

FISCAL PRESSURE IN THE EU: AN ECONOMETRIC APPROACH

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Abstract: *This article assesses the impact of fiscal pressure through the relationship between direct taxes, indirect taxes and taxes received by the central government as a percentage of GDP, and personal income tax rates, corporate income tax rates and value added taxes using a country sample that includes members of the EU-28, Iceland and Norway. Empirical analyses use annual data from 2004 to 2016 and employ techniques to account for possible linear effects in fiscal policy actions. Results show that for all countries considered in the analyses there is a strong relationship between dependent variables and independent variables in four econometric models.*

Keywords: *taxation; direct taxes; GDP; income tax; corporate tax.*

JEL Classification: *H24; H25; H26.*

1. Introduction

The topic of fiscal pressure is more current than ever within the EU in general and Romania in particular. First of all, Romania is in the process of reforming its fiscal system, which started with the constant updating of the Tax Code. Secondly, country authorities are aware of the lack of major investments needed to create stable and well-paid jobs. Thirdly, the income of most taxpayers is burdened by excessive taxation that discourages investors and encourages tax evasion. Regardless of the terminology used in the financial literature (i.e., fiscal coefficient, fiscal tension, tax burden, compulsory tax rate, etc.), the concept of fiscal pressure expresses the same idea, namely the tax burden exerted by the state on individual and corporate income. The global financial crisis has imposed the need for a stronger fiscal reform, which is directly linked to the banking system. Some authors like Batrancea et al. (2013) show that the banking crisis has revealed severe shortcomings of the monetary policy, deregulation, financial innovation, and other government policies. In another paper, a summary of the world economy emphasizes that other countries like Brazil and Mexico have experienced crises, which were caused by poor government policies based on low taxation and a fixed rate of converting national currencies (Batrancea et al., 2009c).

From the point of view of the economic and financial analysis, the fiscal pressure rate highlights the confiscatory aspect of mandatory levies, neglecting the fact that such levies are being reinvested in the economic circuit as public expenditures. The fiscal pressure rate measures the part of tax proceeds that undergoes a compulsory and public distribution process instead of being left to the discretion of private initiative.

Over the last two decades, most of the EU tax systems have undergone significant changes, amid the adoption of a new fiscal stance. The global financial crisis, the excessive increase in the complexity of tax systems, the negative influence that taxes and duties had on economic growth are the main factors that have led to fiscal reforms. Through fiscal reforms, EU member states have the difficult task of finding the adequate formula that provides the resources needed for the activity of public institutions and for achieving the abovementioned goals. The reminder of the paper has the following structure. A brief survey of the empirical literature highlights relevant studies tackling the problem of fiscal pressure. The section entitled "Method and research hypotheses" presents the hypotheses, the proposed linear and panel econometric models together with their estimated outcomes. The final part emphasizes the main results of the study, limitations and concluding remarks.

2. A brief survey of the empirical literature

There is an extensive literature analyzing fiscal pressure in the different countries. The present research has focused on the fiscal pressure in EU countries across a period of 13 years. Using a meta-regression analysis, Belz and von Hagen (2019) focused on the relationship between effective tax rate and firm size, showing that Hofstede's cultural dimensions theory, a transparency index and a corruption index explain the variation of this relationship. However, Lai (2019) investigates the effects of tax havens on nonhaven countries' redistributive policies and finds that a stricter antihaven regulation may lower tax rates. He shows that income shifting is likely to reduce the amount of the transfers, when considering also tax evasion.

