THE IMPACT OF THE VAT GAP ON THE DEGREE OF TAXATION OF AN ECONOMY - ANALYSIS WITH PANEL DATA

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Abstract
In this article we use econometric methods to identify and analyze the intensity of potential causality links between the VAT gap and the ability or the performance of a state to collect taxes and, consequently, to finance public projects and programs. This capacity or performance is assessed by the share of tax revenues to GDP, which also reflects the degree of taxation of an economy. On the other hand, the determinants of the VAT gap were investigated. The data set used is of the panel type, consisting of values with an annual frequency, for the period 2014-2019, for 26 Member States of the European Union. The methods used in the analyzis are single and multiple linear regressions on panel data with fixed effects. Based on the results obtained for the mentioned sample, the existence of a statistically significant linear link between the mentioned variables is confirmed, but it was also found that, in general, the performance of tax revenue collection in a certain period depends on the performance of the previous period. Therefore, the influence of other exogenous, economic and non-economic variables is visible, which must be identified and analyzed. However, it was found that the level of government spending, confirming to some extent the Keynesian growth model, significantly influences the level of tax revenue. At the same time, the following variables were found to have an overwhelming influence on the VAT gap: the share of people exposed to the risk of poverty or social exclusion, the level of employees' compensation, the final household consumption and the level of gross value added created in the economy. All these variables significantly determine the formation of the VAT tax gap, in a proportion of 95%.

Keywords
taxation, public finance, panel analysis, VAT gap, share of tax revenues to GDP

JEL Classification
H20 and C51

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Introduction

In recent years, there has been a growing concern for the development of models to estimate tax gaps, the calculation of this indicator being a measure of the performance of a tax administration to collect a certain type of tax. The most advanced models are currently those developed for estimating the tax gap with respect to value added tax (VAT), the calculation methodologies being in a process of "standardization" at the international level. Among such methodologies, the best known are those applied by the European Commission and the ones developed by the International Monetary Fund. The approach is top-down in both cases and the only difference is the macroeconomic benchmark against which the potential tax base is estimated.

In addition, monitoring the share of tax revenues to GDP is the way used by public finance analysts to "instantly" assess the level of the tax burden. As we have shown elsewhere, this indicator can be considered to reflect the ability of a state to tax the economy.

The present study aims to assess the relationship between the VAT gap and the share of tax or public revenues to GDP. In a previous research (Ogneru and Panait, 2020; Ogneru and Stancu, 2021) we identified that the variation of tax revenues in Romania follows atypical patterns compared to other Member States of the European Union. We also found that there is no link between the tax bases and the associated tax revenues, as well as the relative independence of the variation of the tax revenues in relation with the macro-financial indicators. On the other hand, the economic context does not seem to be equally reflected in the level of tax revenues.

VAT is an important resource for establishing public revenues, the European Union average being about 7% of GDP. However, the EU area is heterogeneous in this respect, with the difference between the maximum value (Croatia) and the minimum value (Ireland) being over 9 percentage points (Figure no. 1).

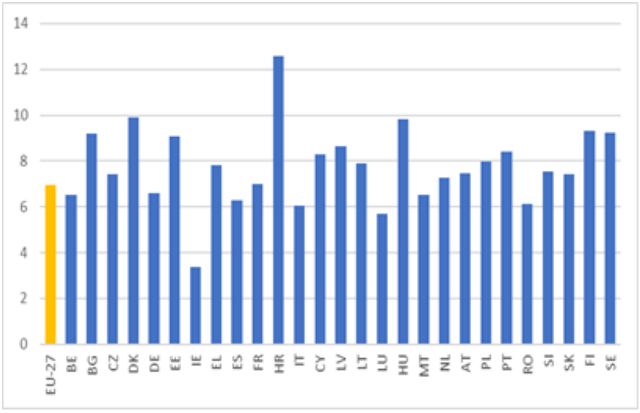

Figure no. 1: The share of VAT revenues to GDP in 2020, in EU Member States
Source: Eurostat

The heterogeneous nature of the European Union is also present in terms of the share of tax revenues (including social contributions) to GDP. The EU average was 41.3% in 2020, and the evolution over the last 10 years indicates an upward trend (figure no. 2). The degree of taxation of the Romanian economy represents about 66% of the EU average, with periods of increase and decrease. The gap between the maximum (Denmark) and minimum (Ireland) values recorded at Member State level is almost 27 pp, with a high degree of heterogeneity. Declining trends are seen in Ireland and Romania, whereas other Member States show generally increasing trends. The degree of taxation remains relatively constant in Finland and Sweden.

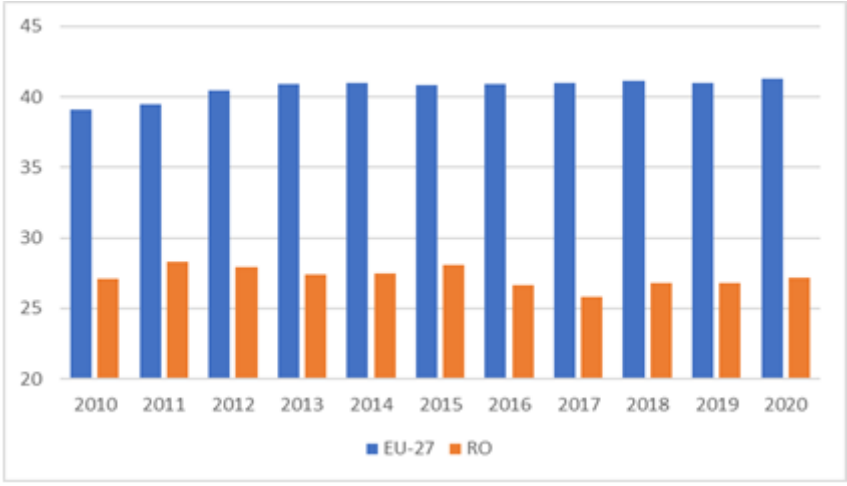

Figure no. 2: The share of tax revenues to GDP, including social contributions, in EU-27 and Romania
Source: Eurostat

