TAX GAP AS A TOOL FOR MEASURING VAT EVASION IN THE EU COUNTRIES

[a]ALENA ANDREJOVSKÁ, [b]VERONIKA KONEČNÁ, [c]JANA HAKALOVÁ

[a b]*Faculty of Economics, Department of Finance, Technical University of Košice, Slovak Republic*
[c]*Faculty of economics, Department of Accounting and Taxes, VSB – Technical University of Ostrava, Czech Republic*
email: [a]alena.andreovska@tuke.sk, [b]veronika.konecna@tuke.sk, [c]jana.hakalova@vsb.cz

Abstract: VAT is one of the most decisive tax revenues sources in the EU Member States. Due to financial frauds and insufficient tax system, there is a billion loss of EUR every year in the European budget. The article deals with the impact of the tax evasion on economies of the EU Member States. By applying the top-down approach, we observed tax gaps as a quantifier of tax evasion from 2004 to 2017. The period around the economic crisis in 2009 was examined in more detail, as there was a sharp change in the evolution of tax gaps. We constructed a regression model, which examined the relationship of the tax gap and VAT tax revenues to selected determinants of tax evasion. The results showed that tax gaps in the Member States have been growing every year. We also found that there is an increase in tax revenues, but tax liabilities increase to greater extent.

Keywords: tax evasion, tax gap, tax transparency, tax collection efficiency.

1 Introduction

As each tax, value-added tax (VAT) is sensitive for tax evasion and frauds. VAT mechanism allows to economic entities and companies many unique ways for tax abuse. At the EU level, there is a quite common discussed tax evasion and frauds in recent times. The estimates of tax gaps represent gross indicators of tax revenues loss. In recent decades, the national tax reports, and international institutions, such as FISCALIS 2020 Project, developed several methods for estimation of tax revenue loss. FISCALIS 2020 is coordinated by the European Commission and contains a group of projects for tax gaps analysis. The aim is to gather knowledge and exchange experience with existing tax gap estimates. To find a solution, it is crucial to increase transparency and knowledge about these tax issues within the wider public. Generally, tax frauds, especially VAT frauds, cause a shock in all the economic sectors in a country. They cause widespread damage to economic and social life, mainly serious losses of state budgetary revenues. Due to the consequence of tax frauds, there is insufficient funding of the areas needed to ensure a standard level of service to citizens. Tax frauds distorts healthy competition in the business sector and leads to illegal activities in other forms of criminal activity.

2 Literature review

VAT belongs to indirect tax and represents the core of the entire tax system. According to the Council Directive No. 2006/112/EC of November 28th, 2006 on the common system of value-added tax, VAT shall be applied to all transactions carried out in counter value by the taxable person. VAT system has also some advocates and opponents. In general, there is a widely accepted opinion that VAT makes it easier to increase revenue for the state budgets, and thereby helps to improve the efficiency of the tax system. However, this argument is true only for a short-term view. VAT is no longer a privilege for rich countries only. Keen & Lockwood (2010) points out the fact that the more open countries, the less prone to VAT. The necessary and sufficient condition for acceptance or the change in VAT is to reduce the marginal cost of public spending. Measuring tax evasion is a complex process that cannot be measured with complete accuracy. However, different methods will give us different estimates. Hutton (2017) states that the VAT evasion is often quantified through tax gap. To measure VAT effectiveness, it is used c-efficiency ratio   VAT performance and VAT compliance gap. Rubin (2011) characterized the VAT gap as a difference between theoretical tax liability set by legislative and real tax liability of gained revenues. Gemmel (2012) found out