Recent approaches have incorporated panel data techniques. Thus, Kottaridi et al. (2019) expand the notion of escapism involving foreign direct investment and integrate it into the framework of developed economies struggling with high fiscal pressure or inefficient policies. The authors stress that such developed economies need efficient public authorities and lower tax rates in order for domestic firms to succeed on foreign markets. Therefore, the paper emphasizes the moderating effect domestic market regulations have on taxation. Based on the Porter hypothesis, You et al. (2019) use data from 1,962 Chinese industrial companies listed on the stockmarket and covering the period 2004-2015 in order to investigate the influence of environmental regulation on company eco-innovation and the moderating effects of fiscal decentralization and political competition. Referring to the efficiency of local administration in Spain, Narbón-Perpiñá et al. (2019) explore the overall cost efficiency of Spanish local governments during the 2008-2013 economic crisis, considering four different non-parametric techniques. Their results suggest that local government efficiency has improved during the analyzed period because budgetary outlays decreased while the quality of local public goods and services has been maintained constant. Fiscal pressure is an important field of empirical research and it is also determined by tax compliance (Batrancea, 2012a,b; Nichita & Batrancea, 2012).

Empirical studies on fiscal pressure within the healthcare sector (Asensio & Popic, 2019) emphasize the need for more in-depth analyses of welfare reforms during crises periods that focus on the institutional characteristics and political contexts of

analyzed countries. After investigating UK employer-employee data for the period 2002-2016, Singleton (2019) concluded that no significant public sector wage premium was registered for male subjects. Lehner and Wasserfallen (2019) analyzed the conflict dimensions that shaped reform negotiations within the Economic and Monetary Union (EMU). Empirical findings show that political contestation regarding the Eurozone reform between the supporters of fiscal transfer and those of fiscal discipline is one-dimensional.

Based on the abovementioned opinions, it can be stated that financial ratios represent a very reliable research instrument when investigating economic phenomena, especially fiscal pressure (Batrancea et al., 2009a, b; Moscviciov et al., 2010). Therefore, as a macroeconomic phenomenon, fiscal pressure represents the taxation level a taxpayer is subject to, depending on the annual financial and fiscal policies enacted by the government. The amount of taxes levied on taxpayers' income can be determined both at the macroeconomic and microeconomic levels using a system of indicators among which the rate of fiscal pressure plays a central role. In this current paper, taxation patterns of countries belonging to EU-28, in addition to Iceland and Norway are analyzed by means of econometric models.

3. Method and research hypotheses

In order to run the analyses, taxation indicators from 30 countries (28 EU members, Iceland and Norway) were used. All data were taken from the European Commission AMECO (Annual Macro-Economic Data) database, covering the period 2004-2016. Country sample included EMU countries, as well as Eastern European economies outside EMU.

3.1. Analysis of correlation regarding taxation ratios

As a next step, based on data retrieved from the official website of the European Commission, the indicators presented below have been determined:

Indicator 1: Direct taxes ratio (DT_GDP) = Direct taxes/Gross domestic product

Indicator 2: Personal income taxes ratio (PIT_GDP) = Personal income taxes/Gross domestic product

Indicator 3: Indirect taxes ratio (IT_GDP) = Indirect taxes/Gross domestic product

Indicator 4: Company income taxes ratio (CIT_GDP) = Company income taxes/Gross domestic product

Indicator 5: Value added taxes ratio (VAT_GDP) = Value added taxes/Gross domestic product

Indicator 6: Taxes received by level of government ratio (TaxGov) = Central government taxes/Gross domestic product

Indicator 7: Personal income tax rates (PIT)

Indicator 8: Company income tax rates (CIT)

Indicator 9: Value added tax rates (VAT).

Regarding the correlation coefficients, two significance thresholds were considered: 0.01 and 0.05. The first threshold shows that the correlation coefficient is equal to 0 with a probability of 99%, while the second threshold shows that the correlation

coefficient is equal to 0 with a probability of 95%. Table 1 presents the correlation matrix for the taxation indicators of the European countries analyzed.

