What Causes the VAT Gap?[1]

*Hana ZÍDKOVÁ – Jan PAVEL**

Abstract

This paper is focused on the possible factors influencing the value added tax (VAT) gap. The VAT gap is an estimate of unpaid VAT in the economy calculated as the difference between the theoretical VAT liability and VAT actually paid into the state budget. It is often expressed in relative terms as a percentage of unpaid VAT from the theoretical VAT that would be collected if all taxpayers report and pay VAT in full. The high value of this indicator may imply problems with tax evasion and inefficiency within the tax system. The article summarises the existing studies quantifying the VAT gap and seeking to identify the relationship between the VAT gap or VAT revenues and various economic, tax and social factors present in individual countries. The panel regression and pooled regression models were used in this paper to identify the statistically significant variables that have an impact on the VAT gap. From 21 variables, only four factors proved to be statistically significant. The analysis revealed that the increase in the ratio of VAT revenues to GDP causes a reduction in the VAT gap. Further findings were that if the standard VAT rate and the difference between the standard and reduced VAT rate are increasing, the VAT gap grows. Finally, the control variable – share of household consumption in GDP is increasing the VAT gap.

Keywords: *tax evasion, VAT gap, determinants of VAT gap, theoretical VAT liability*

JEL Classification: H26

Introduction

Value added tax (VAT) is an important and relatively stable source for public budgets. According to the European Commission (2013), revenues from VAT in 2011 in EU Member States on average represented around 7.1% of gross

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domestic product (GDP) and about 22% of total tax revenues. Since the 1950s, VAT has gradually been introduced in more than 150 countries worldwide. VAT is considered a very efficient tax, as pointed out in, e.g. Bodin et al. (2001) or Tait (1988). The ease with which it is collected has even led to it being labelled a "money machine", a designation used within the debate on the introduction of VAT in the United States.[2]

Following the introduction of the single EU market, however, there emerged so-called carousel fraud, sometimes also known as a criminal attack on the VAT system (HMRC, 2011). Such scams are based on the VAT exemption on intra-community supplies of goods and the abuse of the right to claim the input VAT deduction. Their modus operandi is described in greater detail in, e.g. Keen and Smith (2007), where other, more traditional types of tax fraud are also listed, such as unreported income, tax registration avoidance, etc. For the EU as a whole, VAT evasion was recently assessed within a study conducted for the European Commission by the Centre for Social and Economic Research (CASE, 2015) and was put at approximately 168 billion EUR for all the Member States which in relative terms represents approximately 15% of the theoretical VAT that would have been collected if all taxpayers had reported and paid their VAT in full amount. In the Czech Republic, the VAT gap was estimated by the General Financial Directorate (2015) to be 80 bill. CZK. Czech Supreme Audit Office (2015) estimated the VAT gap in the amount of 105 bill. CZK in 2013 which represents approximately 26% of the theoretical VAT liability.

Despite this potential risk of abuse of the VAT system, especially on an international scale, VAT is seen as a better alternative to the labour taxation. The strategy pursued by the EU within the domain of tax policy specifically aims at reducing labour taxation and replacing it with consumption taxes, including VAT (European Commission, 2001). That is why much attention is being paid to the increasing evasion of VAT, along with other, especially corporate taxes, and to the possibilities of fighting such evasion (European Commission, 2012). Procedures considered for limiting VAT evasion are summarised in the so-called Green Paper (European Commission, 2010a), in material from the International VAT Association (2007) or in Barbone, Bird and Vazquez-Caro (2012).

Within the strategy for fighting tax evasion, the EU Commission focuses on the quantification thereof. It aims to determine the so-called VAT gap, representing the difference between the theoretical tax liability and the tax actually collected. When calculating the VAT gap, the theoretical tax liability is defined as the properly applied and paid tax under the effective legislation, as stated by, e.g. the HMRC (2011). This VAT gap includes not only evasion caused by carousel

[2] President's Advisory Panel on Federal Tax Reform (2006, p. 192).

fraud, already mentioned above, but also tax evasion arising within the shadow economy, possibly various errors, as well as unpaid taxes due to insolvency.

