЫХ ПОСТУПЛЕНИЙ И РАЗВИТИЕМ СОЦИАЛЬНЫХ ОТЧИСЛЕНИЙ В СТРАНАХ ЕВРОПЕЙСКОГО СОЮЗА

Аннотация. Цель исследования — проанализировать основные тенденции налоговых поступлений и социальных взносов в странах ЕС, изучить гипотезу о сходстве годовых темпов роста общих налоговых поступлений (в том числе социальных взносов) в ВВП стран ЕС и построить прогнозные значения доли общих налоговых поступлений (включая социальные взносы) в ВВП. Анализ показал, что для многих стран ЕС существует существенная связь между отношением показателя общих налоговых поступлений к ВВП. Несмотря на декларацию единой экономической политики в ЕС, а также систему налогообложения в ЕС, исследование определило некоторые различия в тенденциях отношения совокупных доходов к ВВП. Эти различия объясняются влиянием возможной конвергенции в политике налоговой нагрузки в странах ЕС.

Ключевые слова: налоговая нагрузка, налоговые поступления, страны ЕС, анализ временных рядов, прогнозирование.

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Introduction. Taxes mostly contribute to the state revenue, tax revenue makes up about 90% of the total government revenue in the European Union [1]. State revenue, expenditure and deficit/surplus are main objectives of fiscal policy and the analysis of their dynamics plays a very important role in the formation and coordination of the strategic and tactic tasks regarding socio-economic development in the countries [2-3].

The tax burden is a key criterion for assessing the effectiveness of a country's taxation system. In case of insufficient level of the tax burden, the state budget will not get enough money, and therefore the government will not be able to perform effectively its functions. The excessive tax burden will stimulate shadow economy; decrease the business activity of economic entities. The optimal level of the tax burden is an important factor in ensuring the appropriate dynamics of business activity, economic development, as well as the socio-economic stability of the country.

Thus, to ensure business activity and to implement effective tax regulations of EU-countries it is necessary to investigate the problem of the nexus between tax revenue and social contributions development.

Analysis of research and problem statement. Various aspects of the tax revenues and social contribution development, as well as issues and directions of tax policy in EU have been studied and discussed for centuries by a great number of theorists and practitioners of economics. Problems related to the analysis of the tax revenues and its efficiency and impact on the socio-economic development of the EU-countries are researched in the works by scientist such as H. Celebi [4]; S. Godar, A. Truger [5]; H. Davood, H. Zou [6]; D. Stoilova, N. Patonov [7]; K. Krzikallová and R. Střílková [8]; N. Pestel and E. Sommer [9], N. Rekova, I. Dolozina, V. Nitsenko, Y. Zaitsev and V. Zamlynskyi [10] and others.

The studies of these issues are represented in the works of following scientists: S. Hodzic and H. Celebi [4] analyze the value-added tax and its efficiency; S. Godar and A. Truger [5], review priorities in EU tax policies; H. Davood and H. Zou [6] examine fiscal decentralization and economic growth of countries; D. Stoilova and N. Patonov [7] evaluate impact of taxation on economy growth in the European Union; K. Krzikallová and R. Střílková [8] analyze changes in value added tax revenue; N. Pestel and E. Sommer [9] evaluate issues of shifting taxes from labor to consumption; N. Rekova and others research budgetary revenue structure at central level of public administration in the federal countries [10].

Therefore, the issue of analysis and forecasting of the tax burden of the EU countries, which would ensure the realization of fiscal and regulatory functions of taxes simultaneously, becomes relevant.

The purpose of the article. The purpose of the research: to analyze the main tendencies of the tax revenue and social contributions in EU countries, to study the hypothesis concerning convergence of the annual growth rates of the total tax revenue (including social contributions) to the GDP in EU countries during the last decade and to build the predicted values for the total tax revenue (including social contributions) as GDP percentage in EU countries.

Research results. Concerning to the volume of taxes, majority of countries have about 40 % tax revenues of national income. Monetary transfers are approximately 25 %, which consist of state social benefits, family benefits, and others. Other state expenditures, such as healthcare, police, defence and others come up to 25 % of national income. Nowadays european economies are characterized by such level of taxes to national income which has come up from 10 % to 40 % [11].