Table 1. Correlation matrix corresponding to the taxation indicators in the European countries

Ratios	TAXGOV	DT_GDP	IT_GDP	CIT_GDP
TAXGOV	1.000000			
DT_GDP	0.647100**	1.000000		
IT_GDP	0.261264	0.243073	1.000000	
CIT_GDP	0.493803*	0.340741	-0.137363	1.000000
PIT_GDP	0.497239*	0.886652***	0.220465	-0.004178
VAT_GDP	0.194913	0.048505	0.705922***	-0.083479
CIT	0.094226	0.380912	-0.050632	0.214257
PIT	0.245113	0.636153**	0.274958	0.059543
VAT	0.258145	0.341745	0.480782	-0.119375

Ratios	PIT_GDP	VAT_GDP	CIT	PIT	VAT
TAXGOV					
DT_GDP					
IT_GDP					
CIT_GDP					
PIT_GDP	1.000000				
VAT_GDP	0.005294	1.000000			
CIT	0.252369	-0.332139	1.000000		
PIT	0.605007**	0.023055	0.531834*	1.000000	
VAT	0.374736	0.477608	-0.148195	0.226231	1.000000

Note: *Correlation coefficients significant with $p < 0.1$; **Correlation coefficients significant with $p < 0.05$; ***Correlation coefficients significant with $p < 0.01$. In the table above, one can identify positive correlations between the majority of indicators, excepting the following: IT_GDP, CIT-GDP and CIT; CIT_GDP, PIT_GDP and VAT; VAT_GDP and CIT; CIT and VAT.

In order to highlight the level of fiscal pressure, the relationship between direct taxes ratio, indirect taxes ratio and taxes received by level of government ratio (as dependent variables) and the other ratios (as independent variables) was analyzed on a country sample pool comprising members of EU-28, Iceland and Norway, during the period 2004-2016. The analyses will therefore inform regarding the assessment and understanding of taxation nature and its effects on fiscal reforms across Europe.

The econometric models

The software EViews version 9.0 was used to perform the statistical analyses for the econometric models. Analyses are based on the Least Squares Panel method, which is a specific method of generating equations for time series data. Our empirical research is based on the following hypotheses:

H1: There is a linear dependence between direct taxes ratio (DT_GDP), personal income tax rates (PIT) and company income tax rates (CIT).

H2: There is a linear dependence between taxes received by level of government ratio ($TaxGov$), personal income tax rates (PIT) and company income tax rates (CIT).

H3: There is a linear dependence between indirect taxes ratio (IT_GDP), personal income tax rates (PIT), company income taxes rates (CIT) and value added tax rates (VAT).

H4: There is a linear dependence between taxes received by level of government ratio ($TaxGov$), company income taxes ratio (CIT_GDP), direct taxes ratio (DT_GDP), indirect taxes ratio (IT_GDP), personal income taxes ratio (PIT_GDP) and value added taxes ratio (VAT_GDP).

The link between the abovementioned variables is analyzed by means of the following econometric models:

$$\text{Model 1: } DT_GDP_{it} = a_0 + a_1PIT_{it} + a_2CIT_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

$$\text{Model 2: } TaxGov_{it} = a_0 + a_1PIT_{it} + a_2CIT_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

$$\text{Model 3: } IT_GDP_{it} = a_0 + a_1PIT_{it} + a_2CIT_{it} + a_3VAT_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

$$\text{Model 4: } TaxGov_{it} = a_0 + a_1CIT_GDP_{it} + a_2DT_GDP_{it} + a_3IT_GDP_{it} + a_4CIT_GDP_{it} + a_3VAT_GDP_{it} + \delta_i + \theta_t + \varepsilon_{it}$$

where:

- δ_i represents fixed effects intended to control for time-invariant taxation-specific factors;
- θ_t represents fixed effects intended to control for common shocks (e.g., global financial crisis);
- ε_{it} represents the error term.

In order to compensate for omitting other factors that influence direct taxes ratio, indirect taxes ratio or taxes received by level of government ratio, the specific unobserved effect (δ_i) of a country should be considered. As with time common shocks have an impact on dependent variables, a parameter estimation with fixed effects was also performed.