However, apart from the size of the VAT gap, it is also necessary to address the factors that affect it. Understanding these effects should contribute to identifying ways of fighting against VAT evasion more efficiently. Therefore, the aim of this paper is to examine variables affecting the VAT gap in the EU countries over the period of 2000 – 2011, using econometric analysis based on recently published data on the VAT gap.

Literature Review

Two studies estimating the VAT gap in the EU Member States have been compiled; Reckon (2009) and CASE (2013). In this material, estimates of the VAT gap for 27 countries for the period from 2000 to 2011 are presented. It was updated by the CASE (2014) and CASE (2015), where the figures for the year 2012 and 2013 were added and estimates of the VAT gaps for 2009 to 2011 were recalculated based on new improved methodology. Furthermore, some EU Member States also regularly publish estimates of the VAT gap, such as the United Kingdom (HMRC, 2011), Sweden (Hansson and Wallberg, 2008), Slovakia (Novysedlák and Palkovičová, 2012), Romania (Romania Fiscal Council, 2011), Germany (Chang, Gebauer and Parsche, 2003, and Parsche, 2008), and Italy (Chiarini, Marzano and Schneider, 2009). Other authors who deal with VAT evasion include, e.g. McManus and Neil (2006). Still others examine the efficiency of the VAT system, e.g. Keen and Lockwood (2006), or several experts within the document by the European Commission (2010a) or International VAT Association (2007).

The dependence of tax evasion on selected factors was pursued by the following authors. Agha and Haughton (1996) conducted their research on 17 OECD countries in 1987 using ordinary least squares (further "OLS") cross-country regression. They calculated their dependent variable (compliance rate) approximately from final consumption of individual goods and services and applicable VAT rates (they did not use the VAT gap in today´s terms). They found that the higher the VAT rate, the lower the degree of compliance with tax obligations. In a similar way, the number of tax rates negatively affects the payment of VAT. Contrariwise, revenues from VAT increase with the length of the operation of VAT in the given country, and smaller countries have lower levels of tax evasion. Christie and Holzner (2006) examined the 25 European countries in the years 2000 to 2003 by means of panel regression using fixed effects. They found that VAT losses increase with a higher weighted average VAT rate, and decrease

with higher legal and judicial efficiency of the given country, as well as with the tax morale of its population, measured by asking the population of its will to increase the powers of local authorities. According to this study, tax evasion also decreases with an increase in the proportion of revenues from tourism to GDP.

Authors of the Reckon study (2009) elaborated on data from 24 EU countries covering the years 2000 to 2006. They used panel regression with random effects and in other models also the instrumental variables as they realised the endogeneity of the explanatory variable VAT burden (expressed as theoretical VAT liability to GDP). They only found a single instance of significant dependence, namely the negative impact of the level of the corruption perception index on the size of the tax gap. Results of the CASE (2013) confirmed that the VAT gap increases with rising unemployment, i.e. during periods of a recession, it grows. Furthermore, it rises with increases in the standard VAT rate, but only in countries with poorer tax collection and lower tax morale. CASE (2013) used their own data on VAT GAP calculated for 27 EU countries in the period from 2000 to 2011. Their methodology was again the panel regression based on fixed effects. They focused on the influence of the business cycle and VAT rate and used number of control variables as for example Corruption Perception Index (further "CPI") that could influence the tax moral and tax enforcement and GDP per capita which could impact the VAT compliance especially due to the difference in the economic development between the old and new member state. Barbone, Bird, and Vázquez-Caro (2012) found a positive correlation between the VAT gap and administrative costs associated with VAT collection in individual European countries using simple correlation analysis. They worked on data for 25 EU countries and the years 2000 to 2006.

D'Agosto, Marigliani and Pisani (2014) studied the factors influencing the VAT gap in Italy in the years 2007 to 2010 in 20 regions. They used panel regression and explanatory variables connected to public administration (as value added in public sector). Activities of revenue agency (e.g. tax assessed during tax audits), social and economic condition of the area (e.g. number of thefts, murders) and finally the spending capacity of households and firms (e.g. amount of bank deposits and energy consumption).