that the tax gap shall be measured from the macro- and microeconomic point of view. From the macroeconomic view, tax gap methodology are top-down or indirect methods and usually use economic aggregates in the whole economy. The microeconomic methodology is the bottom-up (direct) approach and uses more specific and individual data. The top-down approach provides a complex assessment of all tax losses through tax gap measurement. Louvot-Runavot (2011) claims that the top-down approach is focused on providing one estimate based on data independent from the tax authority. The top-down method may potentially be beneficial mainly when operating information of tax administration is inadequate or not sufficient, and even possibly contaminated by governance issues. However, if national accounts data is estimated or adjusted through taxes (for example through using risk-based audit data to estimate tax evasion and fraud), then it will worsen formal independence. This method is usually less time-consuming and requires relatively little resources, while the results can be considered as complex and time-comparable, allowing to follow the trend over time. On the other hand, it is limited by the fact that through this approach can be estimated only sectors in macroeconomic statistics, and the estimation quality is dependent on the completeness of adjustments for the shadow economy in the national accounts. Besides that, the foreign tax evasion aspects (such as offshore procedure, bank deposits, or foreign assets) cannot be classified based on national accounts data. Rodrigues (2015) claims that the top-down approach is based on the presumption that the data source to estimate the tax gap covers the entire tax base. Therefore, data for tax gap estimation is usually derived from macroeconomic models or national accounts. National accounts describe a structure and development of the economy within the country or geographic area (for example the EU) and describe all production activities. There is the European System of National and Regional Accounts (ESA 2010) in the EU countries. As European Commission (2013) states, ESA 2010 is the newest internationally compatible EU accounting framework for a systematic and detailed description of an economy. From September 2014, the data transmission from the Member States to Eurostat is following ESA 2010 rules. ESA 2010 encourages the Member States to ensure accuracy, reliability, consistency, and comparability of the accounts by planning and implementing data revisions in line with the revision policies.

Toder (2007) states that the tax gap is the difference between the amount of theoretical VAT liability and the number of actual VAT revenues in the concerned country and year. The VAT gap is not only a tool for measuring tax frauds. Since it can also include VAT paid due to tax strategies or due to insolvency of the taxpayer, quantifying the VAT gap helps realize its size and trend as an indicator of potential VAT evasion. Also, there could be evidence of a higher VAT gap if the tax authorities are not working effectively enough. For this reason, the VAT gap is sometimes used as a measure of the efficiency of tax collection by tax authorities that are not affected by economic or VAT rate changes. Increasing the size of the VAT gap may indicate either tax evasion or low efficiency of tax collection, or both. Therefore, politicians and tax administration should pay adequate attention to these problems.

3 Material and research methods

This contribution aims to quantify VAT evasion, which is based on the tax gap methodology. By applying the top-down approach, we have quantified the tax gaps in all EU Member States from 2004 to 2017. We have examined in more detail the period of the economic crisis as there has been a significant change in the tax gap development at that time. To analyze VAT gap, we used regression analysis, and the data was structured as panel data, retrieved from the Eurostat database (2018) for the EU-28 Member States.

4 The calculation of the tax gap

To calculate the tax gap, it was first necessary to calculate the total tax liabilities. In this calculation, we used theoretical VAT liabilities according to Barbone (2013), included five VAT sub-aggregates, i.e. the final household consumption, government expenditures, intermediate consumption, gross fixed capital formation (GFCF), and the final consumption of non-profit institutions serving households (NPISH). We considered the sectoral classification of the economy, the effective tax rate, and the percentage of exports of goods that are exempt from VAT. Barbone (2013) classified theoretical VAT liabilities as follows:

$$VTTL = \sum_{i=1}^{n}(rate_i \; x \; Value_i) + \sum_{i=1}^{n}(rate_i \; x \; propex_i + IC \; Value_i + i=1nrate_i \; x \; propex_i + GFCF \; Value_i + net \; adjustmennts \qquad (1)$$

where:
rate – effective tax rate
Value – the final household consumption NPISH and government consumption
IC Value – the intermediate consumption
Propex – a percentage of output exempt from VAT in the sector
GFCF Value – gross fixed capital formation
i – economic sectors.

In our calculation of tax liabilities, we used a study CASE (2018) which the European Commission considers as key research in assessing VAT evasion. We adjusted the total VAT liability and added non-sectoral economic classification, i.e. we considered final consumption of all the products regardless of the goods and services for which reduced or super-reduced tax rate is applied. In the formula, the percentage of output that is exempt from taxation represents the sum of export within the EU (intra-EU export) non-EU export and the percentage of taxes and duties excluding VAT. Total tax liabilities are calculated as follows:

$$Total \; tax \; liabilities = (Gov + Hous + NPISH) * er + (GFCG + IC) * er * out \qquad (2)$$

where:
Gov – the final government consumption, in million EUR
Hous – the final household consumption, in million EUR
NPISH – the final consumption non-profit institutions serving households, in million EUR
er – effective tax rate, in %
GFCF – gross fixed capital formation, in million EUR
IC – the intermediate consumption, in million EUR
out – a percentage of non-EU export and intra-EU export, percentage of taxes and duties excluding VAT, in %.