Results

Estimations of the relationship between direct taxes ratio, taxes received by level of government ratio and the designated independent variables are presented in Table 2.

Table 2. Estimations of the relationship between personal income tax rates (PIT), company income tax rates (CIT), direct taxes ratio (DT_GDP) and taxes received by level of government ratio (TaxGov) via econometric models

	Model 1		Model 2	
Constant	7.578604*** (9.287102)	6.695710*** (7.622477)	19.58236*** (20.07056)	19.81792*** (18.94552)
PIT	0.082198*** (5.415747)	0.086958*** (5.877204)	0.063665*** (3.508315)	0.059213*** (3.360680)
CIT	0.041238 (1.470144)	0.070507** (2.336802)	0.027628 (0.823777)	0.025099 (0.698557)
Prob.>F	0.000	0.000	0.000	0.000
F-statistic	226.9605	178.7166	199.9570	158.9083
Cross-section effects	Fixed	Fixed	Fixed	Fixed
Time fixed effects	No	Yes	No	Yes
R ²	0.951581	0.956916	0.945399	0.951804
Observations	390	390	390	390

Note: The dependent variables are DT_GDP in model 1, TaxGov in model 2 for country "i" in the "t" year. Robust t-statistics are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5% and 1% levels. Prob.>F is the probability of the model not including fixed effects. For all estimated models, the hypothesis of multicollinearity is investigated using the variance inflation test (VIF). In all cases, the VIF values are lower than 3, thus indicating low risk of multicollinearity.

Model 1

In the first equation, the multiple regression model is significant ($R^2=0.95$), meaning that 95% of the variation in the *DT_GDP* is explained by independent variables, while 5% is explained by variables outside the model. The F-statistic of 226.96 shows that predictors are significantly related to the dependent variable *DT_GDP*. The regression estimation reveals the existence of a positive relationship between *DT_GDP* and independent variables PIT and CIT. Namely, the coefficient 0.082 indicates that an increase of 1% in PIT leads to an improvement of 8.2 percentage points in *DT_GDP*.

In the second equation, when taking into account fixed-time effects, the F-statistic of 178.71 shows that predictors are significantly related to the dependent variable *DT_GDP*. Moreover, the multiple regression model is significant ($R^2=0.95$), meaning that 95% of the variation in the *DT_GDP* is explained by the independent variables, while 5% is explained by variables outside the model. Results indicate that an increase of 1,000 units in PIT and CIT generate the increase of *DT_GDP* with 86 units and 70 units, respectively.

Based on the results above, the null hypothesis is rejected and the alternative hypothesis is accepted, hence there is a positive significant impact on direct taxes ratio.

Model 2

In the first equation, the results show that the multiple regression model is significant ($R^2=0.94$), meaning that 94% of the variation in the DT_GDP is explained by the independent variables, while 6% is explained by variables outside the model. The F-statistic of 199.95 shows that predictors are significantly related to the dependent variable. The regression estimation reveals the existence of a positive relationship between DT_GDP and the independent variables PIT and CIT. Namely, the coefficient of 0.0636 indicates that an increase of 1% in personal income rates leads to an improvement of 6.36 percentage points in DT_GDP . Hence, a 1,000-unit rise in PIT will determine a 27-unit rise in DT_GDP .

In the second equation, when taking into account fixed-time effects, the multiple regression model is significant ($R^2=0.95$), meaning that 95% of the variation in the DT_GDP is explained by independent variables, while 5% is explained by variables outside the model. Also, the F-statistic of 158.90 shows that predictors are significantly related to the dependent variable DT_GDP . Results indicate that an increase of 1,000 units in PIT and CIT determine an increase of 59 and 25 unites respectively in DT_GDP .

Based on the results above, the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore, one can state that there is a positive significant impact on direct taxes ratio.

Estimates on the relationship between personal income tax rates (PIT), company income taxes rates (CIT), value added tax rates (VAT) and indirect taxes ratio (IT_GDP) are presented in Table 3.

