

CORPORATE TAX RATES IN THE CONTEXT OF MACROECONOMIC INDICATORS IN THE EU MEMBER COUNTRIES

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Abstract: One of the decisive factors that influence the investor when deciding on the location of investments represents corporate tax rates. This contribution evaluates the importance of corporate tax rates in the context of macroeconomic indicators in the member countries (EU-28). Based on selected macroeconomic indicators, the contribution aims to evaluate an impact of corporate rates on the economy in the EU countries. Data was retrieved from Eurostat database (2019a, b, c, 2020). To meet our aim, we used regression analysis which included seven economic models that monitored an impact of relationship between statutory tax rate and selected macroeconomic indicators. We found that the greatest impact of corporate tax rates is on GDP, employment, export, income (wages), and tax revenues.

Keywords: corporate taxation, tax rates, macroeconomic indicators, employment

1 Introduction

The methods and principles of corporate taxation vary in countries, as each country has a different legislated tax system. Globalisation and effort to harmonise tax systems are gradually reducing disparities between countries, and the movement of capital between countries becomes easier. Tax rates has a significant role in segmentation because they indirectly influence tax revenues and economic performance in a country. Tax rates are also an economic and social tool (Balážová et al., 2016). This means tax rates effect mainly on macroeconomic indicators, such as GDP, employment rate, inflation rate, foreign direct investment etc. These segments have also significant role in company's decisions; however, the crucial aspects are tax rates and the economic orientation of the country (Andrejovská, 2019). Although statutory tax rate is the quickest instrument to map tax burden in a country, to secure the comparability of tax burden in different countries we must consider differences in accounting, as well as differences in tax systems. Therefore, statutory tax rate is not sufficient instrument for comparing tax burden, as the actual tax paid by entrepreneur may be much higher or lower than tax set by legislative. For that reason, effective tax rates are crucial because they examine tax impact in capital more comprehensively. Effective tax rate is defined as a ratio between tax charges and profits, and at the same time, it captures the relationship between tax reliefs that reduce the tax base in relation to profits from the financial activities of companies (Gravelle, 2014). Most authors also prefer effective tax rate in their research (Phillips et al., 2004; Dyreng et al., 2017; Agarwal and Chakraborty, 2019). Effective rates consider investor's statutory taxation and other elements of tax system which effect on tax payable and return on investment. Due to the differences in these rates, it is essential to understand their relationship. There is clear evidence of a positive relationship between these rates because if statutory tax rate increases, effective tax rate increases too, but slower. This relationship is reconciled because companies can limit their financial results in relation to the statutory rate to increase their tax savings (Barrios et al., 2014). In the academic area, there has been not found a consensus on corporate taxation and its level (Mihóková et al., 2016). To identify effects of corporate taxation on the economy more accurately, it would be necessary to look directly at empirical evidence of the effect of these changes in the international context. Various factors, such as capital and labour force (Hassett and Mathur, 2015) caused exogenous changes in tax systems and changes in income after taxation.

Corporate taxation has an impact on changes in prices of capital, labour, and production which affect the general equilibrium welfare of market participants. By now little, if any, agreement

remains who bears the burden of corporate taxation (Harris, 2009). Corseuil et al. (2011) evaluated if there are effects of corporate tax on employment in Brazil where a tax incentive program for small businesses was implemented to reduce monetary and administrative costs for micro-enterprises. As a result, the number of companies leaving the market, which opted for this program, has been reduced. Moreover, number of employees increased due to improved tax conditions. Dhaliwal et al. (2015) and Immervoll (2000) prove that inflation has an impact on actual tax burden, moreover, even a low inflation rate increases corporate tax burden. Gravelle (2014) stated in the past that "for capital and resource-intensive companies, the existence of inflation increases the real corporate tax burden". Davies et al. (2018) prove that lower corporate tax rates increase the attractiveness of countries and regions for foreign direct investments, especially in small and peripheral countries, which cannot benefit from advantages such as location, market size and market access. Innovation also plays an important role in the country (Urbaníková et al., 2020). Becker et al. (2012) measured the relative importance of the qualitative and quantitative effects of corporate taxation on foreign direct investment and concluded a negative impact.

2 Materials and Methodology

The contribution aims to analyse effect of corporate tax rate on macroeconomic indicators in the EU member countries. The first part of the contribution dealt with analysis of statutory and effective tax rates and the differentiation of them in the observed period. The second part of the contribution was focused on seven individual econometric models in which, based on the linear regression, we tested effect of selected macroeconomic indicators and statutory tax rate.

Source for our analysis represents annual data of the EU member countries (EU-28) in 2004-2019. In this contribution, we divided the EU member countries into the old member countries (EU-15) and the new member countries (EU-13) because of the entrance of many countries in EU in 2004.

In the contribution, there was analysed the following variables: statutory tax rate (STR), effective tax rate (EATR), gross domestic product (GDP), corporate tax revenues (REV), income (INC), foreign direct investment (FDI), inflation rate (INF), export (EXP), and employment rate (EMP). Data was retrieved from Eurostat (2019a, b, c, 2020). Linear regression, which determines impact between selected variables, was made in the program R. The input data for regression analysis represents average values for EU, and so also outputs of regression analysis must be interpreted aggregately for EU.