However, how should we interpret this data? Are we dealing with a degree of taxation in terms of the level of taxation or in terms of the capacity to collect taxes? A partial answer to this question can be provided by the analysis of the tax gap evolution in relation with the share of revenues to GDP. There is little data to reflect the tax gap and the available data only refers to VAT among EU Member States (official figures). For the other taxes, the number of states that make such estimates is lower, the methodologies are diverse (applied locally) and not all tax administrations publish the figures. Therefore, we consider an analysis of the share of tax revenues to GDP in relation with the VAT tax gap using the figures provided by the European Commission. The latest available estimate is for 2019 (report published in 2021). In order to increase the significance of the data, in this study we used panel data.

The implicit assumption is the inverse relationship between the VAT gap and the share of tax revenues to GDP. The hypothesis was verified using multiple regression on panel

data. Regarding the identification of the determinants of the VAT tax gap, we followed a bottom-up approach, progressively selecting the significant variables from an initial set of 28 economic and social variables, including the lag of the dependent variable.

1. Literature review

The tax gap is the difference between the theoretical liabilities of taxpayers (in aggregate terms), determined by estimating the potential tax base, and the actual revenue for one year in a country. The quantification and analysis of VAT gaps have become important for tax administrations, due to the increase in tax evasion and VAT fraud.

The literature is not very rich in economic theorizing of this indicator and the reports and the few published articles focus on the methodological aspects of measurement.

Two types of tax gap have been defined, one for compliance and the other resulting from the application of tax policies (policy gap). The second concept captures the amounts representing uncollected taxes because of the application of special tax regimes. For example, in the case of VAT, we are talking about the system of lower rates applied to certain categories of products and the exemption regime for certain activities or companies. The tax compliance gap is a measure by which the tax loss from taxpayer non-compliance on registration, filing or payment is assessed. It is widely accepted by practitioners that the compliance gap includes, as sources of incorporation, tax losses resulting from tax evasion, tax avoidance, tax fraud, non-payment of declared obligations, administration errors. This measure also includes amounts lost due to undeclared (but not illegal) activities.

According to Reckon (2009), two different approaches are used to calculate the VAT gap. A common method is the so-called "top-down" approach, using macroeconomic data from national accounts to quantify the theoretical VAT obligation for the whole economy, which is compared to the actual VAT revenues of the tax administration. The other way to estimate the VAT gap and the tax gap in general is the so-called “bottom-up” approach based on random audits, surveys and some official or unofficial registers.

The literature dedicated to the analysis of this measure is focused either on the calculation methodology, or on the identification of the drivers of tax non-compliance (included by the concept of tax gap).

Barbone et al. (2012) analyzed the relationship between VAT tax evasion and administrative costs of compliance. Before them, Bird and Gendron (2006) studied the impact of consumption taxation (through VAT) on the formal sector, and Gupta (2007) investigates the main factors that can determine mobilization of revenues, being considered both economic and institutional factors. Le et al. (2008) were concerned with estimating a country's fiscal capacity and studied how a state can collect taxes at the level of its tax potential.

Romer and Romer (2010) in their reference study identify a significant effect of changes in tax policy on economic output. However, it is difficult to assess whether a visible

economic contraction corresponds entirely to the economic sector as a whole. Namely, unless a contraction in the formal economy corresponds to an expansion of the hidden economy.

Zidkova (2014) analyzed the relationship of several variables with the VAT gap on a sample of data from the 24 EU Member States prior to 2007, using two cross-sectional series for the years 2002 and 2006. The author identified the following determinants of the VAT gap: final consumption of households, tax revenue from VAT (as a share of GDP), standard VAT rate and share of shadow economy on GDP.

More recently, older topics such as the relationship between taxation and economic growth (e.g. Kalaš et al., 2018) or tax revenue elasticities (e.g. Koester and Priesmeier, 2017) were revisited.

Weak links between macroeconomic indicators and fiscal revenues in the case of Romania were reported in Ogneru and Panait (2020), and Ogneru and Stancu (2021).

Butu and Brezeanu (2021) found a positive relationship between the VAT gap and the risk of poverty using data panels for 10 states in Central and Eastern Europe over a period of 10 years (2009-2018). They analyzed both the influence of the risk of poverty and social exclusion and the influence of corruption on the VAT gap.

The present study investigates the relationship between the VAT gap as a measure of non-compliance (including tax evasion and fraud and tax arrears, but also the tax optimization and tax effects of the hidden economy), and the performance of tax revenue collection, as measured by the share of tax revenues to GDP. On the other hand, it identifies the main determinants of the VAT tax gap.

2. Research methodology and data

In order to estimate the influence of the VAT gap on tax revenues as a share of GDP, an initial model of multiple regressions on panel data was run. Subsequently, the significant explanatory variables were selected, obtaining three regression models in which, on the one hand, the influence of the VAT gap variable is captured, and on the other hand, the influence of other significant variables is analyzed. The same set of 28 variables was run in an initial model for the evaluation of the VAT gap determinants, obtaining a statistically significant model that reveals the main determinants.