For the comparative analysis, tax revenues are measured in absolute magnitudes (in millions of euro) as the ratio of taxes to GDP, or as the ratio of absolute magnitudes to taxes of the inhabitants. Concerning to the Eurostat data total tax-to-GDP ratio had dropped from 2000 till 2004 [12]. During the 2004—2007 period ratio become more. For the period 2008—2010 due to the essential impact of global economic crisis tax receipts and social contributions dropped. World-wide economic crisis influenced also on the level of tax revenue (including social contributions) which has fallen during 2008—2010. In 2015 tax proceeds accounted for 40 % of GDP; In whole, tax proceeds and social contributions varied (2012, 2014).

In table 1, data for the tax revenue (including social contributions) as a percentage of GDP is presented for EU-28 countries for the period of 2002—2015.

We can see from the data in table 1 and statistical calculations, that for EU-28 countries the values of tax revenues (including social contributions) as a percentage of GDP changed slowly or varied at the certain level. It is should be noted that tax revenues in the main tax categories displayed a corresponding pattern, with a differing fiscal lag for direct taxes, indirect taxes and social contributions.

It should be noted that in many EU countries ratio of the total tax revenues to the GDP essentially correlate. In the table A.1 (see Appendix), the correlation matrix is presented for 28 EU countries.

According to the previous statement, it is a significant issue to analyze the relationship between the tendencies of the total revenue ratio to GDP taking some EU countries as the example.

The total tax revenue (including social contributions) as GDP percentage

	2002	2006	2008	2010	2012	2015	Min	Max	Mean	Std. Dev.	Coefficient of variance, %
BE	46,28	45,47	45,83	45,5	47,31	47,5	45,16	48,29	46,28	1,05	2,26
BG	27,98	29,89	30,73	25,95	26,69	29,01	25,33	31,69	28,84	2,07	7,16
CZ	33,36	33,86	33,09	32,56	34,26	34,37	32,15	34,85	33,82	0,78	2,30
DK	47,01	47,8	46,02	46,26	46,87	47,56	46,02	50,27	47,43	1,21	2,56
DE	39,09	38,79	39,16	38,24	39,29	39,98	38,24	39,98	39,11	0,52	1,33
EE	31,28	30,65	31,60	33,46	31,87	34,11	30,1	35,15	32,03	1,39	4,34
IE	29,12	32,69	30,42	28,49	29,04	24,41	24,41	32,69	29,66	1,99	6,71
EL	34,61	32,68	33,73	34,23	38,48	39,60	32,05	39,6	35,12	2,64	7,51
ES	34,01	36,68	32,88	32,09	33,09	34,61	30,57	37,09	34,02	1,82	5,35
FR	43,81	44,86	44,28	44,06	46,49	47,87	43,77	47,87	45,15	1,55	3,43
HR	37,62	36,82	36,78	36,15	35,91	37,63	35,25	37,63	36,63	0,65	1,76
IT	39,86	40,37	41,47	41,75	43,76	43,49	39,21	43,76	41,57	1,62	3,89
CY	28,00	32,08	34,75	31,93	31,58	33,05	28,00	36,07	31,82	2,15	6,75
LV	28,02	28,97	28,19	28,13	28,82	29,49	27,62	29,49	28,39	0,59	2,09
LT	29,01	30,44	30,93	28,67	27,32	29,4	27,32	30,93	29,07	1,23	4,24
LU	38,88	37,13	38,06	38,56	40,04	39,1	37,13	40,05	38,8	0,91	2,35
HU	37,44	36,7	39,65	37,49	38,55	39,2	36,7	39,65	38,04	1,07	2,80
MT	30,83	33,35	33,43	32,53	33,4	34,74	30,78	35,09	33,10	1,31	3,97
NL	36,3	36,96	36,94	36,65	36,54	38,23	35,94	38,23	36,7	0,71	1,92
AT	44,23	41,72	42,63	42,11	42,81	44,44	41,72	44,44	42,96	0,94	2,19
PL	33,96	34,48	34,93	32,27	32,93	33,34	32,04	35,44	33,42	1,00	2,99
PT	33,97	34,79	34,93	33,69	34,46	37,03	33,39	37,19	34,93	1,32	3,77
RO	28,39	28,96	28,27	26,87	27,71	28,03	26,87	29,63	27,97	0,74	2,66
SI	37,38	37,89	36,83	37,41	37,44	37,13	36,72	38,2	37,35	0,41	1,09
SK	32,95	29,36	29,08	28,2	28,37	32,4	28,2	32,95	30,34	1,70	5,60
FI	43,49	42,29	41,32	40,92	42,81	44,13	40,92	44,13	42,45	1,06	2,50
SE	45,96	46,77	44,9	44,14	43,49	44,2	43,46	47,47	45,10	1,36	3,02
UK	33,54	35,31	36,64	35,17	34,98	34,92	33,50	36,64	34,79	0,84	2,41

Source: author's development.