Based on simple linear regression that examines linear relationship between one dependent variable and one independent variable, we formulated seven models (A - G). In each model we explain in details effect of statutory tax rate on macroeconomic indicators. We use the following formula to set our models A - G:

$$Y_i = \beta_0 + \beta_1 * x_{i,t} + \varepsilon_{i,t} \quad (1)$$

The created econometric models have the following form:

$$\text{MODEL A} \\ GDP_t = \beta_0 + \beta_1 * STR_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$\text{MODEL B} \\ INF_t = \beta_0 + \beta_1 * STR_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$\text{MODEL C} \\ EMP_t = \beta_0 + \beta_1 * STR_{i,t} + \varepsilon_{i,t} \quad (4)$$

MODEL D

$$EXP_t = \beta_0 + \beta_1 * STR_{i,t} + \varepsilon_{i,t} \quad (5)$$

MODEL E

$$FDI_t = \beta_0 + \beta_1 * STR_{i,t} + \varepsilon_{i,t} \quad (6)$$

MODEL F

$$INC_t = \beta_0 + \beta_1 * STR_{i,t} + \varepsilon_{i,t} \quad (7)$$

MODEL G

$$REV_t = \beta_0 + \beta_1 * STR_{i,t} + \varepsilon_{i,t} \quad (8)$$

In model A – G and in our analysis, we use these variables:

- STR – Statutory Tax Rate expressed in %,
- GDP – Gross Domestic Product expressed in market prices in millions of EURs,
- INF – Annual inflation rate expressed in %,
- EMP – Employment rate: this variable expresses a ratio of employed people from 15 to 64 years and the active population, expressed in thousands of persons,
- EXP – Export: this variable represents export of all products to the world, expressed in millions of EURs,
- FDI – Foreign Direct investment: this variable represents net inflow of FDI into a country, expressed in USD,
- INC – Income: variable monitors average individual annual income, expressed in EUR,
- REV – Corporate Tax Revenues: this variable represents budgetary revenues from corporate tax, expressed in millions of EUR.

Other variables in models A - G are the following:

- β_0 - the intercept of regression line, constant,
- β_1 - regression coefficient, model parameter that expresses the value of the change of the explanatory variable to the response variable Y_i ,
- $\varepsilon_{i,t}$ - random variable in model that includes another effect which may explain response variable Y_i ,

Models A - G were tested on residual normality, heteroscedasticity, and autocorrelation. These tests met assumptions, therefore, models showed correct results.

We tested normality of residuals by Shapiro-Wilk test. On significance level $\alpha = 0.05$ were tested these hypotheses:

Hypothesis 1 (H1): Residuals are normally distributed.

Hypothesis 2 (H2): Residuals are not normally distributed.

If p-value is greater than the specified significance level, we do not reject the hypothesis H1, and model meets assumption of residual normality.

Based on Breusch-Pagan test we tested homoscedasticity in the model, and on significance level $\alpha = 0.05$ were tested these hypotheses:

Hypothesis 3 (H3): Data is heteroscedastic.

Hypothesis 4 (H4): Data is not heteroscedastic.

We do not reject hypothesis H3 if p-value is greater than significance level, and we conclude that data is homoscedastic in the model.

To test autocorrelation, we use Breusch-Godfrey test. On significance level $\alpha = 0.05$ were tested these hypotheses:

Hypothesis 5 (H5): There is no autocorrelation.

Hypothesis 6 (H6): There is autocorrelation.

If p-value is greater than significance level, then hypothesis H5 is not rejected, and there is no autocorrelation in the model.

The selection of indicators was made on the basis of the theoretical findings of Immervoll (2000), Laffer (2004), Lee and Gordon (2005), Clausing (2012), Federici and Parisi (2012),

Davies et al. (2016), Fuest et al. (2018), Glova and Mrázková (2018) and Glova et al. (2020), who examined, among other things, the effects of the corporate tax burden on these macroeconomic determinants.

To reject or confirm our hypotheses about corporate taxation, we studied previous related literature, such as Devereux and Sorensen (2005), Dyreng et al. (2017), Agarwal and Chakraborty (2019), Clausing (2012), Davies et al. (2016). Our hypotheses are in the following form:

Hypothesis 7 (H7): Corporate tax rates (statutory and effective) have been on a declining trend since the accession of the new EU member countries in 2004. This means that by lowering corporate tax rates, countries try to increase their attractiveness and competitiveness.

Hypothesis 8 (H8): The new member countries and smaller economies choose rather lower tax burden due to their less favourable international economic position and competitive disadvantage. On the other hand, larger economies have more opportunities to lower their tax burden.

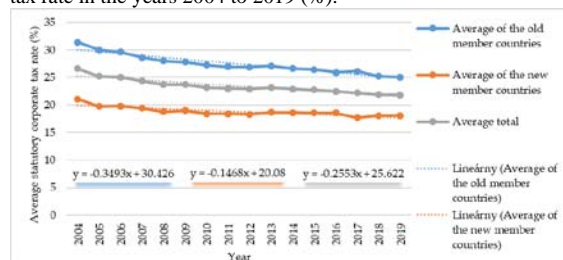
Hypothesis 9 (H9): The greatest expected impact of corporate tax rates is on GDP, export, employment, FDI, and tax revenues (in accordance with Laffer curve). We assume smaller impact on other indicators.