The variables included in the initial model are:

- ***VAT tax gap*** as a share of potential revenues (VAT_GAP) – data were taken from the Study and Reports report on the VAT Gap in the EU-28 Member States, 2021, published by the European Commission;
- ***Share of tax revenues to GDP*** (SHARE_REVENUE_GDP) – for all variables except VAT gap, data were taken from Eurostat;
- ***Upper secondary, post-secondary non-tertiary and tertiary graduate population*** (EDUCATION);
- ***Employment rate*** (EMPL_RATE);

- ***Final consumption expenditure of general government per capita*** (FCEGG_PER_CAPITA);
- ***GDP per capita*** (GDP_PER_CAPITA);
- ***Government deficit*** (GOV_DEFICIT);
- ***Government consolidated gross debt*** (GOV_GROSS_DEBT);
- ***Growth rate of the number of employees as percentage change on previous period*** (GR_EMPLOYEES);
- ***Growth rate of the nominal unit labour cost based on hours worked as percentage change on previous period*** (GR_NOMINAL_LABOUR_COST_H);
- ***Growth rate of the real labour productivity per hour worked as percentage change on previous period*** (GR_REAL_PRODUCTIVITY_HOU);
- ***Growth rate of the number of self-employed as percentage change on previous period*** (GR_SELF_EMPL);
- ***Growth rate of the total employment percentage change on previous period*** (GR_TOTAL_EMPLOYMENT);
- ***Income quintile share ratio S80/S20 for disposable income*** - EU-SILC survey (INCOME_INEQUALITY);
- ***Material and social deprivation rate as percentage of total population,*** considering employed persons over the age of 16 (MATERIAL_SOCIAL_DEPRIVAT);
- ***Median equivalised net income (in euro)*** - EU-SILC and ECHP surveys (MEDIAN_NET_INCOME);
- ***Persons at risk of poverty or social exclusion*** - EU 2020 strategy – as percentage of total population (RISK_OF_POVERTY);
- ***Share of the employee compensation to GDP*** (SHARE_COMP_EMPL_GDP);
- ***Share of exports to GDP*** (SHARE_EXP_GDP);
- ***Share of final household consumption to GDP*** (SHARE_FINAL_CONSUMPTION)
- ***Share of gross fixed capital formation to GDP*** (SHARE_GFCF_GDP);
- ***Share of gross operating surplus and of mixed income to GDP*** (SHARE_GOSMI_GDP);
- ***Share of general government expenditures to GDP*** (SHARE_GOV_EXP_GDP);
- ***Share of gross value added to GDP*** (SHARE_GVA_GDP);
- ***Share of imports to GDP*** (SHARE_IMP_GDP);
- ***Share of subsidies to GDP*** (SHARE_SUB_GDP);
- ***Share of VAT revenues to GDP*** (SHARE_VAT_GDP);
- ***Unemployment rate*** (UNEMPL_RATE).

For the purpose of running the model, panel data were generated with annual frequency for the period 2014-2019, in 26 Member States (Cyprus was excluded from the sample due to incomplete data). We had a balanced data panel set.

After running the initial models, we obtained five models that reflect the influences of different variables on the dependent variables: the share of tax revenues to GDP and the VAT gap.

The five models obtained and which proved to be of the greatest statistical significance and with the highest power of explanation are:

$$SHARE\_REVENUE\_GDP_{ti} = C(1) + C(2)*VAT\_GAP_{ti} + C(3)*LOG(SHARE\_REVENUE\_GDP\ (-1))_{ti} \quad (1)$$

where:

$SHARE\_REVENUE\_GDP_{ti}$ – the dependent variable, but only the share of taxes collected in GDP was considered, excluding social contributions

VAT_GAP_{ti} – VAT gap as explanatory variable
LOG (SHARE_REVENUE_GDP (-1)) – the 1st order lag of dependent variable used as an explanatory variable, in logarithmic form
t = time period (in this case, year)
i = unit of analysis (in this case, Member State)

$$SHARE\_REVENUE\_GDP_{ti} = C(1) + C(2)*GOV\_DEFICIT_{ti} + C(3)*SHARE\_GOV\_EXP\_GDP_{ti} + C(4)*VAT\_GAP_{ti} \quad (2)$$

where:
$SHARE\_REVENUE\_GDP_{ti}$ – the dependent variable, but only the share of taxes collected to GDP was considered, excluding social contributions
VAT_GAP_{ti}, $GOV\_DEFICIT_{ti}$ and $SHARE\_GOV\_EXP\_GDP_{ti}$ – as explanatory variables
t = time period (in this case, year)
i = unit of analysis (in this case, Member State)

$$SHARE\_REVENUE\_GDP_{ti} = C(1) + C(2)*GOV\_DEFICIT_{ti} + C(3)*SHARE\_EXP\_GDPti + C(4)*SHARE\_GOV\_EXP\_GDP_{ti} + C(5)*SHARE\_SUB\_GDPti + C(6)*SHARE\_VAT\_GDPti \quad (3)$$

where:

