

# Argomenti di discussione

(Discussion topics)

## THE IMPACT OF DOMESTIC FACTORS AND SPILLOVER EFFECTS ON EU COUNTRIES VAT GAP

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# The impact of domestic factors and spillover effects on EU countries VAT gap

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## Abstract

This paper analyzes the determinants of VAT gap in the EU Member States, focusing on the role of a series of economic, tax morale and tax law factors. The authors, using a panel Dataset of the 28 EU countries observed over the period 2008-2016, after performing a multidimensional descriptive analysis, investigate through a spatial econometric model on the VAT gap determinants and on the presence of the endogenous spill over patterns given by the trade relations. The results are relevant for both theory and empirical methods on tax evasion. From a theoretical point of view is enhanced the traditional idea that tax evasion depends exclusively on individual monetary incentives to evade and on the probability to be audited. From the empirical point of view the traditional panel and spatial-panel approaches have been improved. Another remarkable finding, coming from the results of the econometric model, regards the identification of some spillover effects, arising from a combination of trade factors, which transcend geographical boundaries and which facilitate the spread of evasion through commercial channels. Overcoming the classic counterpoint between the southern and northern countries or between more or less wealthy countries this evidence is an innovative key to understanding the presence of the VAT gap beside the traditional economic and social features of each country.

## Sommario

In quest'articolo gli autori analizzano le determinanti del tax gap IVA negli Stati membri dell'Unione Europea focalizzando l'analisi sul ruolo di una serie di fattori economici, di *tax morale* e di legislazione fiscale interna. A tal fine essi utilizzano un Dataset panel che raccoglie variabili relative ai 28 Paesi UE osservati nel periodo 2008-2016. Dopo aver effettuato un'analisi descrittiva multidimensionale, gli autori ricorrono ad un modello econometrico *spatial-panel* per individuare le determinanti del gap IVA nei paesi membri e per verificare la presenza di effetti di *spill over* endogeno generati dalle relazioni commerciali che esistono tra i diversi Paesi. I risultati ottenuti sono rilevanti sia dal punto di vista teorico che da quello dei metodi empirici di studio dell'evasione fiscale. Per quanto riguarda l'aspetto teorico, infatti, si supera l'idea tradizionale secondo cui le scelte di attuare fenomeni evasivi dipendono esclusivamente dagli incentivi monetari ad evadere e dalla percezione del

rischio di poter essere individuati dall'autorità fiscale, in quanto emergono altri fattori che sembrano far aumentare la propensione ad evadere. Dal punto di vista empirico si sperimenta un approccio alternativo, basato su un modello di econometria spaziale, quindi differente da quelli tradizionali di tipo panel. I risultati ottenuti dalle stime econometriche mostrano come la "classica" contrapposizione tra paesi del nord e del sud (o tra paesi più o meno ricchi) sia in realtà molto più sfumata rispetto a quanto ci si potesse aspettare e, aspetto forse più interessante, sembra emergere come chiave di lettura della diffusione del gap IVA, l'insorgere di effetti di spill-over legati ai flussi commerciali, che trascendono i confini geografici e che ne facilitano la diffusione, evidenziando quindi la presenza di fattori endogeni ed esogeni ai singoli paesi, oltre ai consueti fattori di contesto socio-economico.

**JEL classification** C23; H20; H26; H30

**Keywords:** EU Member States; Determinants of VAT gap; Spatial Econometrics; Gap spill over effects

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# Introduction<sup>1</sup>

All the countries of the European Union rely on taxes as a fundamental source of income, so as to be able to bear the operating costs of the government apparatus and ensure the provision of services (health, education) to citizens. Despite this, the phenomenon of tax evasion is widespread, although in a heterogeneous manner, in almost all world countries. The “tax gaps” research focuses primarily on a country’s shadow economy and illegal employment (Schneider & Enste, 2013; Schneider et al., 2015).

Among the different types of taxes, VAT has been receiving special attention by European institutions and its members both due to its relevance to the total revenue of each country and because its tax base is a source for the EU budget.

In order to measure the extent of the loss of revenue, we use the size of the VAT compliance gap (hereinafter VAT gap), which is the difference between expected VAT revenues, according to the existing fiscal legislation, and the actually collected VAT. It provides an estimate of revenue loss due to tax fraud, tax evasion and tax avoidance, but also due to both fraudulent and liquidity crises bankruptcies, financial insolvencies or miscalculations. Referring to other authors for the calculation methodology<sup>2</sup>, the VAT gap is estimated annually with a homogeneous methodology for all European Union countries<sup>3</sup>, and this makes it possible to analyze the different determinants that influence this phenomenon in each geographical area.

