Original Paper

DOI 10.15826/jtr.2021.7.1.090

Long-run equilibrium between personal income tax and economic growth in Bulgaria

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ABSTRACT
The study analyzes the relationship of personal income tax and economic growth in the long and short runs to show which type of income tax (progressive or proportional) is more compatible with Bulgaria's economic growth. The methods of Vector Error Correction and Correlation are applied to determine the long-run and short-run impacts of the two types of income tax. The research covers the period from the first quarter of 1999 to the first quarter of 2020. Eurostat data (85 observations) were used. The empirical research has been divided into two periods. The long-run and short-run relationships between economic growth and tax revenue from progressive income tax in Bulgaria have first been studied, followed by the relationship between economic growth and the tax revenue from proportional income tax. The research results show that there is a long-run equilibrium relationship, but not a short-run relationship, between personal income tax and economic growth. The results imply that the progressive income tax is more compatible with economic growth than proportional income tax in Bulgaria in the long run. In the short run, the progressive income tax and proportional income tax have not shown statistically significant relationships with economic growth. Therefore, a progressive income tax leads to greater economic growth than a proportional income tax. From a long-run equilibrium standpoint, it is advisable that Bulgaria switch from proportional to progressive income taxation. It may be inferred that progressive taxation is more appropriate for economic growth than proportional taxation. The results are in conformity with the theory of endogenic growth and reject the neoclassical theory.

KEYWORDS
personal income tax, tax policy, long-run equilibrium, economic growth

JEL H21, H24, D50

Оригинальная статья

Долгосрочное равновесие между подоходным налогом с физических лиц и экономическим ростом в Болгарии

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АННОТАЦИЯ
В исследовании анализируется взаимосвязь подоходного налога с физических лиц с экономическим ростом в долгосрочной и краткосрочной перспективе, чтобы показать, какой тип подоходного налога (прогрессивный или пропорциональный) более совместим с экономическим ростом в Болгарии. Для определения долгосрочного и краткосрочного воздействия двух типов подоходного налога на экономический рост в Болгарии применялись методы кор-

рекции векторных ошибок и корреляции. Использовались данные Евростата (85 наблюдений) за период с первого квартала 1999 г. по первый квартал 2020 г. Эмпирическое исследование разделено на два периода. Сначала была изучена долгосрочная и краткосрочная взаимосвязь между экономическим ростом и налоговыми поступлениями от прогрессивного подоходного налога, а затем взаимосвязь между экономическим ростом и налоговыми поступлениями от пропорционального подоходного налога. Результаты исследования показывают, что между подоходным налогом с физических лиц и экономическим ростом существует не краткосрочное, а долгосрочное равновесное соотношение. В долгосрочной перспективе в Болгарии прогрессивный подоходный налог более совместим с экономическим ростом, чем пропорциональный. В краткосрочной перспективе нет статистически значимой связи между прогрессивным или пропорциональным подоходным налогом и экономическим ростом. Следовательно, прогрессивный подоходный налог в меньшей степени препятствует экономическому росту, чем пропорциональный. С точки зрения долгосрочного равновесия, Болгарии рекомендуется перейти от пропорционального подоходного налогообложения к прогрессивному. Можно сделать вывод, что прогрессивное налогообложение больше подходит для экономического роста, чем пропорциональное. Полученные результаты соответствуют положениям теории эндогенного роста и отвергают положения неоклассической теории.

КЛЮЧЕВЫЕ СЛОВА
налог на доходы физических лиц, налоговая политика, долгосрочное равновесие, экономический рост

1. Introduction

Income tax is a subject of a serious interest in the economic and political circles. It concerns the long-run and short-run growth of economy. The decrease of a tax rate brings to an increase of budget revenues, investments, employment rate and people's incomes. It has an impact on the business cycle, too.

In the course of the past thirty years, a trend has been observed, at which some developing countries replaced the progressive income tax with a proportional one. These are countries mainly of Central and East Europe, as well as some Asian and African countries. Their major objective is the increase of economic growth.