$SHARE\_REVENUE\_GDP_{ti}$ – the dependent variable, but only the share of taxes collected to GDP was considered, without social contributions
$SHARE\_VAT\_GDP_{ti}$, $GOV\_DEFICIT_{ti}$, $SHARE\_GOV\_EXP\_GDP_{ti}$, $SHARE\_EXP\_GDP_{ti}$ and $SHARE\_SUB\_GDP_{ti}$ – as explanatory variables
t = time period (in this case, year)
i = unit of analysis (in this case, Member State)

$$SHARE\_REVENUE\_GDP_{ti} = C(1) + C(2)*GOV\_DEFICIT_{ti} + C(3)*SHARE\_GOV\_EXP\_GDP_{ti} + C(4)*SHARE\_REVENUE\_GDP(-1)_{ti} \quad (4)$$

where:

$SHARE\_REVENUE\_GDP_{ti}$ – the dependent variable, but only the share of taxes collected to GDP was considered, without social contributions
$GOV\_DEFICIT_{ti}$ and $SHARE\_GOV\_EXP\_GDP_{ti}$ – as explanatory variables
SHARE_REVENUE_GDP (-1) – the 1st order lag of dependent variable used as an explanatory variable
t = time period (in this case, year)
i = unit of analysis (in this case, Member State)

$$VAT\_GAP_{ti} = C(1) + C(2)*RISK\_OF\_POVERTY_{ti} + C(3)*SHARE\_COMP\_EMPL\_GDP_{ti} + C(4)*SHARE\_FINAL\_CONSUMPTION_{ti} + C(5)*SHARE\_GVA\_GDP_{ti} \quad (5)$$

where:

VAT_GAP_{ti} – the dependent variable
$RISK\_OF\_POVERTY_{ti}$, $SHARE\_COMP\_EMPL\_GDP_{ti}$, $SHARE\_FINAL\_CONSUMPTION_{ti}$ and $SHARE\_GVA\_GDP_{ti}$ – as explanatory variables
t = time period (in this case, year)
i = unit of analysis (in this case, Member State)

As we have shown, the population considered in the sample is heterogeneous, with significant differences between the different units of analysis (Member States). Therefore, the panel data model cannot be analyzed as a simple regression, but with dummy variables for each unit. Following Baltagi (2005) we opted for a model with fixed effects, this type of model being the most suitable for the situation in which we are focused on a specific set of units (Baltagi, 2005:12), in our case the Member States of the EU. In fact, running the Hausman test also indicates that the use of fixed effects is a valid option. It was also observed that the time variations of the variables considered for each unit do not show breaking points. In addition, it is assumed that a major economic event will affect all Member States. Therefore, for the longitudinal series we did not introduce error components, opting for a One-way Error Component Regression Model. After running several versions of the panel regression to increase the significance, we concluded that it is necessary to adopt a dynamic model, inserting a lag variable that adds dynamics to the panel data individual effects framework to analyze the influence of VAT gap on tax revenues.

The models were estimated using the least squares method, and the variance-covariance matrix of the estimators for each model was determined using the White cross-section method, the panel regression being treated as a multivariate regression considering an equation for each cross section.

3. Results and discussion

The stationarity of the variables selected was first verified. Unit root test Levin, Lin & Chu indicates that the string corresponding to the dependent variable has no root unit. The same test was run for the variable VAT gap, noting that this series was also stationary. So both variables were stationary in level.

Table no. 1: The results of the Unit Root test Levin, Lin & Chu for panel data

Variable	Statistic	Prob.	Cross-sections	Obs.
Share_revenue_gdp	-6.44801	0.0000	26	130
Vat_gap	-6.15183	0.0000	26	127

Source: Own calculations using Eviews 9.0

As a next step, the Chow test was run to decide whether the panel data model would be run with common effects or fixed effects. The results indicate that fixed effects must be considered.

Table no. 2: The results of the Chow test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	75.011905	(25,99)	0.0000
Cross-section Chi-square	380.091713	25	0.0000

Source: Own calculations using Eviews 9.0

Subsequently, the Hausman test was run, which invalidates the possibility of using random effects.

From the scatter diagram (figure no 3) it is observed that the two variables are correlated, but the presence of extreme values (outliers) is noticed.

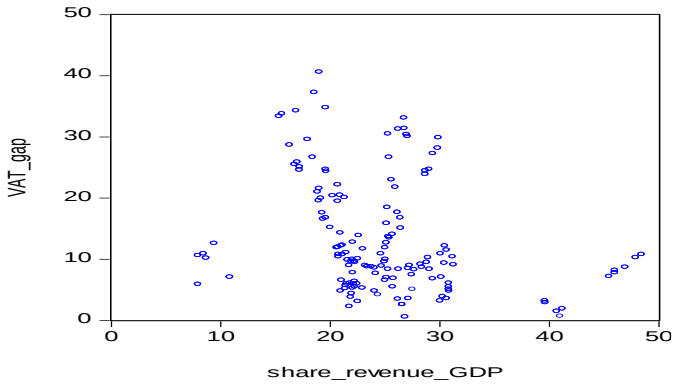

Figure no. 3: The scatter diagram for the two variables considered (VAT gap and the share of revenues in GDP)

Source: Own calculations using Eviews 9.0 based on Eurostat and EC data

In the next stage, we generated in turn explanatory models for the two variables considered: share of fiscal revenues in GDP and VAT gap.