Bodin et al. (2001) explores inter alia the openness of the economy using the share of international trade as the explanatory variable for the VAT revenue ratio (further "VRR"), he also includes standard VAT rate in his models, the difference between standard and reduced VAT rates and the education of the citizens. Aizenman and Jinjarak (2005) studied a panel of 44 countries over 1970 to 1999. Their dependent variable was VRR and their explanatory variables were share of agriculture, share of international trade, GDP per capita, years from the

implementation of VAT, etc. Bird, Martinez-Vazquez and Torgler (2004) focused on the explanation of the tax evasion in the developing countries. They used as explanatory variables mainly institutional and social factors as government effectiveness index or GINI coefficient. Sanack, Velloso and Xing (2010) analysed the dependence of the collection efficiency (so called "C-efficiency") ratio or VRR on selected factors. They explore the impact of economic factors and from those mainly the economic growth. According to these authors, the tax evasion could increase in times of economic recession as individuals and companies shift to shadow economy. The works mentioned in the last sub-paragraph use as dependent variable not the VAT gap but rather VAT system efficiency indicators, as described in, e.g. OECD (2008). These indices compare the VAT actually collected with an ideal tax that would be collected from equal taxation of all consumption by a standard tax rate at one hundred per cent compliance with tax laws. Keen (2013) then decomposes the VRR into the so-called policy gap that arises from the use of reduced rates and exemptions, and the compliance gap, while the latter corresponds exactly to the VAT gap.

In this paper, we shall discuss the impact of selected factors on the VAT gap. We therefore focus on tax evasion within the meaning of non-compliance or direct fraud, as opposed to reductions in VAT revenue due to the tax policy.

The economic and social variables suggested in the literature are used mostly as control variables in this paper. Our priority is to identify the tax policy factors that impact the VAT gap. As those factors can potentially be changed by the policy makers acknowledging the results of our research.

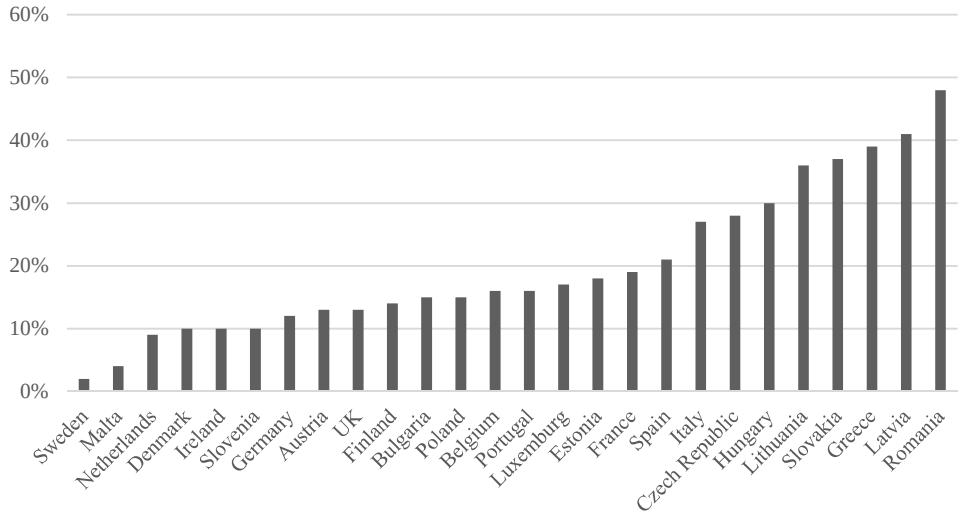
Methods and Data

Analysis of factors affecting the VAT gap in European countries was carried out by means of multiple regression analysis on panel data of 27 EU countries for the years 2000 to 2011. Values of the dependent variable, the relative VAT gap, were taken from the study by the CASE (2013). To give an idea, the following chart summarises the VAT gap values in relative terms across the EU in 2011.