For example, essential positive correlation (values exceeding 0.6) of the total revenue to the GDP in the UK are observed with such countries as Cyprus, Netherlands, Poland and Portugal. The visible negative correlations of the total revenue to the GDP in the UK (values equal or less than -0.4) were in Luxemburg, Austria and Slovakia. In the case of France, the more correlated tendency of the total revenue to the GDP was with Belgium and Greece where positive correlations exceeded 0.6. The visible positive correlations of the total revenue to the GDP in France, (with the values more than 0.4, but less than 0.6) were with the Czech Republic, Romania and Finland. The visible negative correlations of the total revenue to the GDP in France were observed with Estonia, Croatia and Lithuania, in such cases the values of the correlation coefficients equalled or were less than -0.4.

The tax burden policy in Germany weakly correlates with the tax burden policy in most EU countries. It means that the related positive or negative correlation values of the total revenue to the GDP in Germany and other EU countries are small. On the contrary, the tax burden policy and their relation with other EU countries differ for Austria. The essential positive correlation (values equal to 0.6 or closed to this level) of the total revenue to the GDP in Austria are observed with such countries as Belgium, Luxemburg, Slovakia and Finland. The visible negative correlations of the total revenue to the GDP in Austria were observed in the case with Denmark, Ireland, Spain, Cyprus, Lithuania, Latvia,

Malta, Netherlands, Poland, Portugal, Romania and UK. In these cases, values of the correlation coefficients were equal or less than-0.4.

The essential positive correlation (values more than 0.4) of the total revenue to the GDP in Slovakia are observed with Czech Republic, Croatia, Austria, Slovenia, Finland and Sweden. Nevertheless, the visible and essential negative correlations of the total revenue to the GDP in Slovakia (values equal or less than -0.4) were observed with Estonia, Italy, Cyprus, Malta, Netherlands, Portugal and UK.

In the case of the Czech Republic, the more correlated tendency of the total revenue to the GDP was with Bulgaria, Denmark, Spain, Lithuania and Slovenia, where positive correlations were more than 0.6. The visible positive correlations of the total revenue to the GDP in the Czech Republic (values exceeding 0.4, but less than 0.6) were with France, Romania, Slovakia, Finland and Sweden. The visible negative correlations of the total revenue to the GDP in the Czech Republic were noticed in Estonia, Italy and Luxemburg. In such cases values of the correlation coefficients are equal or less than -0.4.

The tax burden policy in Poland essentially positively correlates with the tax burden policy in most EU countries. It means that the related positive or negative correlation values of the total revenue to the GDP in Poland and other EU countries are relatively large. However, in the cases with Luxemburg and Austria, the tendency of the total revenue to the GDP in Poland is correlated negatively.

The total revenue to the GDP in Hungary positively correlates with the named tendency in Italy and Cyprus. For the cases with Germany, Estonia, Malta, Netherlands and Poland, the related correlation values are positive and exceed 0.4. It means that these and previously mentioned tendencies of the total revenue to the GDP in Hungary are visibly correlated. The negative essential correlation of the total revenue to the GDP in Hungary was observed in the case of Belgium, Slovenia, Slovakia and Finland.

Thus, analysis of the tendencies of the total revenue to the GDP in EU-28 countries revealed the common characters of the tendencies for one group of countries and the opposite behaviour in another group. Despite the declaration of the common economic policy, as well as tax consolidation policy in EU, we observed some differences in the total revenue concerning the GDP tendencies.

Nevertheless, the effect of possible convergence in tax burden policy in EU countries explains these differences. We assume this hypothesis by using a simple econometric model, where we test the relationship of the annual growth rates of the total tax revenue and social contributions to the GDP and their level in previous years. This model is given below:

$$\tau_{tax\,j}(t-1,t) = 1.017883 - 0.00046 \cdot TR\_GDP_{j,t-1}, \tag{1}$$

where $\tau_{tax\,j}(t-1,t)$ is an annual growth of the total tax revenue (including social contributions) to the GDP in country j for a period of (t-1,t); $TR\_GDP_{j,t-1}$ is the level of the total revenue to the GDP in a country j per year (t-1).

Both estimated parameters are statistically significant at $p < 0,05$, but correlation and determination coefficients for this model are relatively low, due to the essential heteroscedasticity of the errors. Some institutional factors explain this effect of the essential heteroscedasticity of the errors in EU countries, as well political and economic differences in EU countries.