The first one to introduce income taxation with a proportional tax was the small British colony of Jersey in year 1940. In year 1947 while under British ruling, Hong Kong also adopted a proportional tax. Guernsey became the third British colony that started using a proportional tax in year 1960. In year 1986, Jamaica started taxing income with a proportional tax. The rising success was achieved at the end of the 1990s and at the beginning of the new millennium when a number of countries of Central and East Europe (CEE) adopted a proportional tax. Estonia became the first CEE country, which replaced the progressive tax with a proportional one in year 1994. Since then another fifteen countries of the CEE have introduced a proportional tax.

After the good results achieved by the countries of the CEE and within a period of a high economic growth in year 2008, Bulgaria, too, started taxing income with a proportional tax. The progressive tax rates of 20%, 22% and 24% were replaced by a proportional tax rate of 10%, no tax-free limit. The main goal of the government was to achieve an increase of the budget revenue and an improvement in the long-run growth of economy.

Figures 1 and 2 provide an illustration of the revenue from a progressive and from a proportional tax (in millions of BGN) in the budget of Bulgaria. 1999–2007 is the period with a progressive tax, and 2008–2019 – with a proportional one.

The budget revenue from progressive income tax (see Figure 1) showed an increase by 2.3 or a by a bit more than 230% during the studied period. The revenue increased in nominal values. A deceleration was only in 2001–2002. After this period the nominal value of the progressive income tax has shown an increase.

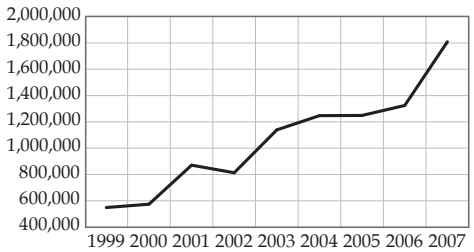

Fig. 1. **Revenue from progressive income tax (millions of BGN)**

Data: Eurostat

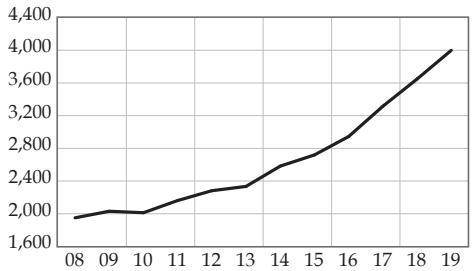

Fig. 2. **Revenue from proportional income tax (millions of BGN)**

Data: Eurostat

The revenue from proportional income tax (see Figure 2) showed an increase by 1.05 or a by a bit more than 100% during the studied period. After the implemented reform, the revenue increased in nominal values. A deceleration was only registered during the Global financial and economic crisis in 2008–2010. After that period the indicator has shown an increase.

Figure 3 shows the nominal values of GDP of Bulgaria in 1999–2019.

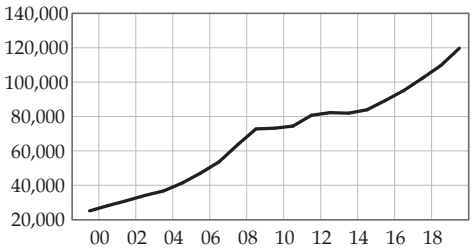

Fig. 3. **Nominal value of GDP (millions of BGN)**

Data: Eurostat

The nominal value of GDP (see Figure 3) showed an increase by 3.8 or a by a bit more than 380% during the studied period. Before the tax reform the increase was 1.5 and after the reform only 0.6. This means that the increase of GDP before the income tax reform is higher than after the reform.

In this study, an empirical analysis is made showing that the progressive income tax has a more favouable impact on the long-run growth of Bulgarian economy than the proportional income tax.

On the one hand, the economy of Bulgaria developed well during the period when a progressive tax was used, and on the other hand, the proportional tax did not succeed in stimulating the economic growth, which was the main aim for which it was adopted.

2. Theoretical background

The discussion of the advantages and disadvantages of a proportional income tax is a subject frequently encountered in empirical literature. In its essence, a proportional tax is of a simple structure at a rate of usually below 20%. The defenders of the proportional tax (liberal economists) claim that these features of its underlie its success. The proportional income tax has a stimulating effect on economy and features the following advantages [1]:

– increasing the budget revenue – the low-rate proportional tax increases the budget revenue as it becomes senseless to hide income;

– increasing the efficiency of the use of resources – a low-rate tax brings to increase of employment by not robbing taxpayers of the additionally earned income;

– increasing the growth of economy – the money remaining available due to the low-rate taxation increases savings and investments;

– providing a fair distribution of income – a flat rate does not rob the high income on the account of the low one.