As the European Union is made up of a wide range of different countries, each with its own structural characteristics in territorial, demographic, social and economic terms, it is really hard to try to analyze the common determinants of tax evasion, given the enormous differences that exist between such diverse countries.

In spite of this, by investigating the data of the 28 (the data refer to the period before the exit of the United Kingdom from the Union) countries that constitute the EU, it is possible to draw up a summary picture of the scenario under examination and therefore try to evaluate some effects, above all of an economic nature, deriving from the composition of the internal economies of the various countries and their structural characteristics.

The objective is, therefore, to identify the socio-economic variables capable of explaining VAT evasion, thereby contributing to the debate on what are the levers on which governments can,

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<sup>1</sup>We would like to thank very much the anonymous referee for his comments. They really helped us to improve the quality of our paper. We really believe our new manuscript is much better than the original one.

<sup>2</sup> See Pisani (2014) and European Union, European Commission (2016)

<sup>3</sup> See CASE (2013-2016).

consequently, act to reduce its entity.

In the following pages, therefore, after a brief overview of the existing literature and the various empirical attempts carried out by researchers and experts with the aim of outlining the salient features of evasion, the data used in this paper will be described, then continuing with the modeling of the relationship, measured by an econometric model, between the VAT gap and a set of economic and demographic variables, ending up by drawing some conclusions.

## **1. A brief review of the theoretical and empirical contributions to VAT gap**

Scholars have been focusing their attention on tax evasion and its effects for a long time. The seminal contribution that highlighted its economic mechanisms is owed to Allingham and Sandmo (1972), referring to personal income tax, which adopts a portfolio approach to decide the amount of tax evasion. This is basically a deterrence model based on the assumption that the higher the penalty rate or the tax audit probability, the lower the amount of taxes evaded. This so-called tax compliance, or evasion, ‘standard model’, has been subjected to widespread empirical testing and challenge – the latter, mainly with respect to its apparently counter-intuitive and controversial prediction that evasion could be decreasing in the tax rate (the sign of the relationship depending on the individual risk aversion). Additionally, the literature has given little consideration to how the predictions of the model are affected where the evaded income can be identified but the associated tax and penalties cannot be fully enforced.

Later, much research was developed, but limited attention was devoted to the analysis of indirect taxation in particular. Marrelli (1984) was the first contribution which focused on ad-valorem tax in a monopolistic environment. The author analyses the compliance choices of a firm under-reporting revenue and concludes that key variables for this decision are the level of production (which affects the shift of the tax) and the amount such that the decision to evade is convenient. The interdependence of these two choices depends on the probability of being detected. If the probability is exogenous, the tax shifting and the decision to evade tax are separable: evasion does not affect the amount of taxes shifted, firms may evade taxes and then shift to the final consumers as if they had not evaded. This result does not apply if the detection probability is a function of reported tax as the equilibrium value of the production will depend on this probability. Furthermore, the production will be smaller or larger than that which it would produce in the absence of evasion

(or in case of exogenous probability) depending on whether the probability of being detected is increasing or decreasing to reported revenue. If decreasing, the firm would produce and report more than in case of constant probability (thus, this rule is efficient). In a later paper, Marrelli and Martina (1988) addressed their analysis to the relationship between production decisions and compliance within an oligopolistic market by examining various taxes including indirect ones. The authors find that the amount of production is not affected by the decision on reporting revenue, but the reverse nexus does not work. Therefore, there exists a weaker separability condition in case of exogenous probability. This means that collusion implies higher evasion only if it leads to higher profits: however, authors are not conclusive about this link. If the market share of each firm is quite homogenous within the industry, an increasing degree of collusion leads to an increase in tax evasion regardless of the type of tax considered. In case of detection probability function of reported taxable base, once again, the authors state that the firm economic decisions are not independent. If detection probability decreases with increasing reported taxable base, this will lead to a lower evasion and lower tax shifting. The authors focus their attention on a system of international trade relationships by stressing that the influence of trade partners on tax-evasion behaviors must to be taken into account in an empirical analytic model.