Since one of the input variables is the effective VAT rate, we used the following formula for its calculation:

$$Effective \; Tax \; Rate = \frac{tax \; revenues}{Hous + corporation} \qquad (3)$$

where:
Hous – the final household consumption, in million EUR
corporation – output for the final consumption of non-financial corporations, in million EUR.

We included the final household consumption in the tax base as VAT is the most burdened by it, and also received output for the final consumption of non-financial corporations retrieved from Eurostat (2018) which includes all economic sectors based on NACE classification. After calculation total tax liabilities, we measured the tax gap using the following formula:

$$Tax \; Gap = \; total \; tax \; liabilities \; - total \; tax \; revenues \qquad (4)$$

5 The regression analysis

The regression analysis examined the relationship between individual variables and the evolution of tax gaps. The explained variable represents the tax gap with VAT tax revenue. The general panel model for our regression analysis is defined as follows:

$$y_{it} = \alpha + \beta_{it}^{T} x_{it} + u_{it} \qquad (5)$$

where:
y_{it} - dependent (response) variable (i.e. tax evasion as a proportion of tax gap to tax revenues);
x_{it} - independent (explanatory) variables (GDP per capita, import ratio, standard VAT rate, consumption-to-GDP ratio, intermediate consumption, unemployment rate, corruption index, value added-to-GDP ratio, shadow economics, gross public debt, and the amount of population (Tab.1).

The selection of variables for both analyses was determined by the theoretical basis of the following studies: Aizenmann & Jinjarek (2008), Ebrill et al. (2001). Agha & Haughton (1996). Bird et. al. (2004), Barbone et al. (2013), CASE (2018), and Reckon (2009). In these studies, authors followed many variables which have either a direct, or an indirect impact on the volume of tax evasion. The degree of impact of the above factors varied depending on the intensity of the relationship between the variables. The determinants themselves were specific and dynamic, constantly evolving and influencing each other.

Table 1 Independent explanatory variables X_{ij}

Variable	Abb.	Unit	Reason for inclusion in the model	Relation to the tax gap (hypothesis)	Author	Source
GDP per capita	GDPpc	mil. €	wealth level of development	decrease	Reckon (2009)	Eurostat
unemployment	unemp	% of active population	economic cycle tax revenues inequality	increase	Barbone (2013)	Eurostat
import to GDP	IMP	%	economy openness carousel fraud risk	increase (if there is VAT carousel)	Aizenmann & Jinjarak (2008), Ebrill (2001)	Eurostat
VAT	VAT	%	tax burden	increase	Reckon (2009), Ebrill (2001), Agha (1996)	European Commission
Corruption Perceptions Index	CPI	index	level of corruption population trust in the public sector	decrease (the higher CPI the lower corruption)	Bird et al. (2004), Reckon (2009)	Transparency International
population	pop	mil. €	country size	increase	Barbone (2013)	Eurostat
public debt	debt	%	worse financial condition	increase	Barbone (2013)	Eurostat
shadow economy	shadow	%	significance of the shadow economy	increase	Bird et al. (2004)	IMF
added value to GDP	AV	%	the relative size of economic sectors	decrease	Reckon (2009)	Eurostat
intermediate consumption to GDP	iC	%	incorporating the corporate sector	increase	the variable we choose	Eurostat
consumption to GDP	C	%	size of potential tax base	decrease	Reckon (2009)	Eurostat

Source: own calculation based on Zidková (2014)