Notwithstanding the patent arguments stated hereinabove, a proportional tax has still not been applied to the largest economy of the world – the US one. According to R. Hal and A. Rabushka [2] the proportional tax is fair to every taxpayer. They developed further the views of M. Friedman [1] adding the following advantages of a proportional tax:

– a low tax rate – the tax rate should be below 20%, taxation is even, income remains available and entrepreneurs' investments rise;

– double taxation is removed, income is taxed only once regardless of its source. For example, dividends and corporate tax;

– no income is hidden – the low tax rates do not stimulate income hiding;

– income from the same activity taxed by the same rate, equalize the marginal tax rate and remove the obstacles to demand and supply of labor and capital.

The difference between the views of M. Friedman and those of R. Hal and A. Rabushka concern the tax rate. M. Friedman considers that the tax rate should be near 40%, while R. Hal and A. Rabushka assume that the tax rate should be below 20%.

Therefore the Hal's and Rabushka's contributions prove that:

– a personal income taxation from higher to lower tax rates brings to an increase of savings and investments;

– the taxation of high income by lower rates has a stimulating effect on the higher return on investments;

– the same taxation brings to elimination of all the concessions and allowances in the different sectors – this way there is no redirection of businesses from one branch into another for tax reasons, and any movements of capital are lead only by purely market reasons;

– the tax base is expanded, and the tax system is simplified – the cost of administration and control are significantly lower for a proportional taxation;

– the lowered tax rates have a favourable impact on limitation of grey market business operations – the budget revenue increases and the competitiveness of economy rises.

Similar conclusions were published by A. Ambrus [3] who stated the following advantages: the entire tax system of the country is simplified, productivity is fostered, tax income hiding is decreased, employment is increased, income rises, bureaucracy is lowered, the economy growth is boosted, savings and investments increase, economy becomes more and more competitive. The fact that a proportional tax enhances inequality is stated as a disadvantage. In a study of L. Schiau et al. [4] it is confirmed that at proportional taxation the tax-payers are not stimulated to hide income and thus tax collection is increased.

It can be summarized that the benefits from a proportional tax are, as follows:

– significant simplification of procedures of administrating revenue and increased efficiency of tax authorities;

– the economy becomes less grey and the stimuli for income hiding are minimized;

– stimulation of business and increase of consumption;

– those working are stimulated to exert further efforts and to undertake further risk as they would not be "punished" for the extra income they will earn;

– the available income is increased thus bringing to an increase of consumption or increase of savings and investments;

– the direct foreign investments increase thus increasing the funds available for investments in business;

– a favourable impact on business because the motives for moving industry from one place to another resulting not from market signals but for tax purposes are removed.

– there is an easy opportunity to increase or decrease the tax rate depending of the economic cycle phase. When a state needs higher revenue, it just increases the tax rate, and when it needs smaller revenue, it decreases the tax rate.

According to R. Radonshiqi [5] a proportional tax, apart from advantages, features some disadvantages, too. They are, as follows:

1. Elimination of social justice and enhancement of inequality.

2. At keeping a tax-free limit, the medium-level income groups bear the greatest tax load.

3. The state spends more money on paying social benefits to people with low income who are affected by the tax changes.

4. There are no convincing evidence that a flat tax is a reason for the increase

of employment-rate, investments and growth.

5. Import rises owing to the higher available income of tax-payers with high income.

6. There are more stimuli for hiding income by the part of a large group of tax-payers with low and medium income, with regard to whom the tax load is increased.

Similar findings have been published in another empirical studies [6; 7].

Table 1 provides a summary of advantages and disadvantages of a proportional tax based on the studies published.

Table 1

Advantages and disadvantages of a proportional income tax

Advantages	Disadvantages
Easy administration	Enhances inequality
Increase of income	Increase of a state's social payments
No hiding of taxable income	Persons with low and medium income hide taxable income
Increase of savings and investments	The unit cost of income increases
Increase of employment rate	Increase of import
Increase of direct foreign investments	
No redirection of business from one branch to another for tax purposes	
Easily possible to increase or decrease the tax rate depending on the business cycle phase	
Stimulate economic growth	

Source: Prepared by the author

Certain conclusions can be drawn of the advantages and disadvantages of a proportional tax as listed in Table 1. Although it is believed that a proportional tax ensures a higher business activity, the one thing it cannot cope with is the enhancement of inequality. This advantage is recognized by the supporters of the proportional tax, too. Another substantial disadvantage of its concerns the unit cost of income. At a proportional tax the number of the taxable persons increases owing to the expanded taxation mass. Thus the expenditure of tax administration increases and the cost-effectiveness of revenue decreases. The groups earning smaller income would probably evade taxes, too. A proportional tax threatens their social existence and becomes a major motive for hiding income.