Explanatory variables were chosen based on the results from the cited references and at our own discretion. The factors included economic, tax and institutionally-social variables as listed in the following table. The Table 1 also contains the source from which the data was drawn and reason why they were included in the regression model. Only variables that could influence the VAT gap per the reviewed literature (for more detailed explanation please see directly the relevant sources) or based on our opinion inferred from our knowledge of the VAT system are examined in the model.

F i g u r e 1

Relative VAT Gap in EU Member States in 2011
(Amount of VAT gap/theoretical VAT liability)



Source: CASE (2013).

T a b l e 1

Candidate Explanatory Variables

Variable	Underlying Factor Captured by Variable	Hypothesis of Relationship with VAT Gap	Reason for Including Variable to the Model/ Authors that used this Variable	Source of Data
Economic variables				
GDP per capita	Wealth/Level of development	Decreases	Aizenmann and Jinjarak (2005)	Eurostat (national accounts)
GDP	Size of economy	Decreases	Reckon (2009)	Eurostat
Growth of GDP	Business cycle	Decreases	Sancak, Velloso and Xing (2010), CASE (2013)	Eurostat
Unemployment	Business cycle and income inequality	Increases	CASE (2013)	Eurostat
Final Consumption of Households and NPISH* on GDP	Size of potential VAT base	Increases	CASE (2013), D'Agosto, Marigliani and Pisani (2014)	Eurostat (national accounts)
Final Consumption per capita	Size of potential VAT base and also level of development	Increases with size of tax base/decreases with level of development	Variable expresses the spending capacity of the citizens and is not influenced by the size of population	Eurostat (national accounts)
Government Consumption Expenses on GDP	Size of public sector	Decreases	D'Agosto, Marigliani and Pisani (2014), Reckon (2009)	Eurostat (national accounts)

Household Final Consumption of Restaurants and Hotel Services on Total Consumption	Proxy for effect of tourism	Decreases	Reckon (2009), Christie and Holzner (2006)	Eurostat (national accounts)
Share of Intra-community Trade in Total Imports	Exposure to carousel fraud/Openness of economy	Increases if carousel fraud takes place/ ecreases if impact of openness of economy prevails	Aizenmann and Jinjarak (2005), Bodin et al. (2001)	Eurostat (national accounts)
Value Added in Construction on GDP	Relative size of construction industry	Decreases	Reckon (2009)	Eurostat (national accounts)
Value Added in Agriculture on GDP	Share of agriculture	Increases	Bird, Martinez-Vazquez and Torgler (2004), Aizenmann and Jinjarak (2005)	Eurostat (national accounts)
Tax variables				
Standard VAT Rate	VAT burden	Increases	Agha and Haughton (1996), CASE (2013), Bodin et al. (2001), Reckon (2009)	European Commission (VAT rates in EU)
VAT Revenues on GDP	Tax quota (VAT burden)	Increases	Agha and Haughton (1996)	European Commission (Taxation Trends in EU)
VAT on Total Tax Revenues	Significance of VAT in tax structure	Increases	Variable included as the authors believe that if VAT is a significant source of state budget, the tax authorities might collect it better.	European Commission (Taxation Trends in EU)
Tax Quota (total tax revenue incl. social security) on GDP	Total tax burden	Increases	Aizenmann and Jinjarak (2005)	European Commission (Taxation Trends in EU)
E-filing in VAT Compliance (percentage of VAT returns filed electronically)	Access of tax administrators to on-line data and simplification for VAT payers	Decreases	Extended E-filing could simplify the work of tax administration and tax compliance for the tax payers, so it can reduce the tax evasion or mistakes in tax compliance	OECD (2011)
Number of VAT Rates	Complexity of VAT system/ fiscal policy	Increases due to complexity/ Decreases if impact of more effective taxation of goods with lower demand elasticity prevails	Christie and Holzner (2006)	European Commission (VAT rates in EU)
Difference between Standard and Reduced Rate (if multiple reduced rates, then average thereof)	Tax policy and complexity of VAT system	Increases	Bodin et al. (2001)	European Commission (VAT rates)