3 Results and Discussion

3.1 The analysis and comparison of tax corporate tax rates

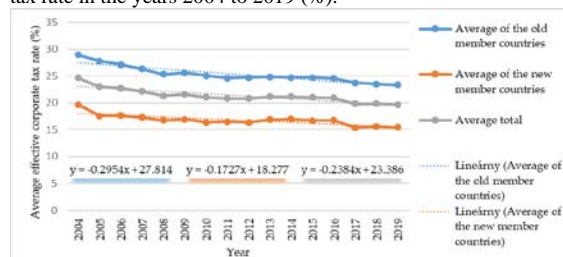
Tax burden can be monitored and compared by statutory and effective corporate tax rates. Generally, as the analysis has shown, statutory tax rates are much higher than effective tax rates. We observed this trend in the old member countries, as well as in the new member countries. There was a change in statutory tax rates during the period. The average tax rates ranged from 11.09% to 36.01%. We can state that the major tax reforms have taken mainly in the old member countries, while the new member countries maintained relatively stable tax rates. On average for the old member countries (EU-15), tax rates ranged from 15.45% to 19.69%. We found that changes in statutory tax rates are caused by various factors, such as effects of economic, financial or debt crisis, and effect of political cycle or other various factors. Based on our findings, we confirmed that legal entities are subject to bigger tax burden in the old member countries and larger economies than in the new member countries and smaller economies. Based on the detailed analysis of tax rates, we can conclude that the Western EU countries achieve the highest level of tax burden. To countries with the highest statutory tax rates belong: France (44.4%), Italy (37.3%), Spain (35%), Portugal (31.5%), and Germany (38.4%). The reason why statutory tax rates are the highest in the Western EU countries is that these countries belong to large economies and their GDP creates significant part of GDP in Europe. Therefore, countries such as Germany, France, or Great Britain, use various instruments of fiscal policy to secure sufficient income, and so they do not need to use tax rates to increase their competitiveness in the same extent as smaller economies. On the other hand, corporate tax burden of countries in the Middle and Eastern Europe, so called transitive economies, is the lowest within the Europe. To these countries belong: The Czech Republic (19%), Poland (19%), Slovakia (21%), Croatia (18%), Romania (16%) and others. As the situation in the transitive economies is the opposite than in countries of the Western Europe, statutory tax rates represent important instrument to increase competitiveness and to harmonize rates with the Western countries. In the Northern countries corporate tax rates are around the level of tax rates of the Western countries and transitive economies. The Northern countries are famous with the advanced social policy. This means that they try to find a balance between suitable conditions for domestic entrepreneurs and sufficient tax revenues.

Figure 1. Development of the average statutory corporate tax rate in the years 2004 to 2019 (%).



Source: own processing according to Eurostat (2019 a, b, c, 2020).

Figure 2. Development of the average effective corporate tax rate in the years 2004 to 2019 (%).



Source: own processing according to Eurostat (2019a, b, c, 2020).

The first figure (Figure 1) shows average statutory tax rates and the second figure (Figure 2) shows average effective tax rates in period of 2004-2019. In both graphs (Figure 1 and 2), there is linear decline in tax rates during the period. Based on this analysis, we can conclude the following findings:

- Average statutory tax rates of the EU countries decreased slightly from 24.64% to 19.69%.
- Total average statutory tax rates decreased around -0.25 pp/year.
- Average statutory tax rates of the old member countries decreased from 28.93% to 23.37%. They declined faster (-0.35 pp/year) than average rates of the new member countries (-0.15 pp/year) which decreased from 19.69% to 15.45%.
- Total decline of average statutory tax rates for the old member countries was 6.33%.
- Total decline of average statutory tax rates for the new member countries was 2.98%.
- Total decline of average statutory tax rates for all EU countries was 4.78%.

Findings stated above effect on real economy in EU differently. The most significant impacts are the following:

- Lower tax rates increase competitiveness of the economy in the international context and influence economic position of countries.
- Lowering tax rates can be positive for improvement of business sector in the economy; therefore, employment and GDP can increase through the development of entrepreneurial sector.
- Favourable tax conditions for business attract foreign direct investment what can lead to stronger economy, infrastructure development in the country, and creation of new work positions. Generally, the centre of large and medium-size companies are countries with favourable corporate tax system.
- Lowering tax rates within EU can help to harmonize tax systems of countries, and so to increase and simplify the international cooperation and international trade.

Table 1. Differences between statutory and effective tax rates (%)

- We evaluate trend of lowering tax rates positively although we do not see full tax harmonization as desirable.

According to analysis, we can conclude that the old member countries and larger economies are subject to higher effective corporate tax burden than the new member countries and smaller economies. As was described, statutory tax rates have different effects on the economy, and similarly, effective tax rates have also impact on the economy. The difference is only in the amount of tax rates. Effective tax rates are based on statutory ones; however effective rates include other elements which adjust their level. This difference is caused by some specifics in tax systems of EU countries, i.e., different tax relief policies and fiscal stimulus, effectivity of tax collection, different methodologies of corporate tax calculation etc.

Hypothesis 7 (H7): Corporate tax rates (statutory and effective) have been on a declining trend since the accession of the new EU member countries in 2004. This means that by lowering corporate tax rates, countries try to increase their attractiveness and competitiveness.

We confirmed hypothesis H7. Indeed, corporate tax rates have a declining trend since the new member countries entered in EU. Based on our findings, lowering corporate tax rates is one of the instruments to increase attractiveness and competitiveness of countries.