Another disadvantage can be related to the easy possibility of increasing or decreasing the tax rate depending on the business cycle phase. If a tax does not work properly throughout a business cycle (does not increase revenue during inflation and does not decrease it during deflation), it is considered ineffective. It does not secure a smooth passing through the phases of the cycle and brings to worsening of recession. Frequent changes of tax rates aimed at collecting revenue result in distrust for the government, disequilibrium of economy and increase of foreign debt.

It should be noted that a proportional tax generates convincing arguments of economic development, on the one hand, but one the other hand, many of them are rejected as unfounded.

Advantages and disadvantages of personal income tax are related with economic growth. Economic growth measures the percentage increase of the real gross domestic product (RGDP). It shows how a nation's wealth is changing. Taxes are considered to change the growth to the direction of decrease. There are two main macroeconomic models explaining the impact of taxes – the neoclassical growth model and the endogenous growth model. The neoclassical model is developed by R. Solow [8]. The endogenous model is related to the works of R. Barro [9] and R. King et al. [10].

According to the neoclassical model taxes do not influence the long-run growth rate. Their impact is only short-run [11]. For example, if the tax rate decreases, the savings and investment will increase. If it increases, it will bring to the opposite effect. That means that tax rates have only a short-run effect on the level of collective output. The main factors contributing to the long-run growth rate are savings,

population growth and technological progress. Hence, they are the ones bringing to a long-run increase of growth.

According to the endogenic model, taxes influence negatively the economic growth rate on a long-run basis. They change tax-payers behaviour at making decisions related to savings, expenses, labour and spare time in long-run [11; 12].

The main difference between the two models is that according to the neoclassical model a change in the tax rate affects economic growth only on a short-run basis, while according to the endogenic model an increase of the tax rate brings to a decrease of the growth.

According to I. Palic at al. [13] an empirical study between the economic growth and revenue from taxes proves a presence of a long-run relationship. The long-run relationship between taxes and growth is equilibrium [14]. Such a relationship can be disturbed in only two cases. First, upon a change of the tax rate. And second, upon economic shocks.

The link between taxes and economic growth can be studied in two directions: from taxes to economic growth and from growth to taxes. That means that this is a two-way relation. In the first case, it is checked whether there exists a short-run and a long-run state of equilibrium between the tax and the growth, and in the second – the efficiency (collection) of revenue. The two analyses differ in conceptual terms. They are calculated using different econometric methods, usually of the VAR group.

A positive relationship (short-run or long-run) means that taxes do not reduce growth. A negative relationship proves that taxes reduce growth.

3. Literature review

In a study of D. Canicio et al. [15] it is proven that there existed the long-run negative relationship for the economy of Zimbabwe between the tax revenue and growth.

G. Edewusi et al. [16] proved that there existed a long-run negative link between the revenue from income tax, profit tax and economic growth in Nigeria.

In a panel study for 79 countries conducted by J. Bakija et al. [17] using a cointegration analysis, it was established that there was no long-run relationship between the tax revenue and the GDP per capita. In another panel study for 27 countries conducted by N. Saidin et al. [18] results were published proving that the income tax influenced positively the GDP.

For economics of Nigeria and Ghana was established a positive impact between the tax revenue and economic growth [19]. Empirical is proved that the income tax influenced negatively on the growth in Croatia [20]. In a panel study for 32 countries conducted by A. Gbato [21], it was proven that in the long-run the tax revenue had a neutral effect on the economic growth.

In a panel study conducted by D. Stoilova et al. [22] for the countries of EU 27, it was stated that the tax systems structured on the basis of direct taxes are more compatible with economic growth. Abdon et al. [23] studied the tax revenues of 13 Asian countries. They proved that the taxes on high and medium income reduced growth. R. Iriqat et al. [24] proved that there was no relationship between the taxes and GDP for Palestine.