Other authors have dealt with the international trade with reference to VAT evasion (Liu and other 2016; Balafoutas 2015). In these papers, for individual countries, the evidence that strong exporting production systems are more able to evade VAT emerges. As many production firms use intermediary trading firms to export indirectly, using Chinese export data, Liu provides strong evidence that production firms can effectively evade VAT by exporting through intermediary trading firms, especially when selling differentiated products. Indirect exporting can save export taxes by 14.5% compared to direct exporting even if no intentional price under-reporting occurs, and even more when domestic purchasing price paid by a trading firm to a production firm is under-reported purposely. The author also finds that such under-reporting behavior through domestic intermediaries may be associated with cross-border evasion through under-reporting export values to foreign partners.

One interesting factor to be investigated, due to its inconsistent results in previous works, is the relationship between effective tax rates and firm size. There are studies that state that larger firms avoid taxes more compared to smaller firms, in line with the political power theory. Also, there are studies that indicate the opposite, that is larger firms avoid taxes less, in line with the political cost theory.

As to Italy, whose economy has a low R&D intensity, firms are smaller and less likely to grow or exit than firms in other advanced countries and the shadow economy is large. Bobbio (2016) shows



how these features arise simultaneously in a Schumpeterian growth model with heterogeneous firms where the tax auditing probability increases with firm size. Tax evasion confers a cost advantage over competitors. In equilibrium, small firms invest less in innovation because growing entails a (shadow) cost of fiscal regularization. Another statement about Italy (but also applying to Denmark and UK), which has a production system with a high proportion of small firms and self-employed professionals, from Carfora et al. (2018) and Kleven et al. (2010) points out that tax-evading chances are clearly higher for taxpayers who self-certify their income (i.e. the self-employed) than those whose income is reported by a third party (i.e. employees).

Virmani (1989) analyses evasion in a competitive industrial framework. First, the author considers a link between tax evasion and efficiency in case of a sales tax. Mainly, these taxes affect consumption decisions and also those concerning production if goods are used in the production process and a credit mechanism in the value added chain is not taken into account. In the presence of evasion, firms produce at a lower level than the minimum efficient scale. This result is robust to various assumptions on detection probability function and affects the optimal tax rate for goods in the presence of evasion. In particular, this entails the hypothesis of burdening with low tax rates those industries with a relatively small scale of production if their firms evade; an extreme case would be to exempt from taxation those with very low scale. The second issue analyzed concerns the relationship between tax rates and evasion. The author derives conditions under which a single tax rate, instead of two, is a threshold for the firm, below they pay taxes and the possibility of evasion may be ignored. Higher rates may lead to a lower revenue, determining an effect similar to Laffer curve.

Yaniv (1995) shows an interesting synthesis of the previous studies, suggesting a general model of tax evasion (considering both underreporting revenue and over reporting costs) applicable to any type of tax. He states that the production choices of risk-averse firms are independent of their tax compliance decisions. The separability is also confirmed in case of endogenous probability of detection (i.e. depending on misreporting), even if it is not in case of uncertainty and an increase in the tax rate will always increase tax evasion under the assumption of decreasing absolute risk aversion (as in the Allingham and Sandmo 1972 model).

From what was mentioned above, the theoretical literature has tried to underline which consequences cause the tax sales non-compliance to the economic system.

In the last 10/15 years, on the other hand, the approach through the MIMIC ("Multiple Indicator Multiple Cause") models has prevailed, namely a kind of analysis borrowed from psychometrics, but which begins to have interesting applications also in econometrics; this approach tends to bring out the latent variables, following the approach of Zellner (1970) and Goldberger (1972) and the

objective is to estimate the size and causes of the underground economy or of the VAT gap in various countries<sup>4</sup>.

The MIMIC approach has been used to highlight the relationship between the cause, the indicator variables, and the latent variables, that is, the underground economy, starting from macroeconomic variables in different countries.