The initial model used to identify the determinants of tax revenues is as follows (table no. 3):

Table no. 3: The results of the initial panel regression model for tax revenues

Dependent Variable: SHARE_REVENUE_GDP
Total panel (balanced) observations: 150

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.37519	24.23642	0.758164	0.4502
EDUCATION	-0.004614	0.049617	-0.092991	0.9261
EMPL_RATE	0.172904	0.086391	2.001401	0.0481
FCEGG_PER_CAPITA	0.062704	0.022587	2.776136	0.0066
GDP_PER_CAPITA	-0.025113	0.020709	-1.212616	0.2282
GOV_DEFICIT	0.142963	0.076410	1.871002	0.0643
GOV_GROSS_DEBT	-0.039899	0.018845	-2.117209	0.0368
GR_EMPLOYEES	0.334542	0.178267	1.876633	0.0635
GR_NOMINAL_LABOUR_COST_H	0.080040	0.036967	2.165162	0.0328
GR_REAL_PRODUCTIVITY_HOU	0.040306	0.029218	1.379490	0.1709
GR_SELF_EMPL	0.024111	0.036512	0.660356	0.5106
GR_TOTAL_EMPLOYMENT	-0.289520	0.207980	-1.392056	0.1671
INCOME_INEQUALITY	-0.213238	0.191738	-1.112131	0.2688
MATERIAL_SOCIAL_DEPRIVAT	0.002226	0.041574	0.053553	0.9574
MEDIAN_NET_INCOME	-0.000188	8.23E-05	-2.290050	0.0242
RISK_OF_POVERTY	0.100844	0.064047	1.574534	0.1186

SHARE_COMP_EMPL_GDP	-0.876680	0.323950	-2.706222	0.0080
SHARE_EXP_GDP	0.216912	0.077300	2.806113	0.0060
SHARE_FINAL_CONSUMPTION	0.147191	0.104740	1.405306	0.1631
SHARE_GFCF_GDP	0.108463	0.075543	1.435781	0.1542
SHARE_GOSMI_GDP	-0.715857	0.317230	-2.256583	0.0263
SHARE_GOV_EXP_GDP	0.175447	0.061540	2.850934	0.0053
SHARE_GVA_GDP	0.334120	0.373773	0.893912	0.3736
SHARE_IMP_GDP	-0.134508	0.073975	-1.818296	0.0721
SHARE_SUB_GDP	1.401378	0.388130	3.610589	0.0005
SHARE_VAT_GDP	0.819108	0.293887	2.787154	0.0064
UNEMPL_RATE	0.122024	0.069382	1.758731	0.0817
VAT_GAP	-0.058753	0.024949	-2.354913	0.0205

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.997387	Mean dependent var	25.17129
Adjusted R-squared	0.996027	S.D. dependent var	7.339794
S.E. of regression	0.462644	Akaike info criterion	1.563949
Sum squared resid	20.97589	Schwarz criterion	2.607636
Log likelihood	-65.29616	Hannan-Quinn criter.	1.987966
F-statistic	733.4207	Durbin-Watson stat	1.449640
Prob(F-statistic)	0.000000		

Source: Own calculations using Eviews 9.0

Gradually eliminating the statistically insignificant variables, we obtained four models that reflect on the one hand the nature of the link between the VAT gap and tax revenues, and on the other hand the main determinants of tax revenues.

A first model (equation (1)) shows the measure of VAT gap influence on the tax revenues, considering the influence of all the other variables altogether, an influence that we catch with the 1st order lag of the dependent variable. The model is valid as a whole, and the regression coefficients are significantly different from zero. The coefficient of determination is 99%, which means that through the two variables selected for analysis is explained 99% of the variation of the dependent variable, namely the share of tax revenues to GDP.

The results of the model are shown in the table below (table no. 4).

Table no. 4: The results of the panel regression model using VAT gap as explanatory variable for tax revenues

Dependent Variable: SHARE_REVENUE_GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.00320	2.570296	-4.280908	0.0000
VAT_GAP	-0.043950	0.006926	-6.345797	0.0000
LOG(SHARE_REVENUE_GDP(-1))	11.49341	0.811268	14.16721	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.996165	Mean dependent var		24.85494
Adjusted R-squared	0.995119	S.D. dependent var		7.193427
S.E. of regression	0.502585	Akaike info criterion		1.653775
Sum squared resid	25.00661	Schwarz criterion		2.280840
Log likelihood	-77.01472	Hannan-Quinn criter.		1.908544
F-statistic	952.3354	Durbin-Watson stat		1.439304
Prob(F-statistic)	0.000000			

Source: Own calculations using Eviews 9.0

Also, the variation of the residues has the characteristic of a white noise (figure no. 4).

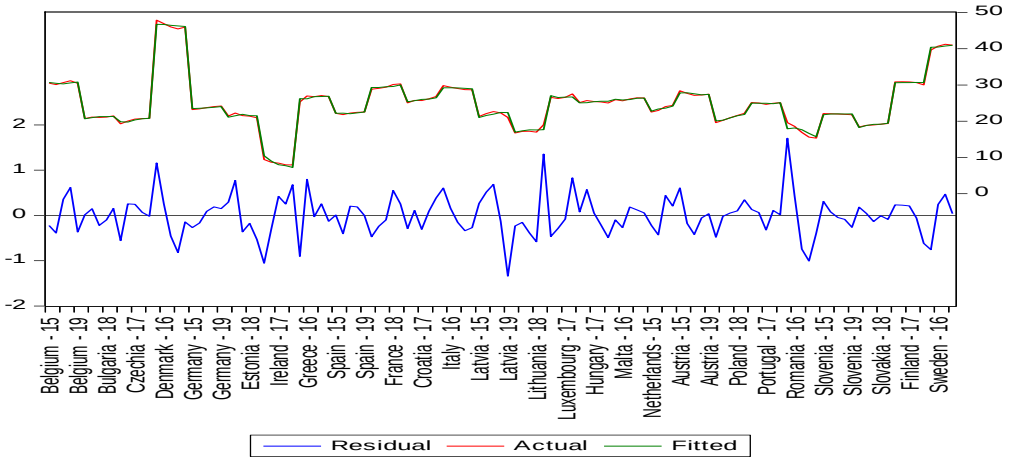

Figure no. 4: Pattern variation of residuals

Source: Own calculations using Eviews 9.0

The share of tax revenues in GDP is in a relationship of inverse determination with the VAT gap. If the gap increases by one percentage point, the share of revenues to GDP will decrease by 0.04 percentage points.