Social and other factors				
Share of Tertiary Education	Level of education	Decreases?	More educated society would in the opinion of the authors be less inclined to tax evasion and more able to comply with difficult VAT rules; also Bodin et al. (2001)	Eurostat
GINI Coefficient	Income inequality	Increases	Bird, Martinez-Vazquez, and Torgler (2004), Christie and Holzner (2006)	Eurostat (indicators of life conditions)
Share of Shadow Economy	Significance of shadow economy	Increases	Bird, Martinez-Vazquez, and Torgler (2004)	Schneider (2012)
Perception of Corruption Index	Level of corruption, confidence of people in public sector	Decreases (higher CPI indicates less corruption in country)	Bird, Martinez-Vazquez, and Torgler (2004), Christie and Holzner (2006), Reckon (2009)	Transparency International Report
Membership in EU	Application of harmonized VAT rules	Decreases?	Reckon (2009), CASE (2013)	European Commission, EU Countries

* NPISH – Non-profit institutions serving households.

Source: Own workingsbased on the review of literature.

In the linear regression model, the values of the dependent variable and explanatory variables were entered for all surveyed countries marked with the index *i*, in 12-year time series differentiated by the index *t* and different factors indexed by letter *j*. The model can be expressed using the following equation:

$$RELGAP_{it} = \beta_0 + \beta_{1,j} \times EF_{i,j,t} + \beta_{2,j} \times DF_{i,j,t} + \beta_{3,j} \times SF_{i,j,t} + a_i + u_{it} \qquad (1)$$

where

$RELGAP_{it}$ – VAT gap expressed relative to theoretical tax liability
β_0 – Constant
$\beta_{1,j}$ – Regression coefficient representing effect of explanatory economic factor *EFj*
$\beta_{2,j}$ – Regression coefficient representing effect of explanatory tax factor *DFj*
$\beta_{3,j}$ – Regression coefficient representing effect of explanatory social factor *SFj*
$EF_{i,j,t}$ – Economic factors in *i*-th country in period *t*
$DF_{i,j,t}$ – Tax factors in *i*-th country in period *t*
$SF_{i,j,t}$ – Social factors in *i*-th country in period *t*
a_i – Undetected (random) component constant over time
u_{it} – Random component varying over time.

In the proposed model, regression coefficients were estimated by the method of least squares. Given the fact that the data represented countries, and we thus did not deal with micro-data, according to Wooldridge (2002), it was useful to perform a regression with fixed effects. The appropriateness of fixed effects was verified by the test of an identical intercept and by the Hausmann test.

To identify those variables that have a not-insignificant relationship with the relative VAT gap, we started with the most general model, including all candidate explanatory variables. The variables were gradually omitted from the model, starting with the one with the highest p value. The final model only contained variables significant at the level of 10% or less.

T a b l e 2

Descriptive Statistics of Dependent and Explanatory Variables

Variable	Average	Minimum	Maximum	Standard Error
Relative VAT Gap	0.17	0.00	0.49	0.11
GDP per capita	21,529	1,700	82,100	14,905
GDP	445,067	6,160	2,592,600	640,269
Growth of GDP	0.02	–0.16	0.12	0.04
Unemployment	0.09	0.02	0.22	0.04
Final Consumption of Households and NPISH on GDP	0.57	0.32	0.75	0.08
Final Consumption per capita	15,807	1,500	39,900	9,284
Government Consumption Expenses on GDP	0.45	0.31	0.65	0.06
Household Final Consumption of Restaurants and Hotel Services on Total Consumption	0.08	0.03	0.19	0.04
Share of Intra-community Trade on Total Imports	0.68	0.00	0.83	0.09
Value Added in Construction on GDP	0.06	0.04	0.12	0.02
Value Added in Agriculture on GDP	0.03	0.00	0.15	0.02
Standard VAT Rate	20	15	25	3
VAT Revenues on GDP	0.08	0.04	0.11	0.01
VAT on Total Tax Revenues	0.21	0.13	0.35	0.04
Tax Quota (total tax revenue incl. social security) on GDP	0.37	0.26	0.51	0.06
E-filing in VAT Compliance (percentage of VAT returns filed electronically)	0.32	0.00	1.00	0.36
Number of VAT Rates	2.61	1.00	5.00	0.85
Difference between Standard and Reduced Rate (if multiple reduced rates, then average thereof)	13.4	6.0	25.0	3.6
Share of Tertiary Education	0.20	0.08	0.35	0.07
GINI Coefficient	29.33	22.00	39.20	4.22
Share of Shadow Economy	0.20	0.07	0.38	0.08
Perception of Corruption Index	6.39	2.60	9.90	1.99
Membership in EU	0.85	0.00	1.00	0.36