The relative value of the MIMIC approach is that it allows to focus on the connection which exists between the "formal" economy, that is, the measured economy, and the underground economy, and various contributions in this way show how this type of approach can make it possible to distinguish between short-term and long-term relations<sup>5</sup>. In particular, using a MIMIC approach, Schneider F., Buehn A. (2012) focus on the "driving forces" of the growth and size of the shadow economy: these forces seem to derive from fiscal policies and state regulation, which, as they grow, seem to have an effect by increasing the shadow economy, just as an active role is played by unemployment, self-employment and the size of the tax burden. The authors show that, looking at the average relative impact of the causal variables on the shadow economy across the 39 OECD-countries between 1999 and 2010, it turns out that indirect taxes have by far the largest relative impact (29.4%), followed by self-employment (22.2%), unemployment (16.9%), personal income taxes (13.1%) and finally tax morale (9.5%). Schneider F., Medina L. (2018) estimate shadow economy for 158 countries all over the world and find the average size over 1991 to 2015 is 31.9 % of GDP; the authors stated that the new methods, especially the new macro method, Currency Demand Approach (CDA) and Multiple Indicators Multiple Causes (MIMIC) in a structured hybrid-model based estimation procedure, are promising approaches from an econometric standpoint, alongside some new micro estimates. These estimations come quite close to others used by statistical offices or based on surveys.

Since there is a strong logical relationship between the tax gap and the underground economy, as a large part of VAT evasion is generated by the latter, the MIMIC approach could serve to highlight potential variables explaining the VAT gap in some EU Member States.

Zídková (2014), by means of a regression model panel on 24 EU countries observed in two years (2002 and 2006, for which data on the VAT gap were available) highlights two common factors for both years examined, which affect the VAT tax gap in the countries surveyed, namely a positive effect on the VAT gap by final consumption of households and non-profit organizations in each country and a negative effect of the VAT share in GDP. There are also other variables that would explain the size of the VAT gap: the share of the shadow economy and the standard VAT rate

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<sup>4</sup> See Breusch (2005).

<sup>5</sup> See Trebicka (2014).

increasing it, while GDP per capita, the share in intra-Community trade, final consumption of restaurant and hotel services and the number of VAT rates, all of which have a negative impact on the VAT gap.

Other contributions in the literature analyze the links between the fiscal gap and pension revenues<sup>6</sup>, investigating whether the pension revenues can give a certain compensation to the fiscal gaps estimated for different Countries (given that the tax revenues from pensions are supposed to be constant with respect to the GDP in the estimate of the gap, while it is believed that they can have an increasing share in time), thereby opening a line of research about the projection of these effects in the future.

Those analyses that study the role of the social aspects connected to the phenomenon of tax evasion are also interesting. For example, Kirchler (1997) and Feld, Togler and Dong (2008) stressed that a positive tax mentality and tax morale have a negative effect on tax evasion. Dell'Anno (2009) reports that tax morale is dependent on the taxpayer's intrinsic attitudes toward honesty and social stigma.

The relationship between family ties and tax evasion falls in the same field of research; indeed, it seems that in societies where family power is very high, the quality of public institutions tends to be low and this connection shapes the behavior of taxpayers and generates the shadow economy<sup>7</sup>.

Steinmo (2018) argues that States most successful in generating high levels of compliance are those which develop strong administrative capacities, treat taxpayers equitably, generate a common sense of purpose or identity and do not discriminate in favor or against specific segments of society.

D'Attoma (2016) points out that the different performances in the compliance between North and South Italy are due to the different historical paths of the two areas starting from unification; in particular, he underlines the influence on the moral tax of the two macro-regions of the main public institutions (State, Church and political parties) and of the different forms of patronage connected to them.

In other studies<sup>8</sup>, the analysis of VAT in Italy can also be traced back to a regional scale, showing that the territorial distribution of the VAT gap is positively correlated with the economic conditions (wealth), the economic cycle and the tax morale of the geographical area, while the deterrent effect exerted by the Italian Revenue Agency (IRA) is significant.

In the literature, the effect of both variables, namely economic well-being and control activity, is controversial. As to the former, Crane and Nouzard (1990) and Becker et al (1987) find a positive

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<sup>6</sup> Auerbach et al. (2015).

<sup>7</sup> Econometric modelling based on linear panel data shows that countries with stronger family ties also show a higher shadow economy. See Marè et al. (2014).

<sup>8</sup> D'Agosto E., Marigliani M., Pisani S. (2014).

relationship between income level and tax evasion; on the contrary, Dubin et al (1990) conclude that there is a strong relationship between real income and reported taxes per return. For the latter, Alm et al (1992) stress that an increase in tax audit leads to decrease in tax evasion; on the contrary, Gemmell and Ratto (2012) conclude that audited taxpayers have reduced subsequent compliance.