Thus, an absolute β-convergence in the total revenue to the GDP over EU-8 countries exists, but this effect is relatively slow and needs a long-run period. Using simple models for time series of the total revenue to the GDP in EU-28 counties, the predicted values were obtained (table 2 and table 3).

It should be noted that at first we estimated parameters for linear trend using OLS method (ordinary least squares). As it is known, linear trend is characterized by two parameters b0 and b1, where b0 is estimated initial level (intercept) and b1 is estimated constant change of variable during one year period (slope). The estimation of slope can be positive (increasing dynamics) or negative (decreasing dynamics). Of course, for real time series the dynamics of the changes of the indicators is more complicated than linear trend, where we assume constant intercept and slope. For some cases of dynamics of the total revenue to GDP the linear trend model is fitted well, and the deviations of real data and predicted by linear model are relatively small and coefficient of correlation R is more than 0.7. For

some countries such as Ireland, Greece, Cyprus, Lithuania, Malta, Poland, Portugal and Slovakia we can consider models of linear trends as good tools for prediction, because coefficients of correlation R are quite closed to 1. Nevertheless, for these countries we assume that these tendencies will keep their characteristics in future, if national government does not decide about changes in tax and macroeconomic policy. For some other countries the tendencies included linear trends, but were more complicated, that is why for these models coefficients of correlation are more than 0.5 but less 0.7. For a few countries such as Spain, Luxembourg, Romania the linear trend is absent, so tax revenue to GDP is more or less stable, for these countries coefficients of correlation are closed to 0.

Table 2

The results of the exponential smoothing (Holt's two-parameter method, α and γ different) for the analysis of the dynamics of the total revenue to GDP in EU 28 countries. Real (2016) and predicted values for 2016—2018

No.	Country	Initial smoothed value S0 and T0 and the characteristics of errors for exponential smoothing (Holt's two-parameter method, α and γ different)						Predicted values						
		α	γ	S0	T0	Mean error (m.e.)	Mean absolute percentage error (m.a.p.e)	Real data (2016)	2016	2017	2018	2016	2017	2018
									α = 0.1, γ = 0.1			α and γ different		
1	BE	1,00	0,00	46,23	0,0945	-0,0034	1,0061	46,8	47	47	47,1	47,6	47,7	47,8
2	BG	1,00	0,00	27,94	0,0793	-0,0028	4,2623	29,0	29,1	29,1	29,1	29,2	29,2	29,3
3	CZ	0,00	0,00	33,32	0,0773	-0,0799	1,8327	34,8	34,3	34,4	34,4	34,6	34,6	34,7
4	DK	0,00	0,00	46,99	0,0427	0,1233	1,8122	47,3	47,7	47,8	47,8	47,7	47,7	47,8
5	DE	0,504	0,00	39,06	0,0681	-0,0283	0,982	40,4	39,5	39,6	39,6	39,9	40	40,1
6	EE	0,008	1,00	31,17	0,2178	-0,5786	3,3428	34,7	33,5	33,7	33,9	34	34,2	34,3
7	IE	1,00	0,00	29,30	-0,362	0,0129	4,0341	23,3	27,5	27,3	27,2	23,7	23,3	23
8	EL	1,00	0,00	34,42	0,3836	-0,0137	2,6933	42,1	37,8	38,1	38,4	40,4	40,7	41,1
9	ES	0,00	0,00	33,98	0,0462	-0,3109	4,2441	34,1	34,1	34,1	34,1	34,7	34,8	34,8
10	FR	1,00	0,00	43,65	0,3128	-0,0112	0,9191	47,6	47,4	47,6	47,9	48,5	48,8	49,1
11	HR	1,00	0,00	37,2	0,0008	0	1,2606	37,9	36,4	36,4	36,3	37,6	37,6	37,6
12	IT	0,307	0,00	39,72	0,2792	0,0184	1,2838	42,9	43,7	44	44,3	44,3	44,6	44,8
13	CY	1,00	0,00	27,80	0,3882	-0,0139	3,2754	33,6	34,8	35,2	35,6	33,8	34,2	34,6
14	LV	0,877	0,00	27,96	0,1128	-0,0058	1,2038	31,6	29,2	29,2	29,3	29,7	29,8	29,9
15	LT	1,00	0,00	29,00	0,0295	-0,0011	2,0912	30,2	29,1	29,1	29,1	29,5	29,5	29,5
16	LU	0,181	0,00	38,87	0,0170	0,0207	1,6865	39,6	39	39	39	39,2	39,2	39,2
17	HU	0,006	1,00	37,37	0,1352	-0,2905	2,1897	39,4	39	39,1	39,2	39,3	39,4	39,6
18	MT	0,00	1,00	30,68	0,3011	0,1594	2,0348	33,6	35,3	35,6	35,9	35,5	35,8	36,1
19	NL	0,765	0,00	36,22	0,1485	-0,0128	1,0368	39,3	37,7	37,8	37,9	38,5	38,6	38,8
20	AT	1,00	0,00	44,20	0,0166	-0,0006	1,0456	42,9	42,9	42,8	42,8	44,5	44,5	44,5
21	PL	0,00	0,00	33,98	-0,048	-0,2057	2,2627	34,4	33	32,9	32,8	33,2	33,2	33,1
22	PT	0,493	0,00	33,85	0,2350	-0,0234	1,9533	36,9	36,6	36,8	37	37,5	37,7	37,9
23	RO	0,004	1,00	28,40	-0,027	-0,2105	1,9301	26,0	27,7	27,6	27,6	27,9	27,8	27,8
24	SI	0,861	0,00	37,39	-0,019	-0,0002	0,8265	36,9	37,2	37,2	37,1	37,1	37,1	37
25	SK	1,00	0,00	32,98	-0,043	0,0015	2,2472	32,4	29,5	29,4	29,2	32,3	32,3	32,2
26	FI	1,00	0,00	43,46	0,0496	-0,0018	1,0834	44,3	42,7	42,6	42,6	44,2	44,3	44,3
27	SE	1,00	0,00	46,03	-0,136	0,0048	1,1719	44,6	43,9	43,8	43,6	43,9	43,8	43,7
28	UK	0,402	0,00	33,49	0,1063	0,0021	1,7481	35,1	35,6	35,8	35,9	35,2	35,3	35,4