Table 3. Estimations of the relationship between personal income tax rates (PIT), company income taxes rates (CIT), value added tax rates (VAT) and indirect taxes ratio (IT_GDP) via econometric models

	Model 3	
<i>Constant</i>	9.549861*** (8.960030)	9.080494*** (8.272872)
<i>PIT</i>	0.016577 (0.834870)	-0.032218*** (-3.407445)
<i>CIT</i>	-0.022039** (-2.170878)	-0.024255 (-1.246451)
<i>VAT</i>	0.230599*** (6.282698)	0.319192*** (7.515658)
<i>Prob.>F</i>	0.000	0.000
<i>F-statistic</i>	106.8243	94.26499
<i>Cross-section effects</i>	Fixed	Fixed
<i>Time fixed effects</i>	No	No
<i>R²</i>	0.905440	0.923208
<i>Observations</i>	390	390

Note: The dependent variable is IT_GDP in model 3 for country "i" in the "t" year. Robust t-statistics are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5% and 1% levels. Prob.>F is the probability of the model not including fixed

effects. For all estimated models, the hypothesis of multicollinearity is investigated using the variance inflation test (VIF). In all cases, the VIF values are lower than 3, thus indicating low risk of multicollinearity.

Model 3

In the first equation, results show that the multiple regression model is significant ($R^2=0.90$), meaning that 90% of the variation in the *IT_GDP* is explained by the independent variables, while 4% is explained by variables outside the model. The F-statistic of 106.82 shows that predictors are significantly related to the dependent variable. The regression estimation reveals a positive relationship between *IT_GDP* and the independent variables *PIT* and *VAT*, and a negative relationship between *IT_GDP* with *CIT*. The 0.83 robust t-statistic for *PIT* indicates statistical non-significance. The t-statistic for *CIT* indicates a statistical significance at the 5% level. For *VAT*, the robust t-statistic of 6.28 indicates a statistical significance at the 1% level.

In the second equation, when taking into account fixed-time effects, the multiple regression model is significant ($R^2=0.92$), meaning that 92% of the variation in the *IT_GDP* is explained by the independent variables, while 8% is explained by variables outside the model. Also, the F-statistic of 94.26 shows that predictors are significantly related to the dependent variable *IT_GDP*. The -3.40 robust t-statistic for *PIT* indicates statistical significance at the 1% level. The t-statistic for *CIT* indicates statistical non-significance. For *VAT*, the robust t-statistic of 7.51 indicates statistical significance at the 1% level.

Based on the results above, the null hypothesis is rejected and the alternative hypothesis is accepted. Hence, there is a positive significant impact on indirect taxes ratio.

Table 4. Estimations of the relationship between company income taxes ratio (*CIT_GDP*), direct taxes ratio (*DT_GDP*), indirect taxes ratio (*IT_GDP*), personal income taxes ratio (*PIT_GDP*), value added taxes ratio (*VAT_GDP*) and taxes received by level of government ratio (*TaxGov*) via econometric models

	<i>Model 4</i>	
<i>Constant</i>	0.185795 (0.283610)	-0.161525 (-0.232168)
<i>CIT_GDP</i>	-0.053956 (-1.143370)	-0.119717** (-2.306637)
<i>DT_GDP</i>	0.926486*** (35.73693)	0.952157*** (35.89451)
<i>IT_GDP</i>	0.80750*** (14.33130)	0.815418*** (14.12796)
<i>PIT_GDP</i>	-0.022980 (-1.312020)	-0.025158 (-1.425909)
<i>VAT_GDP</i>	0.141440 (1.531285)	0.16457* (1.755842)
<i>Prob.>F</i>	0.000	0.000
<i>F-statistic</i>	1615.111	1222.300
<i>Cross-section effects</i>	<i>Fixed</i>	<i>Fixed</i>

<i>Time fixed effects</i>	<i>No</i>	<i>No</i>
<i>R²</i>	0.993577	0.993937
<i>Observations</i>	390	390

Note: The dependent variable is TaxGov in model 4 for country "i" in the "t" year. Robust t-statistics are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5% and 1% levels. Prob.>F is the probability of the model not including fixed effects. For all estimated models, the hypothesis of multicollinearity is investigated using the variance inflation test (VIF). In all cases, the VIF values are lower than 3, thus indicating low risk of multicollinearity.