About regional conditioning, a survey conducted on USA small businesses by IRS shows that low-compliance communities appear to exhibit a stronger association with local institutions than national ones such as the federal government. Moreover, they discovered that taxpayers with high compliance are not concentrated in homogeneous communities, at least not very many of them. Taxpayers in the low-compliance communities appeared in more concentrated geographic clusters across the country, especially in the South and West of USA; so, there is a local reinforcement by the own community in not trusting fiscal administration and in not following compliance behavior.

The debate on the relationship between business cycle and tax gap is widespread and unresolved (e.g., Chiarini et al., 2008; Giles, 1999). By using time series of the Italian VAT base gap for the 1980-2004 period and distinguishing the apparent tax burden (revenues-GDP ratio) from the effective tax burden (revenues-net GDP ratio), the two tax rates show a systematic and persistent gap, with the effective tax rate higher than the apparent one. The statistical properties of this gap clarify that it fluctuates around a fixed value of about 11%, with short-term effects due to exogenous disturbances. This might suggest that taxpayers adopt a strategy of tax evasion aiming to maintain this equilibrium gap, whose size might be related to risk aversion issues, a strategy supported by their estimated model elasticity and dynamic coefficients. Furthermore, the estimated model provides quantitative results about the cross-elasticity between tax evasion and average fiscal pressure. In equilibrium, a percentage increase in tax evasion brings the apparent tax rate up by 0.3% whereas the latter raises the long-run tax evasion by 0.48 %: each variable Granger-causes the other. Moreover, the estimated long-run parameters imply a quick adjustment to equilibrium. This again suggests the existence of a long-run strategy by taxpayers. Whenever a new reform or a tool comes into the system and generates disequilibrium, this is rapidly learned by the evaders and removed. This result confirms that there is an underlying process (behavior) explaining tax evasion in Italy, which is invariant through decades, generations and governments. Finally, despite the fact that tax evasion is an endemic features of the Italian economy, there is no evidence of any vicious circle with fiscal pressure, since the dynamic interaction between these two variables always converges to a stable equilibrium. Both variables are driven by a unique stochastic trend and average fiscal pressure emerges as the long-run trend driving tax evasion.

Some papers have stressed that an increase in the tax rate will result in an increase in the propensity for tax evasion (Clotfelter, 1983; Alm, Jackson and Mc Kee, 1992; Pommerehne and Hannelore,

1996). In Italy, D'Agosto and Santoro A. (2019), by disaggregating policy and compliance gaps by rates, show that the two increases in standard rates in Italy have augmented the standard rate compliance gap as well as the intermediate rate policy gap. After these changes, the share of VAT inefficiency which can be attributed to the application of the standard rate has increased, and this peculiar result is due to the fact that the propensity to evade is higher for transactions taxed at the standard rate.

About payments, Immordino and Russo (2018), using European data, find empirical evidence supporting the claim that cashless payments hinder tax evasion because they build a trail for the underlying transactions: so, credit and debit card payments are negatively related to VAT evasion. They also show that using electronic cards to withdraw cash at ATMs, by making cash more abundant, fosters VAT evasion.

**Table 1.1 Main Explanatory Variables for Tax Gap in literature.**

Variable	HP of relationship with VAT Gap	Author
Activity of control	Negative	Alm, IRA
Audit probability	Negative	Allingham /Sandmo, Marrelli , Virmani
Cash use	Positive	Immordino/Russo
Business Cycle	Not clear	Chiarini, Giles, Schneider
Family ties	Positive	IRS; Marè
Final consumption	Positive	Zidkova
Firm size	Negative	Basso
Fiscal policy	Positive	Schneider
Income level	Not clear	Crane and Nouzard, Becker, Dubin
IT expenditure	Negative	Case
Number of vat rates	Negative	Zidkova
Penalty	Negative	Allingham /Sandmo
Production level	Not clear	Marrelli, Virmani Yaniv
Regulations	Positive	Schneider
Risk adersion	Negative	Yaniv
Self-employment	Positive	Carfora, Kleven, Schneider,
Shadow economy	Positive	Schneider, Zidkova, Mimic
Tax burden	Positive	Schneider
Tax morale	Negative	Kirchler, Feld et al., Steinmo, D'Attoma, IRA
Tax rate	Not clear (the relationship varies according to the country)	Alm, Clotfelter ,Chiarini, Case, Virmani, Yaniv, Zidkova, D'Agosto/Santoro, Pommerehne and Hannelore
Trade partners/export	Positive	Marrelli , Liu, Balafoutas
Unemployment	Positive	Schneider, Case
Vat/gdp	Negative	Zidkova

In their econometric analysis CASE (2019) observe that the dispersion of tax rates and unemployment rate have a positive impact on the VAT Gap. Regarding the variables in the hands of the administration, their results suggest that the nature of the expenditure of the administration, in particular IT expenditure, is more important than the amount of the overall resources.