Source: author's development.

Taking into account more complicated character of dynamics of tax revenue to GDP for most countries of EU we applied another approach for the analysis known as exponential smoothing and Holt's two parameter method [13]. Holt [13] extended simple exponential smoothing to allow the forecasting of data with a trend. This method involves a forecast equation and two smoothing equations (one for the level and one for the trend).

For first models we analyzed exponential smoothing with equal parameters $\alpha = 0.1$, $\gamma = 0.1$ for all EU 28 countries, for second models we analyzed exponential smoothing with different parameters α and γ for all EU 28 countries. In table 2 the optimal estimations for parameters α and γ were found for each EU country, the results of the predicted values of the total revenue to the GDP in EU-28 for 2016—2018 (using exponential smoothing) and their comparision with real data for 2016 are given.

It is clear seen that for most countries EU the mean absolute percentage error does not exceed 5%, even for some models m.a.p.e less than 2%. Thus the models based on the exponential smoothing can be used for forecasts of tax revenue to GDP as alternative scenario. It is shoud be noted that models based on the exponential smoothing are more flexible and adaptive to the different shocks explaining dramatical changes in external or internal socio-economic and political environment.

Table 3

The real (2016) and predicted values of the total revenue to the GDP in EU-28 for 2016—2018
(using linear trend model)