We found that the share of fiscal revenues to GDP is determined not only by the level of the tax gap over the reference period, but also by the level of the share in GDP of tax revenues in the previous period. In addition, the share of revenues in GDP is influenced by the common trend of the two variables.

The overwhelming influence of the share of tax revenues in GDP in the year before the reference year on the share of revenues in GDP in the reference year can be seen, indicating a much greater impact of other determinants than the tax deficit.

VAT represents on average 33% of tax revenues (the average was determined on panel data), other than social contributions, this type of tax being the most important source of public revenue.

For Romania, the value of the coefficient associated with the fixed effect is -3.410031. This means that the impact of the widening VAT gap is much greater on the share of tax revenues to GDP compared to the average sample of Member States.

A second model in which the significant influence of the VAT gap has been reported (equation (2)) also reflects the significant impact of the cumulative budget deficit with that of the level of total government expenditures (including public investments). This model is also valid as a whole, and the regression coefficients are significantly different from zero. The coefficient of determination is 99%.

The results are as follows (table no. 5):

Table no. 5: The results of the panel regression model using VAT gap, general government expenditures and government deficit as explanatory variables for tax revenues

Dependent Variable: SHARE_REVENUE_GDP
Total panel (balanced) observations: 156

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.962149	1.842320	5.407393	0.0000
GOV_DEFICIT	0.476436	0.056687	8.404724	0.0000
SHARE_GOV_EXP_GDP	0.364859	0.042854	8.514012	0.0000
VAT_GAP	-0.046221	0.019259	-2.399979	0.0178
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.994597	Mean dependent var		24.97904
Adjusted R-squared	0.993405	S.D. dependent var		7.261536

S.E. of regression	0.589691	Akaike info criterion	1.947689
Sum squared resid	44.16236	Schwarz criterion	2.514649
Log likelihood	-122.9197	Hannan-Quinn criter.	2.177964
F-statistic	834.8897	Durbin-Watson stat	1.121728
Prob(F-statistic)	0.000000		

Source: Own calculations using Eviews 9.0

If we take into account that the government deficit includes the side of public spending, we can summarize that an increase in aggregate demand by increasing public spending (the Keynesian model) will lead to an increase in the level of total tax revenue. The impact of government spending on revenues is much more pronounced than that of VAT tax losses.

In the third model (equation (3)) the variable VAT gap was eliminated to better capture the potential determinants of tax revenues. The result is as follows (table no. 6):

Table no. 6: The results of the panel regression model using general government expenditures, government deficit, share of exports to GDP, share of subsidies in GDP and the share of VAT revenues to GDP as explanatory variables for tax revenue

Dependent Variable: SHARE_REVENUE_GDP
Total panel (balanced) observations: 150

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.967677	2.392803	0.822331	0.4125
GOV_DEFICIT	0.249547	0.064229	3.885265	0.0002
SHARE_EXP_GDP	0.054222	0.019116	2.836422	0.0054
SHARE_GOV_EXP_GDP	0.223850	0.044819	4.994527	0.0000
SHARE_SUB_GDP	0.513165	0.279347	1.837018	0.0687
SHARE_VAT_GDP	1.132040	0.171724	6.592186	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.995907	Mean dependent var	25.17129
Adjusted R-squared	0.994918	S.D. dependent var	7.339794
S.E. of regression	0.523231	Akaike info criterion	1.719271
Sum squared resid	32.85254	Schwarz criterion	2.321398
Log likelihood	-98.94532	Hannan-Quinn criter.	1.963896
F-statistic	1006.902	Durbin-Watson stat	0.993360
Prob(F-statistic)	0.000000		

Source: Own calculations using Eviews 9.0

This model has a lower statistical significance compared to the first two, but it gives us clues as to the possible determinants of tax revenues. It can be seen that along with government spending and government deficit (understood strictly in relation to the total public expenditure), the volume of exports, the level of subsidies and the share of VAT revenues in GDP have a significant influence on the level of tax revenues. If, regarding the last variable, the link is an expected one given the high share of VAT in total tax revenues, the influence of exports is interesting. Assuming that an increase in the volume of exports is associated with an increase in productivity and technological innovation, and the intensification of economic activity thus obtained leads to an increase in tax revenues, we can consider that the Solow-Swan growth model is also confirmed to some extent.

Finally, in the fourth model (equation (4)), the exclusive influence of the level of public expenditures on economic growth was verified, which results in an increase in tax revenues, considering the influence of the other variables together, in the form of the 1st order lag, to the dependent variable.