Hypothesis 8 (H8): The new member countries and smaller economies choose rather lower tax burden due to their less favourable international economic position and competitive disadvantage. On the other hand, larger economies have more opportunities to lower their tax burden.

We also confirmed hypothesis H8, and indeed, the new member countries and smaller economies choose lower level of tax burden.

3.2 The difference analysis of statutory and effective tax rates

In this part of the contribution, we focus attention to differences between tax rates within analysed period 2004-2019, for each EU country individually.

EU	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Old member states (EU-15)																
IE	1,8	1,8	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,6	1,6	1,6	1,6	1,6
FI	1,8	1,5	1,5	1,5	1,5	1,4	1,1	1,3	1,2	1,9	1,4	1,1	0,9	0,5	0,4	0,4
UK	0,7	0,7	0,8	0,7	0	0,3	0,4	0,9	1,2	1,3	1,4	1,5	1,5	1,5	1,6	1,2
DK	3,2	2,9	2,9	2,5	2,4	2,4	2,4	2,4	3	3	2,3	2,2	2	1,9	2,2	2,2
SE	4,9	3,4	3,4	3,4	3,4	3,1	3,1	3,1	3,1	2,6	2,6	2,6	2,6	2,6	2,6	2
AT	2,8	2	2	2	2	2,3	2,3	2	2	2	2	2	1,9	1,9	1,9	1,9
NL	2,6	3,1	2,9	2,4	2,4	3,3	3,3	3,2	2,4	3,4	2,4	2,5	2,5	2,5	2,5	2,5
EL	4,6	4,2	3,8	3,3	13,2	4,5	3	2,5	2,5	1,9	1,5	1,5	1,4	1,4	1,4	1,4
LU	3,9	3,9	3,7	3,7	3,7	3,6	3,6	3,9	3,9	3,7	3,7	3,7	3,7	3,4	3,2	3,1
PT	2,9	2,9	2,9	2,8	2,8	2,8	2,8	2,8	3,1	3,1	3,1	2,9	2,9	9,5	10,1	10,1
ES	1,5	1,5	1,5	1,2	2,8	2,8	2,8	1,9	2,4	2,9	2,6	4,7	5,1	5,1	5,1	5,1
DE	2,5	2,6	2,9	2,9	1,2	1,4	1,5	1,4	1,4	1,4	1,5	1,6	1,6	1,1	1	1
IT	5,5	5,5	5,5	5,5	4,1	3,9	3,9	5,5	6,2	6,2	7,1	7,5	7,7	4,1	3,2	3,2
BE	4,5	4,5	3,3	3,6	9,1	9,3	8,7	8,1	7,7	7,5	7,3	6,2	5,7	4,7	4,7	4,6
FR	0,4	0,2	0	0,2	0,2	0,3	1,6	3,3	1,9	3,3	0,3	0,3	4	11	1	1
New member states (EU-13)																
CY	4,8	0,6	0,6	0,6	0,6	0,6	1,6	1,6	1,9	2,7	2,7	0,2	0,6	0	0,5	0,9
BG	2,4	1,8	1,8	1,2	1,1	1,2	1,2	1	1	1	1	1	1	1	1	1
LV	0,7	0,7	0,7	0,7	1,2	1,2	1,2	2,8	2,6	2,9	0,7	0,7	0,7	0,7	3,3	3,3
LT	2,3	2,3	3	2,8	2,3	3,2	2,3	2,3	2,3	1,4	1,4	1,4	1,4	1,4	1,4	2,3
RO	2,6	1,3	1,3	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3
HU	0,2	0,9	1,2	1,8	1,8	1,8	1,5	1,3	1,3	1,3	1,3	1,3	1,3	1,3	0,3	0,3
PL	1,9	1,9	1,9	1,6	1,6	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	2,4
HR	4,6	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,2	3,2	3,2
SK	2,5	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,7	2,6	2,4	2,4	2,3	2,3	2,3
SI	3,5	2,9	2,7	2,1	2	1,9	1,8	1,8	1,6	1,5	1,5	1,5	1,5	1,7	1,7	1,7
CZ	3,4	3,3	3	3	2,6	2,5	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
EE	5,6	5,2	4,9	4,7	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,3	4,3	4,3	4,3	6,1
MT	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	10,7	10,6	9,7

Source: own processing according to Eurostat (2019a, b, c, 2020).

Based on the analysis (Table 1), we can conclude that most countries reached higher statutory taxation than effective. Countries with the largest differences in tax rates are Italy, Belgium, Estonia, and Malta. The highest difference was recorded in Greece in 2008 (13.2 pp) what can be associated with the economic crisis. The second highest difference was in France in 2007 (11 pp). To the first three countries belongs also Malta with around 10 pp in the last years of the period. Other countries did not reach such significant values in tax rates differences. Countries with red colouring represent a minority. In these countries, the opposite phenomenon occurred, and thus statutory tax rates were lower than effective. To these countries belong Ireland, Spain, and Cyprus. During the period, a few countries experienced changes from lower statutory rates to lower effective rates (or vice versa), what is described by colour combinations in these countries, i.e., in Great Britain, France, Hungary, and Croatia.