Source: CASE (2013) and own calculation.

The model was identified by statistical inference, and econometric tests were performed to ascertain whether the error terms were independently and identically distributed. First, the normality of residuals was tested using the Chi-square

goodness-of-fit test. Due to the cross-sectional character of the data, White's test for heteroscedasticity was also carried out. The test for multi-colinearity, analysing the correlation matrix of explanatory variables, was conducted as well. The results of the tests performed are stated in further text as a part of description of our work on final models.

Given that, within the scope of panel data, data for a number of consecutive periods was analysed, the degree to which the time series were stationary was verified via an extended Augmented Dickey-Fuller test (ADF test).

Before presenting the resulting model, we include for the readers' reference the descriptive statistics of the dependent and explanatory variables used in the analysis. Except for the figures on GDP and final consumption, almost all other explanatory variables are expressed in relative terms as a ratio in decimal form. The standard VAT rate is reported as a percentage, and the difference in VAT rates in percentage points. This fact is considered when the results of the analysis are interpreted.

Results and Discussions

Several explanatory variables were not stationary in the time series based on the extended ADF test. Therefore, the initial differences thereof were used in the model. As the data used in the analysis were of an aggregate nature, we started creating our model with the panel regression using the fixed effects. Before the creation of the model we checked the co-linearity of the variables and excluded those inter-dependent. We excluded the variable GDP per capita as it was correlated with the final consumption on inhabitant. We also omitted the tax quota as it was correlated with government consumption and CPI and we had other variables for the VAT burden available for the model. Step by step, we dropped the remaining explanatory variables with p-values lower than 0.10. We checked the normality of residuals by the Chi square goodness-of-fit test, and found out that it was breached (p-value for the null hypothesis of normality was 0,0004), which is why the observations for Malta were excluded from the data set after examining the residuals in the model. The resulting model is shown in Table 3 below, designated as Model 1. Cyprus and Croatia are also not included in the model, since the VAT gap was not calculated for them.

Based on the test on the equal intercepts in the groups that did not reject the null hypothesis (the p-value was 0.94), we found that random effects could also possibly be used in the panel regression. Model 2 in Table 3 represents the best result in panel regression using random effects. The Breusch-Pagan test performed on the Model 2 did not reject the null hypothesis, saying that the variance

of residuals related to observational units is zero, with a p-value of 0.16. This would indicate that a pooled regression could be also used for this data set. With a 0.1 level of significance, the Hausmann test did not reject the null hypothesis (p-value was 0.06) that the GLS coefficients estimated using the random effects are consistent. But the p-value of the Hausmann test was borderline. If we were to use a significance level of 0.05, the hypothesis on the consistency of the coefficients would be rejected, and random effects would not be considered appropriate. Therefore, we also set up Model 3 using the pooled regression. All three models indicated the same direction and a similar magnitude of the effects of individual explanatory variables on the relative VAT gap. A more detailed interpretation of the influence of the statistically significant factors follows below Table 3.

White's test for heteroscedasticity was carried out. As the null hypothesis on homoscedasticity was rejected by p-value 0.14, we used the robust standard errors, which deal with this problem in all the models presented below. The test for multi-colinearity, analysing the correlation matrix of explanatory variables used in final models, was also conducted. In all models presented below, the explanatory variables only correlated to an acceptable level (correlation coefficients were lower than 0.7). Autocorrelation of residuals was tested by Durbin-Watson statistic which was 2.12 for the model with fixed effects and 1.95 for the pooled regression. It is not calculated by the software for the random effects model. The values of Durbin-Watson statistic show that autocorrelation was not the problem in our data. Autoregression dos not come into question in our model as it does not use the value of the dependent variable from the previous year as the explanatory variable.