T. Wisdom [25] established a positive short-run and long-run relationship between the tax revenue and economic growth for Ghana. With regard to the economy of Turkey, S. Katircioglu [26] proved the existence of a positive link between tax revenue and economic growth.

Balatsky, E. et al. [27] confirm for economics of Russia that the flat income scale should be raised the rate from 13 to 15%. They concluded that at present Russia needs a balanced project which would include multi-step adjustments of the personal income tax over an extended period of time – ten years or more.

In conclusion, it can be stated that a larger part of empirical studies confirm the presence of a long-run relationship between taxes and growth. A smaller part of them prove the existence of a short-run link. A larger part of the studies confirm that such a relationship is negative and taxes reduce growth. A small part of empirical assess-

ments come to the opposite conclusions. A positive relationship between the taxes and economic growth means two things. First, the increase of taxes by the part of the government (in implementation of a discretionary policy) can be stood by the economic agents. Second, the growth of economy is not slowed down at a certain rate of a particular tax.

4. Empirical research results

The long-run relationship between two variables is researched with cointegration analysis and a vector autoregressive model. In this study Eurostat quarterly data for the period March 1999 – March 2020 with 85 observations are used. The data in the empirical analysis are in growth rates. They are seasonally smoothed using the Seasonal adjustment procedure. The empirical research is separated of two periods. The long-run relationship between economic growth and the tax revenue from progressive income tax of Bulgaria is first studied, and then its economic growth and the tax revenue from proportional income tax is studied. In the first period was included 36 observations. In the second period was included 49 observations. The number of observations in the two periods are difference because there are no quarterly data for previous years in the Eurostat database.

The use of an econometric method assumes that the variables are to be tested for stationary processes which are to be time-independent. If it is established that they are first-order integrated (I1), a series of tests are performed for an optimal number of lags. The optimal number of lags is applied at Johansen test for cointegration and thereafter at the construction of the vector autoregression. If Johansen test establishes a presence of a cointegration between the variables, restricted vector autoregression (VAR) is applied, also known as Vector Error Correction (VEC). If no cointegration is established between the variables, unrestricted vector autoregression (VAR) is applied. If the variables are of different orders (I0) and (I1), an ARDL is applied.

4.1. Empirical analysis of the long-run relationship between progressive income tax and economic growth

The group unit root tests (see Table 2) shows that as a group the revenue of the Progressive income tax and GDP were not stationary, but their first difference is are (see Table 3).

Table 2

Group stationarity tests of Progressive income tax and GDP

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	4.59205	1.0000	2	65

Source: Prepared by the author

Table 3

Group stationarity tests of Progressive income tax and GDP (first difference)

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	–1.64348	0.0501	2	64

Source: Prepared by the author

The test for the optimal number of lags, according to FPE, AIC, SC and HQ criteria, this number was one (see Table 4).

Table 4

Optimal lag length in the VEC model

Number of lags	FPE	AIC	SC	HQ
0	1.38e+11	31.32281	31.41350	31.35332
1	1.97e+08*	24.77322*	25.04531*	24.86477*
2	2.25e+08	24.90052	25.35401	25.05311
3	2.74e+08	25.09026	25.72514	25.30388
4	1.38e+11	31.32281	31.41350	31.35332

Source: Prepared by the author

* Shows the optimal number of lags according to the respective criterion

Johansen's cointegration test (see Table 5 and 6) shows that Progressive income tax and GDP are cointegrated according to the criteria of Trace and Max-eigenvalue.

Table 5

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.464923	23.72641	15.49471	0.0023
At most 1	0.089387	3.090036	3.841465	0.0788

Source: Prepared by the author

Note: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-values

Table 6

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.464923	20.63637	14.26460	0.0043
At most 1	0.089387	3.090036	3.841465	0.0788

Source: Prepared by the author

Note: Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-values

According the above statistics, an restricted vector autoregressive model (VEC) with one lag was constructed. The statistically insignificant values are removed in ascending order. The vector autoregression was estimated with one lags.

The equation for the target variable in the VEC model GDP after the step-by-step removal of statistically insignificant variables is as follows:

(1) D(GDP) = C(1) ·(GDP(–1) – – 0.24228688236 ·PROGT(–1) + + 13514.2232898) + C(6)

The results from the evaluation of Equation (1) are shown in Table 7.