From the above findings concludes that in the analysed countries can be identified a trend which is associated with effectiveness of tax systems, profit spill over in transnational corporates, tax heavens, tax evasions etc. These facts have economic effect on countries, such as:

- Investment allocation in countries with low effective taxation and in countries with various tax reliefs and fiscal stimulus.

- Decline in tax revenues in countries with high tax rates where business entities are reluctant to pay taxes. As a result, there will be tax evasion or relocation to other countries.
- In general, the fact that effective taxation is lower than statutory taxation indicates the efforts of entrepreneurs to reduce tax bases, and therefore it is necessary to reduce the statutory tax burden.
- High statutory taxation stimulates development of grey economy and new ways of circumventing the law.
- Generally, problem with corporate taxation in EU is that business entities are willing to pay taxes until statutory tax rates do not reach marginal value (the theory sets tax limit at the level of 33%). In this case, Laffer curve applies and after reaching the tax limit, corporate tax revenues decrease.

3.3 The regression analysis of statutory tax rates and macroeconomic indicators

As the last method to examine effect of corporate taxation in the EU countries we used regression analysis. In this analysis, we included 7 macroeconomic indicators, i.e., GDP, inflation, employment, export, foreign direct investment, wages, and tax revenues. The following tables (Table 2 and Table 3) and figures (Figure A1) show final outputs of regression analysis.

Table 2. Results of individual models and average values of indicators

Model	Model formula	Average value of indicator for EU
MODEL A: GDP ~ STR	$GDP_t = \beta_0 - 38\,020 * STR_t + \varepsilon_t$	487 476 mil. EUR
MODEL B: INF ~ STR	$INF_t = \beta_0 + 0.514 * STR_t + \varepsilon_t$	2.1 %
MODEL C: EMP ~ STR	$EMP_t = \beta_0 - 106.094 * STR_t + \varepsilon_t$	8 442 thousands of persons
MODEL D: EXP ~ STR	$EXP_t = \beta_0 - 19\,414 * STR_t + \varepsilon_t$	154 774 mil. EUR
MODEL E: FDI ~ STR	-	-
MODEL F: INC ~ STR	$INC_t = \beta_0 - 645.9 * STR_t + \varepsilon_t$	15 721 EUR
MODEL G: REV ~ STR	$REV_t = \beta_0 - 817.1 * STR_t + \varepsilon_t$	12 606 mil. EUR

Source: own processing in the program R according to Eurostat (2019a, b, c, 2020)

Table 3. Results of regression analysis models

Model	GDP ~ STR	INF ~ STR	EMP ~ STR	EXP ~ STR	INC ~ STR	REV ~ STR	FDI ~ STR	
p-value for determinant	2.28*10 ⁻⁶	0.0697	4.03* 10 ⁻¹⁰	1.88*10 ⁻⁶	0.0092	0.0207	0.202	
Parameter estimation β	-38 020	0.514	-106.09	-19 414	-645.9	-817.1	3.673*10 ⁹	
Determination coefficient	0.807	0.2161	0.9433	0.8124	0.3939	0.3265	0.1134	
p-value for model	2.284*10 ⁻⁶	0.06967	4.025*10 ⁻¹⁰	1.877*10 ⁻⁶	0.009246	0.0207	0.2022	
Normality	p-value	0.651	0.583	0.227	0.134	0.104	0.714	-
	result	✓	✓	✓	✓	✓	✓	
Homo- scedasticity	p-value	0.471	0.7885	0.9788	0.8214	0.0096	0.9877	-
	result	✓	✓	✓	✓	X	✓	
Auto- correlation	p-value	0.0041	0.2211	0.341	0.0273	0.3546	0.0085	-
	result	X	✓	✓	✓	✓	X	

Source: own processing in the program R according to Eurostat (2019a, b, c, 2020)

MODEL A represents the output of regression analysis between response variable gross domestic product (GDP) and statutory tax rate (STR), and it is described by formula a0. As we can see, p-value for investigated determinant is 2.28*10⁻⁶. This means that regressor STR is statistically significant because p-value is lower than significance level α (0.05). There is also information about determination coefficient in the table. Its value is 0.8073 what indicates that our Model A explains 80.73% of examined variability of variable GDP, therefore, it is enough precise. P-value for model is 2.284*10⁻⁶ what is lower than significance level α (0.05), and so the model is statistically significant. The assumption of residual normality and homoscedasticity is met. There is a problem with autocorrelation in the model, but it is expected because the level of GDP is directly influenced by statutory tax rate. Also, random components in observations show some similarity and a tendency to remain unchanged. This problem associates with the nature of the data and can be understandable, so we did not try to eliminate it further. The result of the first simple linear regression estimates parameter β that is equal to 38 020. This means that an increase in statutory tax rate by 1% causes a decline in GDP by 38 020 mil. EUR for EU. Our previous results are confirmed, and we can conclude that GDP and statutory tax rate are indirectly correlated, i.e., an increase in corporate statutory tax rate causes a decline in GDP. Average value of GDP for EU during the period is 487 476 mil. EUR, so parameter β represents around 7.8% (i.e., 38 020/487476). This means that an increase in statutory tax rate causes a decline in GDP by around 7.8%. Our findings are supported by Lee and Gordon (2005) which found also negative correlation between tax rate and GDP. Previous studies from

1970-1977 detected if corporate tax rate decreases by 10%, annual economic growth increases by 1%.