In the regression analysis, there were used the Pooling model (PM), Fixed effects model (FEM), and Random effects model (REM), as well as the first difference model and the difference between model. Based on our testing, we found out that statistically insignificant are difference between model and first difference model, the other models were statistically significant while the significance was determined by Hausmann test. The statistical test determined as the most appropriate model for testing the Pooling model (PM). The results of the original Pooling model in which were included all variables pointed out that the shadow economy, unemployment, and public debt were statistically insignificant. Therefore, we removed these variables from the model correction. Another variable that has also been removed from the model was the value-added-to-GDP ratio, as its presence in the model is irrelevant in terms of the presence of intermediate consumption and total GDP consumption. Finally, we also removed the GDP per capita variable as it became statistically insignificant after several adjustments to the model. The modified model is shown in Tab. 3 and it is statistically significant. Further testing of the adjusted Pooling model revealed the following model features: (1) according to Lagrange Multiplicate test, an individual effect in the model is significant, while the time effect is insignificant; (2) according to the Chow pool ability test, it is necessary to take into account the panel data structure; (3) according to Woldridge test, it is rejected the presence of autocorrelation; (4) testing the model for absolute correlation confirmed that correlation is insignificant for the whole model; (5) Maddala-Wu unit root test confirms the existence of time series stationarity; (6) according to White test, there is not confirmed heteroscedasticity in the model; (7) normal distribution was tested according to Jarque-Bera test, Shapiro-Wilk test and Kolmogorov-Smirnov test.

6 Results and discussion

Tax gaps in the EU Member States from 2004 to 2017 are shown in Tab.2. Based on our calculation, the lowest tax gap was reported in 2004 at the level of 614,000 mils. EUR. On the other hand, the highest tax gap was quantified in 2017 at the level of 946,000 mils. EUR. If we look at tax gaps in the individual countries, we can conclude that in Germany and France were tax gaps for the whole observed period higher than 100,000 mils. EUR every year (in Germany higher than 200,000 mils. EUR, from 2006 to 2015 even higher than 300,000 mils. EUR). On the other hand, the smallest tax gaps were quantified in Malta (540 mils. EUR on average for period) and Cyprus (980 mils. EUR on average). To sum up, tax gaps in the EU countries grew continually from 2004 to 2017, except from 2009 when tax gaps decreased. In the next part of the contribution, we will analyze the period of the financial crisis and its consequences on tax gaps. The highest VAT gaps were measured in Germany, France, the United Kingdom, and in Italy. The smallest VAT gaps we quantified in Malta, Cyprus, and Latvia.

In the last observed year 2017, the Czech Republic moved to the first cluster with higher tax gaps countries. Greece, on the other hand, moved to the cluster with smaller tax gaps. In France, Italy, and the United Kingdom, the total tax liabilities were risen by 28% on average, in Germany even by 79% and in the Netherlands by 61%. German tax revenues were increased only by 34%. Generally, we can say that even though tax revenues in all EU countries rose, but tax liabilities rose at a greater extent. Therefore, there was an increase in tax gaps each year.

Table 2 Tax gap in EU in period 2004-2017 (in mil. EUR)