The variables in Equation (1) are statistically significant at a critical level of 5%. The first term of Equation (1) is named an error correction term and shows the long-run relationship between the variables of D(GDP) and progressive income tax (–1). The sign is negative and shows that the relationships long-run and equilibrium. Its absolute value (–0.24) indicates the rate of correction of deviations from the long-run equilibrium by 24% per period/quarter. The coefficient of error correction is negative (–0.041393) and confirms that the revenue from a progressive tax reduces growth in the long-run. The last term of Equation (1) is a constant and is also statistically significant. The coefficient shows that there is no short-run relationship between the growth rate of a progressive income tax and the growth. The VEC does not report statistically significant values in long-run.

The value of the coefficient of determination (R-squared = 0.48) proves that 48% of the change of the GDP in Bulgaria can be explained through the changes of the independent variable. The probability of the F-statistic (0,00) indicates that the alternative hypothesis of the adequacy of the model used is confirmed.

The correlation between progressive income tax and economic growth is positive whit value 0.56. It should be made clear that this does not mean that the

Table 7

Results from the econometric estimation of Equation (1)

Variable	Coefficient	Standard error	t-statistics	Probability
GDP(–1)	0.041393	0.007385	5.604675	0.0000
Constant	325.2932	27.22673	11.94757	0.0000
R-squared	0.487676	Mean dependent var	313.5404	
Adjusted R-squared	0.472151	S.D. dependent var	221.0461	
S.E. of regression	160.5970	Akaike info criterion	13.05112	
Sum squared resid	851116.5	Schwarz criterion	13.14000	
Log likelihood	–226.3946	Hannan-Quinn criter	13.08180	
F-statistic	31.41238	Durbin-Watson stat	2.455010	
Prob(F-statistic)	0.000003			

Source: Prepared by the author

Data: Eurostat

model is the best possible one but simply that it adequately reflects the relationship between the dependent and independent variables.

The results from the CUSUM test (Figure 4) prove that Equation (1) is steady in a dynamic time plan. The actual values of CUSUM are within the frames of the confidence interval at a 5% level of significance.

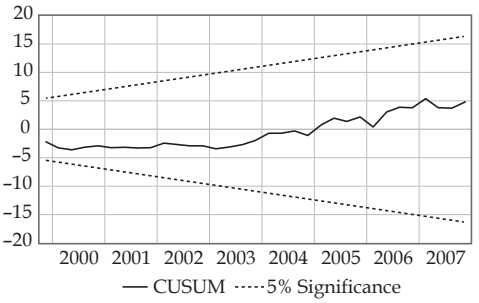

Fig. 4. **CUSUM test for dynamic stability of Equation (1)**

Source: Prepared by the author

The test for an absence of a serial correlation of disturbances shows that the null hypothesis is valid in Equation (1) (see Table 8). The results from the heteroscedasticity test on the residuals in the VEC model (see Table 9) is reason to accept the null hypothesis for lack of heteroscedasticity.

Table 8

Results from the serial correlation test of residuals in Equation (1)

F-statistic	1.276564	Probability F (2,37)	0.2933
Observations R2	2.663223	Probability Chi-square (2)	0.2641

Source: Prepared by the author

Table 9

Results from the heteroscedasticity test of residuals in Equation (1)

F-statistic	1.256221	Probability F F(6,37)	0.2984
Observations R2	2.547936	Probability Chi-square (3)	0.2797

Source: Prepared by the author

The probability of Jarque-Bera statistics is 0.57 (see Figure 5), which justifies the acceptance of the null hypothesis of normal distribution of the residuals in Equation (1).

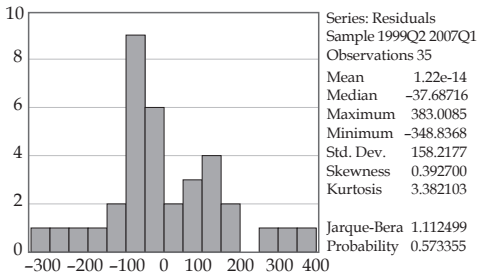

Fig. 5. **Test for normal distribution of residuals in Equation (1)**

Source: Prepared by the author

4.2. Empirical analysis of the long-run relationship between proportional income tax and economic growth

The group unit root tests shows that as a group the revenue of the Proportional income tax and GDP were not stationary, but their first difference is are. (see Tables 10 and 11).