MODEL B represents the output of regression analysis between response variable inflation (INF) and statutory tax rate (STR), described by formula b0. P-value for determinant is equal to 0.0697. This means that regressor STR is statistically significant because p-value is lower than significance level α (0.10). In this case, we chose a significance level $\alpha=0.10$ because $\alpha=0.05$ proved to be too strict criterion for analysing data of this nature. The value for determinant coefficient is equal to 0.2161, meaning that this model explains 21.61% of examined variability of variable INF. The accuracy of model is not so high; therefore, it may cause high p-value for regressor estimation. Result is influenced by high volatility of inflation during the period. However, this should be sufficient to assess the relationship between inflation and tax rate, so we decided to continue the regression analysis further. P-value for model is equal to 0.06967 and is less than significance level α (0.10), so our model is statistically significant (there is similar problem as for regressor parameter). The assumption of residual normality and homoscedasticity is met in the model. However, there is problem with first order autocorrelation. Result of the second simple regression analysis estimates parameter β that is equal to 0.514. This means that an increase in statutory tax rate by 1% causes an increase in inflation by 0.514% for EU. Our findings differ from result by Dhaliwal et al. (2015) which clarified a negative relationship between tax rates and inflation in the research.

MODEL C represents a relationship between employment (EMP) and statutory tax rate (STR) and is described by formula c0. P-value for examined determinant is 4.03×10^{-10} , meaning that regressor STR is statistically significant in the model because p-value is lower than significance level α (0.05). Determination coefficient is equal to 0.9433, meaning that our Model C explains 94.33% of examined variability of variable EMP. The accuracy of Model C is very high, so this correlation is described well. P-value for model is equal to 4.025×10^{-10} and is lower than significance level α (0.05), so our model is statistically significant. The assumption of residual normality, as well as homoscedasticity is met and there is no problem with first order correlation in the model. Result of the third simple linear regression estimates parameter β that is equal to -106.094. This means that an increase in statutory tax rate by 1% causes a decline in employment at average by 106 thousand of work positions for the EU. The average employment rate for all EU countries during the period was 8 442 thousand of persons, so coefficient β represents around 1.3% (i.e., $106/8\ 442$). This means that an increase in statutory tax rate by 1% causes a decline in employment by around 1.3%. Feldman (2011) examines 19 industrial countries in 1979-2005 and his results suggest that an increase in corporate tax rate by 10% is associated with a decline in unemployment rate by 2.1%. We confirm a negative correlation between tax rate and employment.

MODEL D represents a relationship between export (EXP) and statutory tax rate (STR), described by formula d0. P-value for examined determinant is 1.88×10^{-6} , meaning that regressor STR is statistically significant in the model because p-value is lower than significance level α (0.05). Determination coefficient is equal to 0.8124, so our Model D explains 81.24% of examined variability of variable EXP. We consider this value of determination coefficient to be high enough, which increases the relevance of the model itself. P-value for model is equal to 1.877×10^{-6} and is lower than significance level α (0.05), so Model D is statistically significant. The assumption of residual normality and homoscedasticity is met in the model; however, there is small problem with first order autocorrelation. If we increase significance level $\alpha=0.10$, then problem with autocorrelation is no longer relevant. Result of regression analysis estimates parameter β that is equal to 19 414. This means that an increase in statutory tax rate by 1% causes a decline in export by 19 414 mil. EUR for EU. The average export level for all EU countries during the period is 154 774 mil. EUR, so coefficient β represents around 12.5% (i.e., $19\ 414/154\ 774$). This means that an increase in statutory tax rate by 1% causes a decline in export by around 12.5%. Authors Federici and Parisi (2012) found that a decrease in statutory tax rate can be considered as a reduction in the cost of corporate tax, which can expand business activity and increase export.

MODEL E represents a relationship between foreign direct investment (FDI) and statutory tax rate (STR), described by formula e0. P-value for examined determinant is equal to 0.202, so regressor STR is not statistically significant because p-value is higher than significance level α (0.05). Determination coefficient is equal to 0.1134. This means that our Model D explains only 11.34% of examined variability of variable FDI. The accuracy of Model D is very low. Because p-value for model is 0.202, it is a very high value and does not meet any acceptable significance level α . We can conclude that between FDI and statutory tax rate is no significant correlation that would bring noticeable findings for our aim in this contribution. This situation can be caused by the nature of data or large extreme values in the observed period. We could not use logarithmic transformation in this model either, so we decided to exclude this determinant from the model because it is inadequate and insignificant for assessing the impact of the corporate tax burden on the EU economies. On the other hand, Grubert and Mutti (1991), Hines (2003) and Hines and Rice (1994) found a large and significant negative impact of average corporate tax rate on total capital of companies. Estimates suggest that an increase in effective corporate tax rate by 10 percentage points in one year reduces the investment rate by 2.2 percentage points and the volume of foreign direct investment by 2.3 percentage points.