Country/Year	2004	2005	2006	2007	2008	2009	2010
AT	9,955	10,809	11,024	11,860	12,831	12,923	13,283
BE	18,003	19,399	20,663	22,155	22,318	21,491	23,302
BG	853	991	1,257	1,319	1,733	1,328	1,310
CY	391	465	537	586	637	592	588
CZ	4,071	4,687	5,104	5,901	6,992	6,584	7,259
DE	176,709	181,286	200,171	242,316	252,871	240,435	254,188
DK	12,812	14,094	14,951	16,087	16,004	15,924	16,061
EE	340	385	489	593	580	649	651
ES	32,146	37,682	41,623	42,625	36,069	27,145	37,033
FI	7,973	8,594	9,215	9,582	9,688	9,375	9,546
FR	114,868	119,315	121,616	123,911	124,420	117,383	121,628
GR	5,046	5,366	6,338	7,140	6,994	6,604	6,801
HR	1,758	1,949	2,223	2,455	2,623	2,423	2,422
HU	4,457	4,807	4,559	5,167	5,424	5,200	5,727
IR	8,028	9,106	10,285	10,396	8,957	7,616	6,833
IT	66,523	70,252	78,031	81,291	78,748	68,412	76,738
LT	418	527	660	775	902	709	821
LU	1,257	1,568	1,669	2,015	2,110	2,123	2,379
LV	319	407	519	697	698	478	487
MT	157	182	202	215	255	237	255
NL	32,843	35,671	40,990	44,973	48,039	47,714	49,505
PL	6,500	8,804	10,900	13,452	15,492	11,612	14,686
PT	5,494	6,267	6,487	6,473	6,354	5,448	5,987
RO	1,388	2,269	2,715	3,114	3,681	2,816	3,502
SE	19,143	20,355	22,240	23,619	24,166	21,137	25,244
SI	1,012	1,111	1,250	1,353	1,495	1,359	1,398
SK	1,101	1,323	1,467	1,678	1,943	1,887	1,942
UK	80,607	83,606	90,531	90,475	77,030	61,513	77,723
Total	**614,174**	**651,278**	**707,716**	**772,224**	**769,051**	**701,117**	**767,299**
Country/Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
AT	13,445	14,098	14,166	14,390	14,873	15,406	16,045
BE	24,761	25,468	25,462	25,711	25,080	25,811	26,905
BG	1,354	1,458	1,675	1,628	1,729	1,823	1,919
CY	559	551	481	472	469	501	562
CZ	8,080	8,080	8,291	8,117	8,772	9,225	10,382
DE	278,428	276,591	278,765	296,217	309,689	321,820	335,230
DK	16,087	16,569	16,230	16,763	16,911	17,162	17,647
EE	715	778	805	901	997	1,073	1,164

ES	35,599	34,586	37,705	39,570	42,938	43,724	45,687
FI	10,757	11,434	11,954	11,878	11,664	12,090	12,369
FR	125,872	128,760	127,932	131,572	134,028	135,178	142,451
GR	6,357	5,819	5,158	5,139	5,254	5,817	5,964
HR	2,323	2,448	2,505	2,564	2,706	2,857	3,057
HU	5,706	5,869	5,895	6,568	7,205	7,188	8,037
IR	6,265	6,095	6,029	6,666	7,067	8,344	8,359
IT	76,409	73,754	70,792	73,359	73,143	74,741	78,336
LT	891	873	867	901	962	981	1,065
LU	2,596	2,935	3,187	3,641	3,327	3,377	3,504
LV	571	655	691	736	793	855	908
MT	284	302	316	364	389	407	461
NL	50,144	50,892	50,980	51,286	53,300	56,472	60,584
PL	15,629	14,300	14,589	15,724	16,443	16,911	19,821
PT	6,093	5,630	5,685	5,949	6,161	6,295	6,816
RO	4,154	4,243	4,265	4,298	4,743	4,045	4,207
SE	27,374	28,585	28,518	28,174	29,934	31,874	32,828
SI	1,433	1,359	1,425	1,437	1,493	1,545	1,625
SK	2,168	1,960	2,179	2,458	2,802	2,795	3,097
UK	89,779	95,000	96,955	102,411	119,236	101,237	97,401
Total	**813,834**	**819,094**	**823,500**	**858,896**	**902,108**	**909,553**	**946,432**

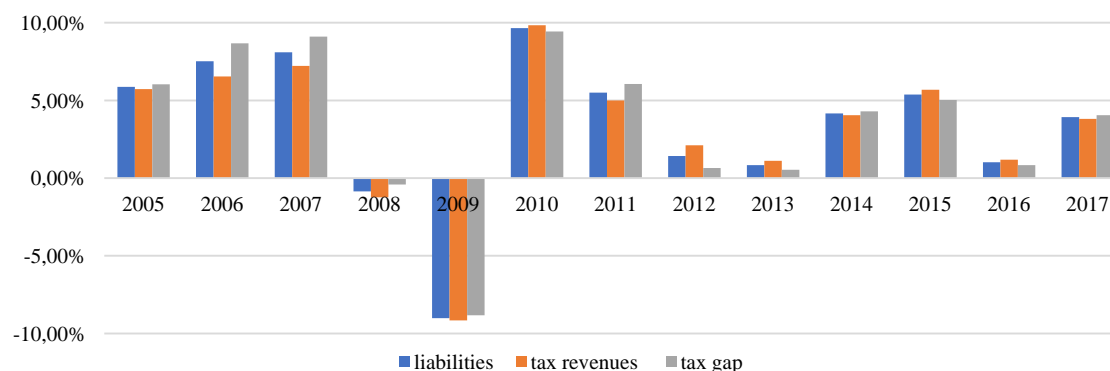Source: own calculation based on Eurostat (2004-2018)