No.	Country	Real data (2016)	2016			2017			2018		
			$\hat{y}-\Delta_y$	$\hat{y}$	$\hat{y}+\Delta_y$	$\hat{y}-\Delta_y$	$\hat{y}$	$\hat{y}+\Delta_y$	$\hat{y}-\Delta_y$	$\hat{y}$	$\hat{y}+\Delta_y$
1	BE	46,8	45,3	46,2	47,1	45,3	46,2	47,1	45,2	46,2	47,2
2	BG	29,0	26,6	28,9	31,1	26,4	28,8	31,3	26,2	28,8	31,4
3	CZ	34,8	32,9	33,9	34,9	32,8	33,9	35	32,8	33,9	35,1
4	DK	47,3	45,8	46,8	47,8	45,6	46,7	47,8	45,5	46,6	47,8
5	DE	40,4	37,2	38,2	39,1	37	38	39	36,8	37,9	38,9
6	EE	34,7	31,7	33,4	35	31,7	33,6	35,4	31,8	33,7	35,7
7	IE	23,3	27,1	28,5	29,9	26,8	28,3	29,8	26,5	28,1	29,6
8	EL	42,1	36,9	39,2	41,4	37,3	39,9	42,4	37,7	40,6	43,4
9	ES	34,1	31,5	33,4	35,4	31,3	33,4	35,5	31,2	33,4	35,7
10	FR	47,6	44,5	45,5	46,6	44,5	45,6	46,7	44,5	45,7	46,9
11	HR	37,9	34,7	35,5	36,4	34,5	35,4	36,3	34,3	35,3	36,3
12	IT	42,9	41,1	42,4	43,8	41,1	42,5	44	41,1	42,6	44,2
13	CY	33,6	34,2	36,6	39	34,6	37,2	39,7	35	37,7	40,4
14	LV	31,6	25,5	26,6	27,8	25,2	26,4	27,7	24,9	26,3	27,6
15	LT	30,2	24,7	26,8	28,9	24,1	26,5	28,8	23,6	26,2	28,8
16	LU	39,6	38,1	39,2	40,2	38	39,2	40,3	38	39,2	40,4
17	HU	39,4	36,6	37,9	39,2	36,5	37,9	39,2	36,4	37,8	39,3
18	MT	33,6	35	36,4	37,9	35,3	36,9	38,4	35,7	37,4	39
19	NL	39,3	35	35,9	36,8	34,8	35,8	36,8	34,7	35,7	36,7
20	AT	42,9	40,4	41,5	42,6	40,2	41,3	42,5	39,9	41,2	42,4
21	PL	34,4	30,3	31,6	32,8	30	31,3	32,7	29,6	31,1	32,5
22	PT	36,9	35,6	36,5	37,4	35,7	36,7	37,7	35,9	36,9	37,9
23	RO	26,0	26,5	28	29,6	26,4	28	29,7	26,3	28	29,7
24	SI	36,9	36,4	37,1	37,7	36,4	37,1	37,7	36,3	37	37,7
25	SK	32,4	23,6	25,2	26,7	22,9	24,6	26,3	22,2	24	25,8
26	FI	44,3	39,2	40,5	41,9	38,8	40,3	41,8	38,5	40,1	41,6
27	SE	44,6	42,2	43,4	44,7	41,8	43,1	44,5	41,4	42,9	44,3
28	UK	35,1	35,4	36,5	37,6	35,4	36,6	37,8	35,4	36,7	37,9

Source: author's development.

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Thus, we presented forecasts of the tax revenue to GDP based on two approaches: prediction on the linear trend model and prediction on the exponential smoothing (Holt's two-parameter method). The results of the predicted values of the total revenue to the GDP in EU-28 for 2016—2018 (using linear trend model) and their comparision with real data for 2016 are given in table 3.

Thus, the predicted values of tax revenue to GDP for recent years taking into account different scenarios about the tendencies and their possible character for EU 28 countries has been presented.

The results presented in the research has determied that tax-to-GDP ratio reduced until 2004, and from 2004 to 2007, trend increased. As a consiquense of the essential influence of the global economic crisis, tax revenues and revenues of social contributions dropped from 2008 to 2010.

Using the presented models for the time series of the total revenue to the GDP in EU-28 counties, the predicted values were obtained. The model of estimation relationship of the annual growth rates of the total tax revenue and social contributions to the GDP shows the political and economic differences in EU countries. Investigation has shown that some countries have common characters of the total revenue, and some gruop of countries has varies.

It is should be noted that it is interesting to provide the comparative analysis real data and predicted data for period 2017—2018 and receive arguments about changes in tax and macroeconomic strategies for each country and factors which can infuence on them.

Conclusion. Regardless of the declaration of the common economic policy in EU, as well as levy system in EU, the research has noticed some differences in the total revenues concerning the GDP trends. The impact of possible convergence in tax burden policy in EU countries explains these differences.

In fact, problems arise due to the lack of a proper level of coordination between the tax policies of the EU-countries. The analysis confirmed the conclusion that the creation of a successful economic space is impossible without the use of tax mechanisms that regulate not only the smooth movement of goods within the market, but also ensures economic equilibrium within the country. Modern conditions for the emergence of economic threats should target EU-countries not to obtain fiscal assistance from the outside, but to conduct an independent fiscal and budget policy that will neutralize these threats within the state and ensures economic growth.

According to conclusions some changes in tax and macroeconomic strategies can be proposed: it's necessary to convergence in the area of tax relations, as a subsystem of the European Union's financial system, among Member States at the national and supranational levels, which requires the application of similar types of procedures and conditions for the administration of tax and other budget revenues, must be implemented; differentiation of tax rates and establishment of the upper limit of their size, parameters and conditions of adjustment; introduction of unified tax bases; the differentiation of tax objects in order to increase tax revenues and avoid increasing tax rates as a burden for the population. These measures should promote the harmonization of direct taxation and the priority of indirect taxes to increase the role of tax revenues in GDP.