Model 4

In the first equation, results show that the multiple regression model is significant ($R^2=0.99$), meaning that 99% of the variation in TaxGov is explained by the independent variables, while 1% is explained by variables outside the model. The F-statistic of 1,615.11 shows that predictors are significantly related to the dependent variable. The regression estimation reveals that a positive relationship exists between TaxGov and the independent variables DT_GDP, IT_GDP and VAT_GDP. Moreover, TaxGov has a negative relationship with CIT_GDP and PIT_GDP. The -1.43 robust t-statistic for CIT, the -1.31 t-statistic for PIT_GDP and the 1.53 t-statistic for VAT_GDP indicate statistical non-significance. Moreover, the 35.73 t-statistic for DT_GDP and the 14.33 value for IT_GDP indicate statistical significance at the 1% level. For VAT, the 6.28 robust t-statistic indicates statistical significance at the 1% level.

In the second equation, when taking into account fixed-time effects, the multiple regression model is significant ($R^2=0.99$), meaning that 99% of the variation in TaxGov is explained by the independent variables, while 1% is explained by variables outside the model. The F-statistic of 1,222.30 shows that predictors are significantly related to the dependent variable TaxGov. The -2.30 robust t-statistic for CIT shows statistical significance at the 5% level. The -1.42 robust t-statistic for PIT_GDP indicates statistical non-significance. The 1.75 robust t-statistic for VAT_GDP shows statistical significance at the 10% level. The 35.89 t-statistic for DT_GDP and the 14.12 t-statistic for IT_GDP indicate significance at the 1% level. Based on the results presented above, the null hypothesis is rejected and the alternative hypothesis is accepted. Hence, one can conclude that there is a positive significant impact on taxes received by level of government ratio within the analyzed country pool.

4. Conclusion and recommendations

This paper investigates the existence of a high fiscal pressure on a country sample pool including members of EU-28, Iceland and Norway, based on the linear relationships between government revenues and income taxes. Analyses do not consider a particular threshold level of taxes received by level of government as a percentage of GDP when assessing fiscal pressure but they explore the impact of direct and indirect taxation, as well as of other taxation rates.

Firstly, empirical results indicate a linear relationship between the direct taxes ratio, personal income tax rates and company income tax rates. In this situation, a small increase in these taxation rates can trigger government insolvency and delay the efforts to achieve fiscal sustainability.

Secondly, another interesting result is the significant positive link between indirect taxes as percentage of GDP, company income tax rates and the value added rates within the country sample.

Thirdly, analyzed countries amass rather consistent tax revenues levied by central governments, ranging between 10% and 45% of GDP, while also registering a strong dependence of direct and indirect taxation. Therefore, policy makers need to improve the management of national fiscal pressure in order to foster economic growth, so that the taxes received by level of government remain at a stable level.

Finally, one could observe that results indicate correlations between the direct taxes ratio (dependent variable), personal income tax rates and company income tax rates (independent variables), meaning that direct taxes increase in the same time as labor and company taxation. From the investors' point of view, an increasing fiscal pressure diminishes future investments. From the employees' point of view, an increasing fiscal pressure diminishes purchasing power.

The present study recommends the following measures concerning the fiscal pressure management:

- optimizing budgetary resources by increasing tax collection;
- ensuring an adequate management by efficiently allocating budgetary resources for investment and creating new jobs – the latter measure would increase the collection of direct taxes levied on labor;
- providing tax incentives to investors who create new jobs and introduce new technologies into production.

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