T a b l e 3

Alternative Regression Models Using Relative VAT Gap as Dependent Variable and Final Explanatory Variables from Data for 25 EU Member States (except Cyprus, Malta and Croatia) for Years 2000 – 2011

Explanatory Variable	Model 1 Coeff. (S.E.)	Model 2 Coeff. (S.E.)	Model 3 Coeff. (S.E.)
	Fixed Effects	Random Effects (GLS)	Pooled Regression (OLS)
Final Consumption on GDP	0.57**(0.17)	0.48**(0.14)	0.48**(0.14)
VAT Revenues on GDP	–8.226**(0.66)	–8.298**(0.36)	–8.298**(0.67)
Difference between Standard and Reduced VAT Rate	0.004**(0.001)	0.003**(0.001)	0.003**(0.001)
Standard VAT Rate	#	0.007**(0.002)	0.007* (0.004)
Adjusted R^2	0.6266		0.6588
Log-Likelihood	625.4	625.6	625.6

* $p < 0.1$; ** $p < 0.05$ in two tailed tests. The analysis file contains 275 observations. # the variable was not significant in the regression. Standard errors are in brackets.

Source: Own calculation.

The resulting models were of a dynamic nature, as they include the initial differences of both dependent and explanatory variables. The fixed effects model and pooled regression model were subject to the F-test, which confirmed that all coefficients were jointly statistically significant at a level of 1% significance. These two models account for more than 60% of the variance of the data. For the model calculated based on random effects, the software used for the panel regression did not calculate the R^2.

The interpretation of the impact of each explanatory variable on the VAT gap must reflect the dynamic nature of the model and the relative expression of the variables (in percentage or decimal form). The variable VAT on revenues exhibits the largest influence on the VAT gap. If the annual change of the share of VAT revenues on GDP increases by one p.p., the annual change of the VAT gap decreases by 8.226, or alternatively 8.298 percentage point (p.p.). If the difference in VAT rates accelerates over time by 1 p.p., it would cause the acceleration of the growth of the VAT gap by 0.4 p.p.[3] Two of the above models[4] also indicate the standard VAT rate as a significant factor, the increase of which causes an increase of the VAT gap. The regression coefficient for the standard VAT rate shows that accelerating the increase in the standard VAT rate by 1 p.p. would result in an accelerated increase of the VAT gap by 0.7 p.p.[5] One of the economic factors also turned out to be statistically significant in the final models. If the annual change in the share of final consumption on GDP increases by 1 p.p., then the change in the relative VAT gap grows by 0.57, or alternatively 0.48 p.p.

Although various economic factors were included in the regression, only the share of final consumption on GDP proved to be a significant variable affecting the VAT gap. This can possibly be explained by the fact that final consumption represents the major part of the theoretical tax base on which VAT is levied. Per the CASE (2014), VAT imposed on household consumption creates 65% of the theoretical VAT liability computed for all member states. It is presumably more difficult to collect VAT from the consumption of final consumers than from the intermediate consumption of industries with a partial right to VAT recovery. This is derived from the fact that sales to end customers can often be in cash, and receipts can be hidden from the financial authorities more easily. On the other hand, one of the most significant sectors that do not recover input VAT in full is the government. Other taxpayers not able to reclaim all their input VAT from

[3] The coefficient was multiplied by 100 to reflect the fact that the difference in VAT rates is expressed in p.p., whereas the relative VAT gap is in decimal form.

[4] The fixed effects model unfortunately does not show the impact of the variables that do not change so much over time (the standard VAT rate could be such a case).

[5] The coefficient is again multiplied by 100 due to the different forms of variables.

the state are, for example, financial institutions, healthcare providers, or educational institutions. The VAT that the suppliers of the government or other partially exempt institutions applied to their outputs is collectable very efficiently, as those supplies are supported by written contracts and payments are made to bank accounts. Household consumption must, in our opinion, be part of the model as it serves as a control variable apparently significant for the level of VAT gap.