6.1 The tax gap analysis

The fact that tax gaps grew continually can be explained by an increase in the final consumption of individual component of tax liabilities. In 2009, there was reported a steep drop in tax gaps in all the Member States caused by a decrease in total tax liabilities (the most significant decrease was in intermediate consumption by 1,499,000 mils. EUR in the EU). The gross fixed capital formation has fallen by 404,000 mils. EUR in comparison to 2008. Since in the calculation the components of tax liabilities were expressed as a percentage of output exempt from VAT, then from this point of view the most significant drop was in final household consumption by 333,000 mils. EUR.

6.2 Tax revenues

In 2009, tax revenues in the EU fell by 18% in comparison to the previous year. It can be explained by the fact that state budgetary revenues significantly decreased in the financial crisis due to the impact of many indicators, such as tax revenues, corporate profits, the final consumption, or commodity prices. In this context, in all EU countries, there was an increase in the budgetary deficit, and it occurred the problem of the impossibility of financing public expenditure. The highest decrease in VAT revenues was reported in Romania by 29%, Latvia by 28%, and in Spain by 25%. However, in Luxembourg, Germany, and Austria in 2009 tax revenues did not fall.

Figure 1 Percentage of year-to-year change in tax liabilities, tax revenues and tax gap in the EU

Source: own calculation based on Eurostat (2019)

6.3 The global financial crisis in 2009

The crisis year 2009 meant for the Member States difficult period. Gross domestic product in the EU fell by 2.5% quarterly. The negative economic environment was the most affected by the Slovak economy, which fell by 11.2%. This steep economic drop caused a decrease in foreign demand. Also, the gas crisis and the production limitation played its role in this recession in Slovakia. As a result of the crisis, most countries have set a government budgetary deficit above 3% of GDP. The government consumption slightly rose, NPISH increased negligibly, however, output for final consumption of non-financial corporations dropped by 13,000 mils. EUR together with VAT effective rate. Within the Baltic States, the financial

crisis hit the worst Latvia, which had the slowest economic growth, high state's deficit at the level of 12% and enormous government expenditures. Despite the Latvian government measure which rose the standard VAT rate from 18% to 21%, tax revenues decreased rapidly. Also, there was a drop in intermediate consumption, household consumption, and GDP. Due to the crisis problems, Latvia asked the International Monetary Fund (IMF) and the EU for emergency rescue loan in the amount of 7.5 bill. EUR. To provide this financial mechanism, there was a request by the IMF to decrease deficit under 4.9% of GDP. Macroeconomic indicators in Romania are for many years under the European average level. The financial crisis, moreover, caused an increase in the VAT rate from 19% to 24% in 2010. This government measure was important for the Romanian budget, as well as tax revenues and consumption because consumption has fallen since 2009 rapidly. We have to