The results are as follows (table no. 7):

Table no. 7: The results of the panel regression model using general government expenditures, government deficit and 1st order lag of the dependent variable as explanatory variables for tax revenue

Dependent Variable: SHARE_REVENUE_GDP
Total panel (balanced) observations: 130

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.712843	2.109983	-0.337843	0.7362
GOV_DEFICIT	0.352464	0.050813	6.936488	0.0000
SHARE_GOV_EXP_GDP	0.219889	0.041748	5.267070	0.0000
SHARE_REVENUE_GDP(-1)	0.654983	0.058940	11.11263	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.997525	Mean dependent var		25.00693
Adjusted R-squared	0.996839	S.D. dependent var		7.246236
S.E. of regression	0.407397	Akaike info criterion		1.235684
Sum squared resid	16.76323	Schwarz criterion		1.875365
Log likelihood	-51.31948	Hannan-Quinn criter.		1.495608
F-statistic	1453.932	Durbin-Watson stat		1.833196
Prob(F-statistic)	0.000000			

Source: Own calculations using Eviews 9.0

These results and the high level of significance of the model show that the level of total government spending has an indisputable influence on the increase in tax revenues. It can be said that one enters a virtuous circle. Of course, the situation is valid for the European Union as a whole.

To identify the determinants of the VAT gap we proceeded similarly, running an initial multiple regression model, with the whole set of variables. We added, in this case, to the initial set of variables the first order lag of the dependent variable.

The results generated are presented below (table no. 8):

Table no. 8: The results of the initial panel regression model for VAT gap

Dependent Variable: VAT_GAP
Total panel (balanced) observations: 125

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-248.9716	109.4058	-2.275672	0.0258
EDUCATION	0.507095	0.240282	2.110413	0.0383
EMPL_RATE	0.248619	0.387182	0.642125	0.5228
FCEGG_PER_CAPITA	0.068690	0.104165	0.659431	0.5117
GDP_PER_CAPITA	-0.075719	0.111571	-0.678664	0.4995
GOV_DEFICIT	0.420297	0.319866	1.313980	0.1930
GOV_GROSS_DEBT	-0.064621	0.086301	-0.748783	0.4564
GR_EMPLOYEES	0.747333	0.831105	0.899204	0.3715
GR_NOMINAL_LABOUR_COST_H	0.034659	0.152334	0.227517	0.8207
GR_REAL_PRODUCTIVITY_HOU	0.054004	0.127131	0.424786	0.6723
GR_SELF_EMPL	0.082155	0.153326	0.535818	0.5937
GR_TOTAL_EMPLOYMENT	-0.767068	0.936591	-0.818999	0.4155
INCOME_INEQUALITY	0.370519	0.954730	0.388088	0.6991
MATERIAL_SOCIAL_DEPRIVAT	0.205868	0.188986	1.089326	0.2796
MEDIAN_NET_INCOME	-0.000841	0.000345	-2.441286	0.0171
RISK_OF_POVERTY	0.385155	0.284434	1.354108	0.1799
SHARE_COMP_EMPL_GDP	-0.375053	1.445846	-0.259400	0.7961
SHARE_EXP_GDP	0.525316	0.314569	1.669957	0.0993
SHARE_FINAL_CONSUMPTION_	0.978096	0.517606	1.889655	0.0628
SHARE_GFCF_GDP	0.621919	0.301190	2.064876	0.0425
SHARE_GOSMI_GDP	0.230370	1.414978	0.162808	0.8711
SHARE_GOV_EXP_GDP	0.407752	0.252009	1.618008	0.1100
SHARE_GVA_GDP	1.477989	1.582414	0.934009	0.3534
SHARE_IMP_GDP	-0.521061	0.296384	-1.758063	0.0830
SHARE_REVENUE_GDP	-0.408083	0.417838	-0.976654	0.3320
SHARE_SUB_GDP	1.233942	1.725133	0.715273	0.4768
SHARE_VAT_GDP	-1.383317	1.340375	-1.032037	0.3055
UNEMPL_RATE	0.030031	0.299297	0.100339	0.9204
VAT_GAP(-1)	0.118217	0.106236	1.112778	0.2695

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.979817	Mean dependent var	12.73680
Adjusted R-squared	0.965241	S.D. dependent var	8.677376
S.E. of regression	1.617786	Akaike info criterion	4.096347
Sum squared resid	188.4407	Schwarz criterion	5.295552
Log likelihood	-203.0217	Hannan-Quinn criter.	4.583521
F-statistic	67.21993	Durbin-Watson stat	2.265449
Prob(F-statistic)	0.000000		

Source: Own calculations using Eviews 9.0

We gradually eliminated the statistically insignificant variables and obtained a valid explanatory model, the results of which are presented below (table no. 9):

Table no. 9: The results of the panel regression model using risk of poverty, the level of employee compensation, final consumption and the level of gross value added as explanatory variables for VAT gap

Dependent Variable: VAT_GAP
Total panel (balanced) observations: 156

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-143.8813	35.76341	-4.023142	0.0001
RISK_OF_POVERTY	0.610415	0.105168	5.804212	0.0000
SHARE_COMP_EMPL_GDP	-0.996794	0.164258	-6.068479	0.0000
SHARE_FINAL_CONSUMPTION	0.487109	0.126482	3.851219	0.0002
SHARE_GVA_GDP	1.718190	0.383957	4.474956	0.0000

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.960228	Mean dependent var	13.37692
Adjusted R-squared	0.951074	S.D. dependent var	8.846832
S.E. of regression	1.956852	Akaike info criterion	4.351593
Sum squared resid	482.4882	Schwarz criterion	4.938104
Log likelihood	-309.4242	Hannan-Quinn criter.	4.589808
F-statistic	104.8980	Durbin-Watson stat	1.690945
Prob(F-statistic)	0.000000		

Source: Own calculations using Eviews 9.0

About 95% of the VAT gap variation is explained by four variables, one of which being a social-economic indicator. Two of these variables, namely, the final household consumption and gross value added in the economy, are the macroeconomic correspondent of the VAT tax bases. Therefore, there are no surprises from this point of view. However, the links between the compensation granted to employees and the share of people at risk of poverty, on the one hand, and the VAT gap, on the other, are interesting.