Table 10

Group stationarity tests of Proportional income tax and GDP

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.22189	0.5878	2	92

Source: Prepared by the author

Table 11

Group stationarity tests of Proportional income tax and GDP (first difference)

Method	Statistic	Probability	Cross-sections	Observations
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	–8.73997	0.0000	2	91

Source: Prepared by the author

The test for the optimal number of lags, according to FPE, AIC, SC and HQ criteria, this number was four (see Table 12).

Johansen's cointegration test (see Table 13 and 14) shows that Proportional income tax and GDP are cointegrated according to the criteria of Trace and Max-eigenvalue.

Table 12

Optimal lag length in the VEC model

Number of lags	FPE	AIC	SC	HQ
0	10.96299	8.070265	8.149771	8.100049
1	6.978559	7.618226	7.856744	7.707576
2	5.044863	7.292400	7.689931	7.441318
3	5.514408	7.378354	7.934897	7.586838
4	1.083587*	5.745809*	6.461364*	6.013860*

Source: Prepared by the author

Note: * Shows the optimal number of lags according to the respective criterion

Table 13

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.329348	20.08927	15.49471	0.0094
At most 1	0.055472	2.511072	3.841465	0.1130

Source: Prepared by the author

Note: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-values

Table 14

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.329348	17.57820	14.26460	0.0144
At most 1	0.055472	2.511072	3.841465	0.1130

Source: Prepared by the author

Note: Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-values

According the above statistics, an restricted vector autoregressive model (VEC) with one lag was constructed. The statistically insignificant values are removed in ascending order. The vector autoregression was estimated with four lags.

The equation for the target variable in the VEC model GDP after the step-by-step removal of statistically insignificant variables is as follows:

$$\mathbf{(2)\ D(GDP) = C(1) \cdot (GDP(-1) - 0.15597128779 \cdot PT(-1) + 18.7618351218) + C(4) \cdot D(GDP(-2)) + C(6) \cdot D(GDP(-3)) + C(8) \cdot D(GDP(-4)) + C(10)}$$

The results from the evaluation of Equation (2) are shown in Table 15.

The variables in Equation (2) are statistically significant at a critical level of 5%. The first term of the equation (error correction) shows the long-run relationship between the variables D(GDP), GDP(–1) and proportional income *t*(–1). The sign is negative thus indicating that the relationship is long-run and equilibrium. Its absolute value (–0.15) indicates that the rate of correction of deviations from the long-run equilibrium is 15% per period/quarter. The coefficient of error correction is negative (–0.258523) thus confirming that the revenue from a proportional tax on a long-run shall reduce growth. The se-cond, third and fourth terms of the equation show the short-run impact. The last member of Equation (2) is constant (a free term), and is also sta-

Table 15

Results from the econometric estimation of Equation (2)

Variable	Coefficient	Standard error	t-statistics	Probability
GDP(–1)	–0.258523	0.093363	–2.769000	0.0086
D(GDP(–2))	0.257372	0.090385	2.847497	0.0070
D(GDP(–3))	0.517572	0.093274	5.548953	0.0000
D(GDP(–4))	–0.247883	0.121901	–2.033486	0.0488
Constant	0.115262	0.112087	2.628323	0.0103

R-squared	0.639639	Mean dependent var	0.085798
Adjusted R-squared	0.602679	S.D. dependent var	1.236911
S.E. of regression	0.779667	Akaike info criterion	2.446745
Sum squared resid	23.70734	Schwarz criterion	2.649494
Log likelihood	–48.82838	Hannan-Quinn criter	2.521934
F-statistic	17.30621	Durbin-Watson stat	2.154472
Prob(F-statistic)	0.000000		

Source: Prepared by the author

Data: Eurostat

tistically significant. Coefficients prove that there is no short-run relationship between the growth rate of the revenue from a proportional tax and the growth. The VEC model does not establish any statistically significant values in the short-run by the part of the proportional tax, but only by the part of the GDP.

The value of the coefficient of determination (R-squared = 0.63) means that 63% of the change of the GDP in Bulgaria can be explained through the changes of the independent variable. The probability of the F-statistic (0.00) indicates that the alternative hypothesis of the adequacy of the model used is confirmed.