MODEL F represents a relationship between net annual income/wage (INC) and statutory tax rate (STR), described by formula f0. P-value for examined determinant is 0.00925 and is lower than significance level α (0.05), so regressor STR is statistically significant in the model. Determination coefficient is equal to 0.3939, meaning that our Model F explains 39.39% of examined variability of variable INC. The accuracy of Model F is average and should be sufficient for evaluation. P-value for model is 0.0092 and the model is statistically significant. The assumption of residual normality is met, and there is no first order autocorrelation in the model. However, there is a problem with heteroscedasticity in the model. We tried to eliminate it by logarithmic transformation of variables, but results were almost the same and we could not remove our problem from the model. In a case of heteroscedasticity, the T-test and p-value may be skewed. This means that problem with heteroscedasticity may be caused by the nature of data which we cannot influence. The only solution would be to exclude this variable from the analysis of corporate taxation. We have to say that transformation of the model is not adequate solution because there is only one regressor in the model. We do not have other solutions to remove heteroscedasticity in this model, but nevertheless the graph suggests a certain relation between the variables. Therefore, we decided to analyse this model further and accept the risk that result of regression may be skewed. Result of the linear regression analysis of simple estimates parameter β that is equal to -645.9. This means that an increase in statutory tax rate by 1% causes a decline in average net annual income by 645.9 EUR for EU. The average level of net annual income for all EU countries during the period is 15 721 EUR and coefficient β is around 4.1% (i.e., $645.9/15\ 721$), meaning that an increase in statutory tax rate by 1% leads to a decline in net annual income by around 4.1%. To compare our results with other studies, the empirical literature countries a negative impact. Fuest et al. (2018) found that a 1% increase in corporate tax rate would lead to decline in wages by around 0.3-0.5%. Research by Felix (2009) was focused on the situation in the USA and used individual data from survey of the current population in 1977-2005. The author found a negative correlation between wages and corporate taxes and that a 1% decrease in statutory corporate tax leads to an increase in wages by 0.14-0.36%.

MODEL G represents a relationship between corporate tax revenues (REV) and statutory tax rate (STR), described by formula g0. P-value for examined determinant is equal to 0.0207, so regressor STR is statistically significant in the model because p-value is lower than significance level α (0.05). Determination coefficient is equal to 0.3265, meaning that our Model G explains 32.65% of examined variability of variable REV. The accuracy of Model G is not high. P-value for model is 0.0207 and is lower than significance level α (0.05), so our model is statistically significant. The assumption of residual normality and homoscedasticity is met in the model; however, there is a problem with first order autocorrelation. As with the GDP model, this problem may be desirable. Result of the last linear regression estimates parameter β that is equal to -817.1. This means that a 1% increase in statutory tax rate leads to a reduction in corporate tax revenues by 817.1 mil. EUR at average for EU. The average level of tax revenues for all EU countries during the period is 12 606 mil. EUR. Coefficient β represents around 6.5% (i.e., $817.1/12\ 606$), meaning that a 1% increase in statutory tax rate would lead to a decline in tax revenues by around 6.5%. Clausing (2007, 2012) found a parabolic relationship between tax rates and tax revenues within OECD countries, which is in line with the Laffer curve (the higher tax rate, the higher tax revenues). At higher levels of taxation, the author assumed a likely non-linear negative relationship between tax rates and tax revenues. Overall, corporate tax rate maximizing tax revenues is approximately 33%.

Table 4. Comparison of the impact of statutory corporate taxation on individual indicators

Indicators	Author	Relationship between tax rate and indicator	Expected effect	Result effect	Interpretation
GDP	Lee and Gordon (2005)	negative	negative	negative	An increase in tax rate leads to a decline in GDP.
	Kotlán et al. (2011)	negative			
	Johansson et al. (2008)	negative			
Inflation rate	Gravelle (2014)	positive	negative	positive	An increase in tax rate leads to an increase in inflation.
	Dhaliwal et al. (2015)	positive			
Employment	Wang (1993)	negative	negative	negative	An increase in tax rate leads to decline in employment.
	Halko (2005)	positive			
	Fedeli and Forte (2012)	negative			
	Feldmann (2011)	positive			
Export	Federici and Parisi (2012)	positive	positive	negative	An increase in tax rate leads to an increase in export.
	Alworth and Arachi (2008)	positive			
	Keen and Syed (2006)	positive			
FDI	Grubert and Mutti (1991)	negative	negative	-	Indicator excluded from regression due to insufficient statistical significance.
	Hines and Rice (1994)	negative			
	Davies et al. (2016, 2018)	negative			
	Becker et al. (2012)	negative			
Wages	Fuest et al. (2018)	negative	?	negative	An increase in tax rate leads to a decline in wages.
	Hassett and Mathur (2006)	negative			
	Felix (2009)	negative			
	Carroll and Prante (2009)	negative			
Tax revenues	Devereux et al. (2008)	?	?	negative	An increase in tax rate leads to a decline in tax revenues.
	Clausing (2007)	parabolic			
	Bartelsman and Beetsma (2003)	negative			

Source: own processing.

Table (Table 4) evaluates an impact of statutory corporate taxation on macroeconomic indicators. In this table, we compared findings of other authors, our expected estimation, and result effect. As we can see, all estimations for GDP are confirmed. We assume that inflation is negatively correlated with tax rate; however, other authors had the opposite opinion. Result effect confirmed that inflation is positively correlated with tax rate. Opinions on employment level differ from our findings. We found a negative effect of tax rate on employment. We assume a positive relationship between export and tax rate, what supported also theoretical studies. However, results of regression indicate a negative impact of corporate taxation on export. We expected a clearly negative relationship between foreign direct investment and tax rate; however, we must this determinant excluded from regression. Results of other authors indicated a negative correlation between wages and tax rate, but we did not know to say exactly what is the effect on wages. Our regression showed a negative relationship between statutory corporate taxation and wages. Lastly, we investigated effect of tax rates on tax revenues. Other theoretical findings were not consistent, and we cannot estimate this correlation. Regression showed a negative relationship between statutory corporate taxation and corporate tax revenues.