state that since economic growth in 2008 was at the level of 2.9%, the final consumption fell in real terms by 2.8%, and the final household consumption fell by 4.7% due to reduction in the volume of sales of retail goods and services. The actual VAT revenues in 2008 were by 30.8% in nominal terms higher than in the previous year. In real terms, the final household consumption increased by 9.2%, total consumption increased by 8%, and GDP by 7.1%. However, in 2009, there was a significant decrease in VAT revenues compared to 2008, when they dropped by 16% because of the actual drop in the final household consumption by 10.8% a drop of the total final consumption by 8.2% and GDP by 7.1%. The increase in the VAT rate in Romania had a significant impact on tax revenue, as the share of VAT revenue in GDP was constantly increasing in 2010, influenced by the purchasing power of consumers. In Spain, tax revenues began to fall sooner in 2008 when the "Great Spanish Recession" appeared and lasted until the end of 2014. The decline in tax revenues was the most affected by a decline in household consumption and intermediate consumption, while government consumption increased, as well as a decline in oil prices and deflation. From long-term view was this situation unsustainable, and so the Spanish government introduced several fiscal measurements. The main aim of this fiscal consolidation was to reduce government expenditures by 1% of GDP until 2010, and simultaneously increase government revenues at the same time. As a result of the economic crisis, the Spanish government raised the standard VAT rate from 16% to 18% in 2010, intended to increase VAT revenue by 0.2% in 2010, and subsequently by 0.3% in 2011. Public sector wages were cut by 5% on average and government investment was suspended. These measures resulted in an overall decline in government expenditures of 7.9% in 2011. However, the situation was so difficult to control that in 2012 it resulted in a sovereign debt crisis and Spain had to borrow 100 trillion. EUR from the EU funds. To conclude, in 2009 total tax liabilities decreased by 9%. During the financial crisis, the evolution of potential tax expenditure was significantly affected, causing the biggest changes in the tax gap. As tax revenues declined more strongly than tax liabilities, the tax gap in the EU countries grew throughout the period what can be explained by the constant increase in the individual components of consumption, and by the increase in the standard VAT rate in all the Member States.

6.4 Regression analysis of the tax evasion determinants

The differences in VAT evasion can increase in the economic cycle as a response to the tax rate increase. Beside it, these differences can vary within the Member States because of the national and institutional environment. This point of view considers the potential benefits of measures to reduce VAT non-compliance as a tool for increasing government revenue to improve the productivity loss resulting from behaviour mismatches. To further investigation of these assumptions, we conducted an econometric analysis where the main objective was to create a model that would reflect the significant explanatory variables X_{ij} and their impact on the dependent (response) variable, which is quantified VAT evasion.

6.5 Interpretation of the influence of tax evasion determinants

The final adjusted model which we have tested is in Tab.3, can be expressed as follows:

$$\frac{tax\ gap}{tax\ revenues} = 5.37 + 4.55\ IMP + 1.46\ VAT - 8.82\ C +$$
$$1.77\ iC - 1.44\ pop + 1.94\ CPI \qquad (6)$$

From the model stated above, an increase in an import-to-GDP ratio by 1% will rise a proportion of tax gap to VAT revenues by 4.55%. If we increase the standard VAT rate by 1%, then the output will rise by 1.46%. However, if total consumption-to-GDP ratio increases by 1%, the tax gap to VAT revenues proportion will drop by 8.82%. The relation between intermediate consumption (iC) and GDP is the following: an increase in iC by 1% will raise output by 1.77%. The population

harms the tax gap because an increase in 1% will fall output by 1.14 units. With an increase in the corruption index of 1 unit, there will be an increase in the proportion of the tax gap to VAT revenues of 1.94 units. Based on our regression model, we can conclude that most variables have a positive impact on the growth of the tax gap to VAT revenues. As the results showed, throughout the EU countries, VAT evasion is the most affected by import, corruption index, intermediate consumption, and the level of VAT standard rate.

Table 3 Adjusted Pooling model

Coeff.	Est.	St. error	t-value	Sign.
Intercept	5.3723e-01	1.1960e-01	4.4919	***
X1	4.5467e-02	2.1402e-03	21.2447	***
X2	1.4621e-02	2.0628e-03	7.0879	***
X3	-8.8181e-03	9.2323e-04	-9.5514	***
X4	1.7652e-01	2.4706e-02	7.1450	***
X5	-1.1400e-09	4.4131e-10	2.5832	*
X6	1.9410e-02	3.7764e-03	5.1398	***
Adjusted R² : 0,85651				

Note: Coeff. – Coefficient; Est. – Estimate; St. error – Standard error; Sing. – Significance. X1 – Import-to-GDP; X2 – VAT rate; X3 – Consumption-to-GDP; X4 – Intermediate consumption-to-GDP; X5 – Population; X6 – Corruption index. Source: own calculation