The correlation between proportional income tax and economic growth is weak with value 0.01. It should be made clear that this does not mean that the model is the best possible one but simply that it adequately reflects the relationship between the dependent and independent variables.

The results from the CUSUM test (Figure 6) prove that Equation (2) is steady in a dynamic time plan. The actual values of CUSUM are within the frames of the confidence interval at a 5% level of significance.

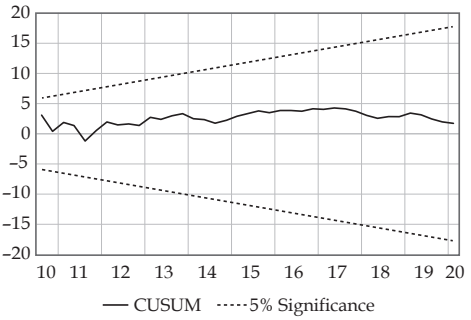

***Fig. 6.* CUSUM test for dynamic stability of Equation (2)**

Source: Prepared by the author

The test for an absence of a serial correlation of disturbances shows that the null hypothesis is valid in Equation (2) (see Table 16). The results from the heteroscedasticity test on the residuals in the VEC model (see Table 17) is reason to accept the null hypothesis for lack of heteroscedasticity.

Table 16

Results from the serial correlation test of residuals in Equation (2)

F-statistic	0.867208	Probability F (2,37)	0.4285
Observations R2	1.970195	Probability Chi-square (2)	0.3734

Source: Prepared by the author

Table 17

Results from the heteroscedasticity test of residuals in Equation (2)

F-statistic	0.377445	Probability F (6,37)	0.7697
Observations R2	1.205913	Probability Chi-square (3)	0.7516

Source: Prepared by the author

The probability of Jarque-Bera statistics is 0.1 (see Figure 7), which justifies the acceptance of the null hypothesis of normal distribution of the residuals in Equation (2).

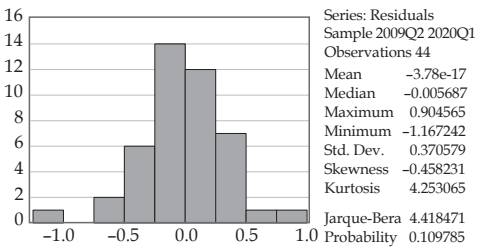

***Fig. 7.* Test for normal distribution of residuals in Equation (2)**

Source: Prepared by the author

5. Conclusions

Several important conclusions can be drawn from the empirical analysis.

First, there exists a long-run equilibrium relationship between the GDP growth rates and the revenue from a progressive tax. This link is negative, which means that income taxation with a progressive tax reduces growth. At an occurrence of shocks the restoration of the state of equilibrium shall take approximately a year. No short-run relationship is established between the economic growth and progressive tax in Bulgaria.

Second, there also exists a long-run relationship between the GDP growth rates and the revenue from a proportional tax. This link is negative, which means that

income taxation with a proportional tax reduces growth. No short-run impact is established by the part of the proportional tax on GDP growth rate. At the occurrence of shocks the restoration of the state of equilibrium shall take approximately two years.

Third, the progressive tax is more compatible with the economic growth than the proportional one. This is supported by the higher coefficient of error correction. Hence, the progressive tax in Bulgaria has a more favourable impact on the economic development.

Fourth, no short-run impact on the economic growth is established for both types of taxes. This result comes to confirm that the progressive and the proportional tax in Bulgaria are in conformity with the theory of endogenic growth and reject the neoclassical theory.

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For citation

Tanchev S. Long-run equilibrium between personal income tax and economic growth in Bulgaria. *Journal of Tax Reform*. 2021;7(1):55–67. DOI: 10.15826/jtr.2021.7.1.090

Article info

Received *February 8, 2021*; Revised *March 2, 2021*; Accepted *April 8, 2021*

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Для цитирования

Tanchev S. Long-run equilibrium between personal income tax and economic growth in Bulgaria. *Journal of Tax Reform*. 2021;7(1):55–67. DOI: 10.15826/jtr.2021.7.1.090

Информация о статье

Дата поступления *8 февраля 2021 г.*; дата поступления после рецензирования *2 марта 2021 г.*; дата принятия к печати *8 апреля 2021 г.*