In our opinion, it is the most important discovery so far related to the exogenous sources of the VAT gap. The model shows that the increase by one percentage point of the share of compensation of employees (wages, salaries and social contributions) will lead to a decrease by almost one percentage point of the VAT gap. At the same time, the increase by one percentage point of the share of the population exposed to the risk of poverty or social exclusion in the total population, will lead to the increase of the VAT gap by 0.6 percentage points. Therefore, the sources of the VAT gap include not only fraud and evasion in the economic sector, but also household income. The VAT gap has also as source the work and income of the households!

Conclusions

A first conclusion that can be drawn from the results of the applied models is that the general degree of taxation of an economy, regardless of how we understand this concept, is determined largely by other factors than the tax gap. One working hypothesis was that the high share of VAT in public revenues as a whole could affect the overall degree of taxation through chain effects. For example, an undeclared economic activity of dimensions exceeding the legal threshold above which an economic agent owes VAT would also imply the non-declaration of profits made in this activity, as well as the non-declaration of income of any natural persons employed by the company not declaring its activity. In the case of the marketing of excisable products, the concealment of excise duties would also mean the concealment of the related VAT rate.

However, there is a significant link between the VAT tax gap and the general degree of taxation of an economy. The higher the non-compliance in the VAT area is, the lower the overall tax rate.

Another aspect investigated was the intensity of this connection. To what extent does non-compliance with VAT impact the general degree of taxation? According to the results of the model, an increase in the VAT tax gap by one percentage point will reduce the share of tax revenues in GDP (excluding social contributions) by 0.04 percentage points. At EU level, the VAT tax gap was € 134 billion in 2019, ie 10.3% of VAT Total Tax Liability (EC, 2021), and tax revenues were € 3.586 billion in 2020, excluding social security contributions (according to Eurostat), which corresponds to a share of 26.8% in GDP. Therefore, an increase of 13 billion euros in the VAT tax gap at Union level would correspond to a reduction of total tax revenues (without social contributions) by 5.4 billion euros.

The above statements are valid in relation to all Member States. In other words, we expect such changes to occur on average in a Member State when appears a significant change in the tax gap. On the other hand, it must not be forgotten that the group of Member States is heterogeneous. The range of values of fixed effects indicates a more pronounced impact in the case of Romania.

Another observation was made regarding the variation of the two variables over a period of 5 years for each Member State (figure no. 5).

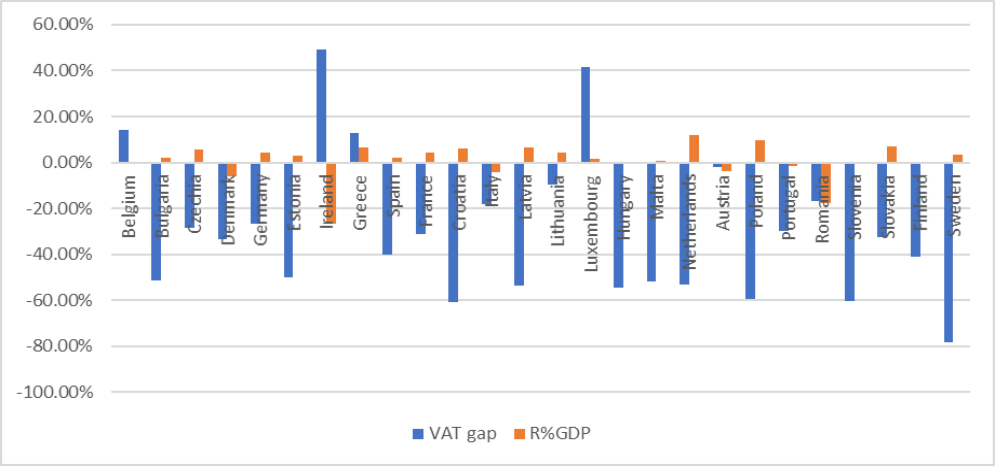

Figure no. 5: Rate grow in the last 5 years of VAT gap and share of revenues to GDP

Source: Own calculations based on Eurostat data

The negative link between the VAT gap and the share of revenues to GDP is not verified for all Member States. Atypical developments have been identified for Denmark, Ireland, Italy, Luxembourg, Austria, Portugal and Romania. For a better understanding of these developments, in-depth research should be developed in order to identify the causes that led to atypical patterns of variation.

Nevertheless, we think the most important conclusions are the following:
(1) The results appear to confirm both the Keynesian growth model and the Solow-Swan growth model;
(2) The sources of VAT gap are endemic. The main determinant is the exposure of the active population to poverty and social exclusion. In other words, the more a country faces geographical or social areas characterized by chronic poverty, the greater the chances that tax evasion and fraud will become widespread. This finding is consistent with the results of other studies. However, this influence is dependent of other factors that are in the relationship to the level of household income.

These two conclusions lead to the idea that a government that wants to increase public revenues and strengthen welfare should initiate programs or strategies in three directions. These directions should be the development of public investment projects and the financing of public services, the stimulation of innovation and research, and active measures to reduce the population's exposure to poverty, by promoting sustainable income growth programs.

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