Other significant factors yielded by the resulting models of our analysis were the variables characterizing the tax system. The first of the tax variables is the ratio of VAT revenues to total GDP, in other words the VAT quota representing the average VAT burden, and at the same time the significance of VAT as a source of public revenue. The VAT quota has a negative effect on the VAT gap. The other two tax factors, being the standard VAT rate and the difference between the reduced and standard VAT rates, increase the VAT gap. The coefficient estimates for tax variables have the expected sign, except for the negative coefficient identified for VAT on GDP.

According to the theory, the VAT burden should have a positive influence on the VAT gap, due to the hypothesis that a higher tax burden serves as a greater inducement to tax payers to commit tax evasion. However, the above result is not completely contradictory to the findings of previous researchers. The Reckon study (2009) did not find any significant relationship between the VAT burden and the VAT gap. The CASE (2013) pointed out that a positive relationship between the VAT burden and VAT gap can only be found in countries more prone to corruption (with a low CPI). In countries with high CPIs, a higher VAT burden actually reduces the VAT gap. Also, Barbone, Bird, and Vázquez-Caro (2012, p. 51) mentioned that a connection between the tax burden and tax evasion was ascertained in older studies, whereas in more recent studies, "institutional variables capturing the culture and attitudes towards the state have begun to appear. The newer studies suggest that countries with better citizen-state relations tend to have higher tax ratios than those in which unhappy citizens are less prone to fulfil their tax obligations".

Therefore, one explanation for the surprising negative relationship between the ratio of VAT revenues to GDP could possibly be the better compliance of taxpayers who are more satisfied with public services financed from higher VAT revenues that are not misused by politicians in countries with low levels of corruption. Another reason why the VAT quota would reduce the VAT gap could be that VAT revenues depend not only on the level of the tax rates, but also on the size and structure of the tax base. A higher VAT quota could potentially be associated with the more significant role of intermediate consumption of partially

exempted businesses and the government in the VAT base. This could explain the lower VAT gap, due to the more efficient collection of VAT from intermediate consumption, as described above. It would, however, require further research to confirm such hypothesis.

According to our models, the standard VAT rate increases the VAT gap, which was found, for example, by Agha and Haughton (1996), and which is supposed by the tax theory, as indicated above. The reason is that the higher tax burden would probably discourage people from VAT compliance. At a certain level of tax rate, the saved amount of tax would be high enough to outweigh the risk of punishment in the case of detection by a tax audit.

The positive impact of the difference between the VAT rates on the VAT gap was also expected and could be reasoned based on the presumption that a significantly lower reduced rate than the standard rate could tempt taxpayers to misuse the reduced rate. Logically, the higher the difference between the rates is, the higher the gap between the correctly applied standard rate and the wrongly applied reduced rate on the same tax base, regardless of whether this was done intentionally or by mistake.

Conclusion

To sum up, and to provide some recommendations, our analysis revealed that, from the factors chosen, the most important were the characteristics of the VAT system, such as the standard VAT rate and the difference between VAT rates. Countries should therefore focus on increasing their VAT revenues by better collection of VAT, rather than increasing the standard VAT rate. From our models, it can be derived that it is not recommendable to use a reduced rate significantly lower than the standard rate. Taking into account that reduced rates are important tax policy instruments protecting socially weak groups or encouraging certain fields of business, we would recommend implementing them carefully, keeping in mind their impact on VAT evasion.

From the economic factors, the final consumption of households proved significant and serves as control variable for our model to reflect different economic structure and development of various countries. An obscure influence discovered in our analysis was the negative impact of the VAT quota on the VAT gap. The VAT quota effectively combines tax and economic factors, as described above. Policymakers, when deciding on an optimal VAT system, should consider not only the VAT rates, but also the structure of the tax base in terms of the proportion of final consumption of households and intermediate consumption of industries with no input VAT recovery.

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