7 Discussion

The previous studies pointed to the ambivalent impact of the VAT rates on the VAT gap. Based on the econometric analysis, Reckon (2009) conducted tax gap analysis in the cross-sectional estimation, which correlates the level of estimated VAT gap in each country at the level of the corresponding explanatory variables. His statistical results assume unobservable factors affecting the VAT gap and explanatory variables of interest. It is unlikely that this approach reveals the real causal determinants of VAT compliance due to omitted variables. Differences between countries may be correlated with some observed explanatory variables, such as tax rates and institutional arrangements. He also examined the links between the estimated differences in VAT compliance and the economic and social characteristics of the EU Member States. Reckon (2009), Aizenmann & Jinjarek (2008), Ebrill et al (2001) and Barbone et al. (2013), Mura (2019) found out that VAT gaps are significantly higher among countries with weaker legal institutions and a higher degree of corruption index. Institutional differences between countries also affect tax enforcement and taxpayer compliance. In our analysis, we described GDP per capita as statistically insignificant, but Reckon (2009) claimed that an increase in GDP per capita would reduce the tax gap. Also, the effect of VAT on GDP should reduce the tax gap, but in our analysis, we have excluded this variable because of the presence of variables, such as consumption-to-GDP and intermediate consumption-to-GDP. Our analysis confirmed the assumption from the abovementioned studies that total consumption-to-GDP ratio reduces the tax gap. On the contrary, with the growing corruption index, the tax gap increases. However, according to Reckon (2009), with a higher corruption index (i.e. with a lower perception of corruption in the country), the tax gap is falling. Agha & Haughton (1996) found out the negative impact of the standard VAT rate on tax gap what is consistent with the hypothesis that the higher VAT rate, the lower VAT compliance. In general, VAT non-compliance is higher in countries with higher standard VAT rates. If the VAT rate increase by 1%, the tax gap will increase by 2.7%. In our sample, however, the VAT rate increase leads to an increase of 1.46% of the tax gap. Aizenman & Jinjarak (2008) examined a VAT impact on international trade and found out that VAT is associated with a lower openness of the economy, particularly, it is true for countries with low incomes. A higher import ratio increases the tax gap, which was also confirmed by our regression analysis, even this variable is statistically significant. According to Barbone et. al. (2013), Kubasciková et.al.(2019), Papcunova & Novakova (2019) and CASE (2018), Glova et.al. (2020) with increasing unemployment, population size, and

public debt, the tax gap also rises. On the contrary, among our variables, we considered only the population, which harmed the tax gap. Thus, with an increasing population, the tax gap is falling. The up-to-datedness and investigation of VAT have recently been intensively discussed topic, both at the level of individual governments and at the level of the European institutions. The EU and the Member States lose a significant proportion of VAT revenue annually. In the context of public finance deficits, it is not an effective solution to increase revenues through an increase in VAT rates. Therefore, the European countries are trying to put in place effective measures that, without raising taxes, would ensure better tax collection.

8 Conclusion

Based on the analysis, we can conclude that the highest tax evasion during the whole observed period was in Germany, France, United Kingdom, and Italy. On the other hand, the lowest tax evasion in the EU was quantified in Malta, Cyprus, and Latvia. From time point of view, VAT evasion grew every year, except 2009 when tax evasion decreased by 18% in comparison to previous year. This drop was influenced by many indicators, such as tax revenues, corporate profits, total final consumption, or commodity prices. However, there were some EU countries (Luxembourg, Germany, and Austria) where tax revenues did not decrease in 2019. The decline in tax evasion can be explained by a decrease in the individual components of tax liabilities, where the most significant drop was recorded in intermediate consumption and gross fixed capital formation in comparison to 2008. Since these tax liabilities components were considered in our calculation as a percentage of output that was exempt from VAT, the most significant was the decrease in final household consumption by 333,000 mils. EUR caused by the financial crisis. The regression analysis confirmed that most variables have a positive impact on the growth of the VAT tax gap. Throughout the EU countries, VAT evasion is most affected by the import-to-GDP ratio, corruption index, intermediate consumption and, of course, the standard VAT rate, and so increasing value of these indicators will increase VAT tax evasion. Among the observed variables, it was confirmed the positive correlation in total consumption and population size. Thus, increasing these variables will reduce VAT evasion. Detecting and taking action to reduce tax evasion, as well as collecting tax itself is a complex process. Tax evasion cannot be prevented completely, but at least government can reduce it by applying some recommendations, limits, or ways how to prevent tax evasion.

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