Appendix

The correlation matrix for the tax revenue (including social contribution) measured as % from GDP

	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK
	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26	Y27	Y28
Y1	1	-0,21	0,37	0,12	0,11	-0,48	-0,13	0,79	0,08	0,73	-0,03	-0,18	-0,52	0	-0,66	0,28	-0,37	-0,36	-0,16	0,6	-0,18	-0,3	-0,01	0,32	0,38	0,82	-0,12	-0,08
Y2	-0,21	1	0,68	0,5	-0,04	-0,55	0,73	-0,4	0,66	-0,13	0,51	-0,34	0,36	0,75	0,63	-0,69	0,28	0,08	-0,1	-0,24	0,54	0,07	0,43	0,32	0,31	-0,18	0,7	0,19
Y3	0,37	0,68	1	0,69	-0,17	-0,88	0,69	0,1	0,81	-0,13	0,45	0,27	-0,47	0	0,71	-0,06	-0,64	-0,26	-0,08	-0,08	0,32	0,02	0,47	0,63	0,47	0,41	0,55	0,03
Y4	0,12	0,5	0,69	1	-0,31	-0,59	0,76	-0,15	0,75	0,32	0,09	-0,55	0,05	0,57	0,15	-0,51	-0,36	0,19	-0,23	-0,43	0,21	-0,05	0,31	0,83	0,27	0,25	0,69	0,05
Y5	0,11	-0,04	-0,17	-0,31	1	0,17	-0,26	0,12	-0,31	-0,04	0,27	0,23	-0,2	-0,12	0,17	0,46	0,43	-0,09	-0,17	0,48	0,03	-0,11	0,04	-0,35	0,2	0,32	-0,02	-0,27
Y6	-0,48	-0,55	-0,88	-0,59	0,17	1	-0,57	-0,05	-0,77	-0,39	-0,45	-0,73	0,67	0,21	-0,73	0,06	0,56	0,45	0,37	-0,07	-0,34	-0,02	-0,45	-0,66	-0,65	-0,58	-0,6	-0,13
Y7	-0,13	0,73	0,69	0,76	-0,26	-0,57	1	-0,29	0,88	0,27	0,29	-0,22	0,44	0,89	0,48	-0,88	-0,02	0,36	0,23	-0,65	0,65	0,29	0,67	0,52	0,01	-0,05	0,62	0,38
Y8	0,79	-0,4	0,1	-0,15	0,12	-0,05	-0,29	1	-0,05	0,69	-0,12	0,2	-0,15	-0,06	-0,12	0,33	-0,03	-0,09	0,14	0,44	0,09	0,08	0,24	-0,08	0,06	0,6	-0,48	0,11
Y9	0,08	0,66	0,81	0,75	-0,31	-0,77	0,88	-0,05	1	0,28	0,5	-0,46	0,19	0,9	0,25	-0,83	-0,2	0,02	0	-0,41	0,58	0,14	0,67	0,68	0,33	0,22	0,68	0,15
Y10	0,73	-0,13	-0,13	0,32	-0,04	-0,39	0,27	0,69	0,28	1	-0,34	0,2	0,05	0,2	0,47	-0,11	-0,23	0,28	0,32	-0,03	0,21	0,27	0,42	0,21	-0,15	0,54	-0,27	0,35
Y11	-0,03	0,51	0,45	0,09	0,27	-0,45	0,29	-0,12	0,5	-0,34	1	-0,47	-0,17	0,56	0,51	-0,28	0,14	-0,52	-0,23	0,23	0,4	-0,23	0,3	0,29	0,65	0,23	0,68	-0,19
Y12	-0,18	-0,34	0,27	-0,55	0,23	-0,73	-0,22	0,2	-0,46	0,2	-0,47	1	0,59	-0,26	-0,03	0,18	0,63	0,66	0,73	-0,19	0,19	0,46	0,15	-0,75	-0,85	-0,45	-0,79	0,35
Y13	-0,52	0,36	-0,47	0,05	-0,2	0,67	0,44	-0,15	0,19	0,05	-0,17	0,59	1	0,39	0,47	-0,53	0,63	0,83	0,72	-0,72	0,71	0,74	0,59	-0,37	-0,7	-0,68	-0,19	0,69
Y14	0	0,75	0	0,57	-0,12	0,21	0,89	-0,06	0,9	0,2	0,56	-0,26	0,39	1	0,47	-0,86	0,05	0,13	0,24	-0,42	0,83	0,38	0,82	0,41	0,2	0,11	0,59	0,45