Hypothesis 9 (H9): The greatest expected impact of corporate tax rates is on GDP, export, employment, FDI, and tax revenues (in accordance with Laffer curve). We assume smaller impact on other indicators.

We cannot confirm the hypothesis H9 because the greatest impact has corporate tax rates on GDP, export, employment, and tax revenues.

4 Conclusion

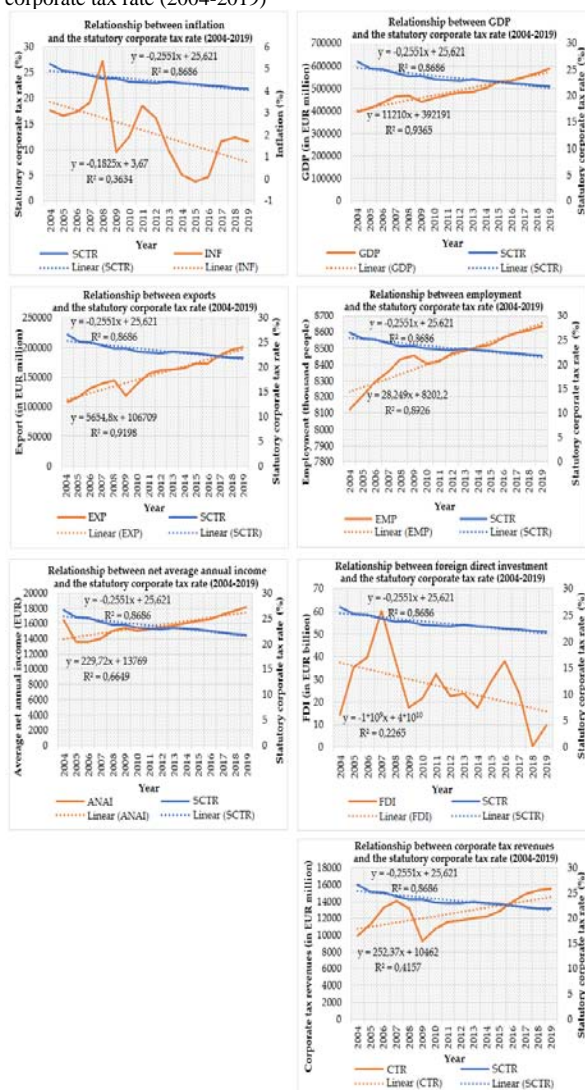
To conclude we can state that potential changes in statutory tax rates are caused by various factors which are specific for each economy. These are effects of economic, financial or debt crisis; however, it also can be an effect of political cycle or other various factors. It was confirmed that legal entities are subject to much higher statutory tax burden than the old EU member countries than the new EU member countries and smaller economies. In our analysis, we found out that the old EU member countries and larger economies are subject to higher effective corporate tax burden than the new EU member countries and smaller economies. As our difference analysis of tax rates have shown, in the EU countries can be clearly identified a trend. This trend is characterized by lower effective corporate tax burden in comparison to statutory corporate tax rates. That may be related to the efficiency of tax systems, the spillover of profits in transnational corporations, the phenomenon of tax havens, tax evasion etc. We have deduced several following conclusions from our investigated models. With the increase in corporate statutory tax rate by 1%, there will be a decrease in GDP by 38 020 mil. EUR for EU, representing around 7.8%. An increase in the corporate statutory tax rate by 1% causes an increase in inflation by 0.514% for EU. An increase in the corporate statutory tax rate by 1% causes a decrease in unemployment by 106 thousand of work positions at average for EU, representing around 1.3%. An increase in the corporate statutory tax rate by 1% causes a decrease in export by 19 414 mil. EUR at average for EU, representing 12.5%. We excluded FDI from regression analysis because this determinant did not meet our chosen criteria either satisfactory level of statistical significance. An increase in the corporate statutory tax rate by 1% causes a decrease in average net annual income by 645.9 EUR for EU, representing around 4.1%. An increase in the corporate statutory tax rate by 1% causes a decrease in tax revenues by 817.1 mil. EUR at average, representing around 6.5%. We confirmed the seventh and eighth hypothesis in our analysis; however, the ninth hypothesis was not confirmed.

Indeed, corporate tax rates have been on a declining trend since the accession of the new EU member countries. Based on our findings, reducing corporate tax rates is one of the instruments to increase the attractiveness and competitiveness of countries. The new member countries and smaller economies choose rather lower tax burden. The greatest impact of corporate tax rates is on GDP, export, employment, and tax revenues where is identified a negative correlation with tax rate.

For further research in this area, we suggest investigating similar studies to analyse the impact of corporate taxation on the economy. It should be researched other macroeconomic indicators or countries individually.

Appendix

Figure A1. Relationship between the development of macroeconomic indicators and the development of the statutory corporate tax rate (2004-2019)



Source: own processing in the program R according to Eurostat (2019a, b, c, 2020)

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Primary Paper Section: A

Secondary Paper Section: AH