Y15	-0,66	0,63	0,71	0,15	0,17	-0,73	0,48	-0,12	0,25	0,47	0,51	-0,03	0,47	0,47	1	-0,4	0,53	0,25	0,18	-0,41	0,54	0,14	0,3	-0,08	-0,05	-0,5	0,53	0,26
Y16	0,28	-0,69	-0,06	-0,51	0,46	0,06	-0,88	0,33	-0,83	-0,11	-0,28	0,18	-0,53	-0,86	-0,4	1	0,06	-0,25	-0,3	0,67	-0,67	-0,47	-0,67	-0,36	0,04	0,23	-0,47	-0,45
Y17	-0,37	0,28	-0,64	-0,36	0,43	0,56	-0,02	-0,03	-0,2	-0,23	0,14	0,63	0,63	0,05	0,53	0,06	1	0,46	0,39	-0,04	0,44	0,21	0,25	-0,62	-0,38	-0,52	-0,21	0,21
Y18	-0,36	0,08	-0,26	0,19	-0,09	0,45	0,36	-0,09	0,02	0,28	-0,52	0,66	0,83	0,13	0,25	-0,25	0,46	1	0,63	-0,73	0,41	0,59	0,41	-0,29	-0,82	-0,51	-0,3	0,54
Y19	-0,16	-0,1	-0,08	-0,23	-0,17	0,37	0,23	0,14	0	0,32	-0,23	0,73	0,72	0,24	0,18	-0,3	0,39	0,63	1	-0,5	0,56	0,66	0,47	-0,42	-0,8	-0,44	-0,49	0,78
Y20	0,6	-0,24	-0,08	-0,43	0,48	-0,07	-0,65	0,44	-0,41	-0,03	0,23	-0,19	-0,72	-0,42	-0,41	0,67	-0,04	-0,73	-0,5	1	-0,48	-0,6	-0,47	-0,09	0,58	0,54	-0,12	-0,5
Y21	-0,18	0,54	0,32	0,21	0,03	-0,34	0,65	0,09	0,58	0,21	0,4	0,19	0,71	0,83	0,54	-0,67	0,44	0,41	0,56	-0,48	1	0,69	0,93	-0,07	-0,16	-0,13	0,2	0,68
Y22	-0,3	0,07	0,02	-0,05	-0,11	-0,02	0,29	0,08	0,14	0,27	-0,23	0,46	0,74	0,38	0,14	-0,47	0,21	0,59	0,66	-0,6	0,69	1	0,69	-0,38	-0,54	-0,28	-0,31	0,78
Y23	-0,01	0,43	0,47	0,31	0,04	-0,45	0,67	0,24	0,67	0,42	0,3	0,15	0,59	0,82	0,3	-0,67	0,25	0,41	0,47	-0,47	0,93	0,69	1	0,02	-0,11	0,1	0,16	0,56
Y24	0,32	0,32	0,63	0,83	-0,35	-0,66	0,52	-0,08	0,68	0,21	0,29	-0,75	-0,37	0,41	-0,08	-0,36	-0,62	-0,29	-0,42	-0,09	-0,07	-0,38	0,02	1	0,55	0,45	0,72	-0,26
Y25	0,38	0,31	0,47	0,27	0,2	-0,65	0,01	0,06	0,33	-0,15	0,65	-0,85	-0,7	0,2	-0,05	0,04	-0,38	-0,82	-0,8	0,58	-0,16	-0,54	-0,11	0,55	1	0,65	0,66	-0,52
Y26	0,82	-0,18	0,41	0,25	0,32	-0,58	-0,05	0,6	0,22	0,54	0,23	-0,45	-0,68	0,11	-0,5	0,23	-0,52	-0,51	-0,44	0,54	-0,13	-0,28	0,1	0,45	0,65	1	0,19	-0,29
Y27	-0,12	0,7	0,55	0,69	-0,02	-0,6	0,62	-0,48	0,68	-0,27	0,68	-0,79	-0,19	0,59	0,53	-0,47	-0,21	-0,3	-0,49	-0,12	0,2	-0,31	0,16	0,72	0,66	0,19	1	-0,21
Y28	-0,08	0,19	0,03	0,05	-0,27	-0,13	0,38	0,11	0,15	0,35	-0,19	0,35	0,69	0,45	0,26	-0,45	0,21	0,54	0,78	-0,5	0,68	0,78	0,56	-0,26	-0,52	-0,29	-0,21	1

Source: own calculations

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