The literature review has highlighted the many variables that can influence the VAT gap. In order to provide a summary view, table 1.1 lists the variables identified by the various authors with an indication of the sign of correlation with VAT gap.

## 2. Data analysis

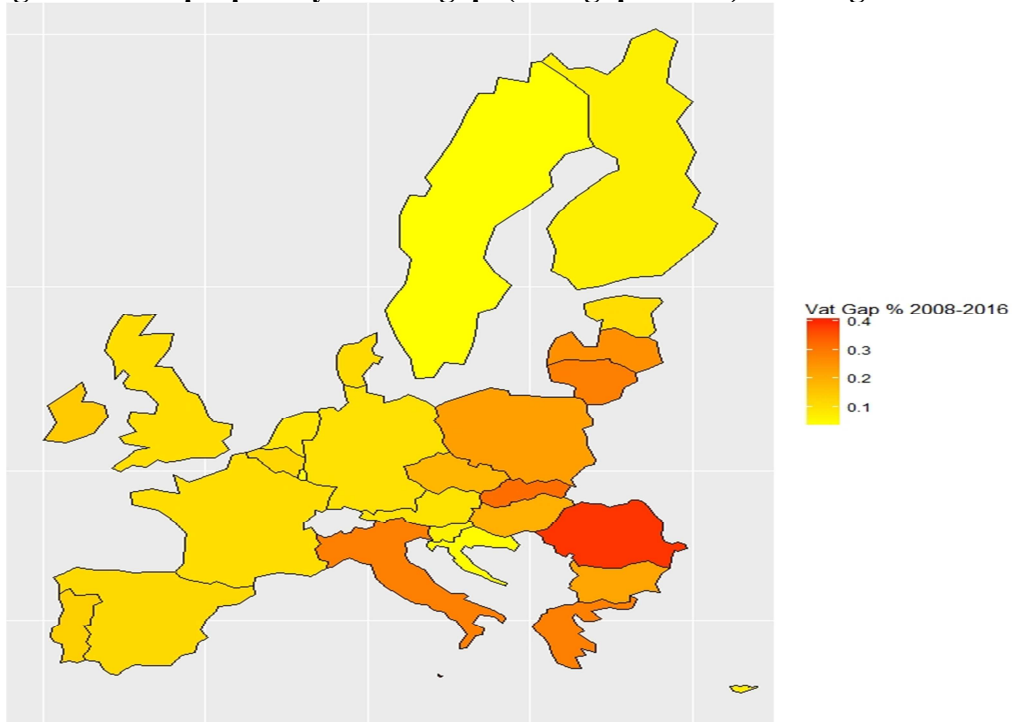
The target variable is the VAT gap as calculated annually by the Center for Social and Economic Research (CASE) society, on behalf of the European Union, for the 2013-2016 period. CASE is an independent, non-profit organization that estimates VAT gap by “top-down” method. It is a deterministic method in which national account figures are used to estimate the VAT liability generated by different sub-aggregates of the total economy. It is derived by the sum of the liability from six main components: household, government and NPISH final consumption, intermediate consumption, GFCF and other, largely country-specific, adjustments (CASE 2019).

We define the expected VAT revenues, according to the existing fiscal legislation, as theoretical VAT (VAT Total Tax Liability, VTTL)<sup>9</sup>. In order to focus our attention on the taxpayers' behavior, we analyze the propensity to the VAT gap (VAT gap %) obtained as the ratio between VAT gap and VTTL. This figure is not affected by the different dimension of the economic systems included in the European Union and approximates the ability of taxpayers to evade VAT. Moreover this indicator avoids the mechanical correlation with the variables used as regressors. In figure 2.1 we present a chart showing the average propensity to VAT gap for the EU countries over the 2008-2016 period. At European level, it is about 15.2% and the countries' distribution shows great dispersion around the average. Such variability between the Member States reflects the existing differences in terms of tax evasion, fraud, avoidance, bankruptcies and insolvencies. The analysis of the literature presented in the previous paragraph shows that the significant differences between the EU countries could be due to multiple causes: cultural, structural or due to the performance of the tax administration.

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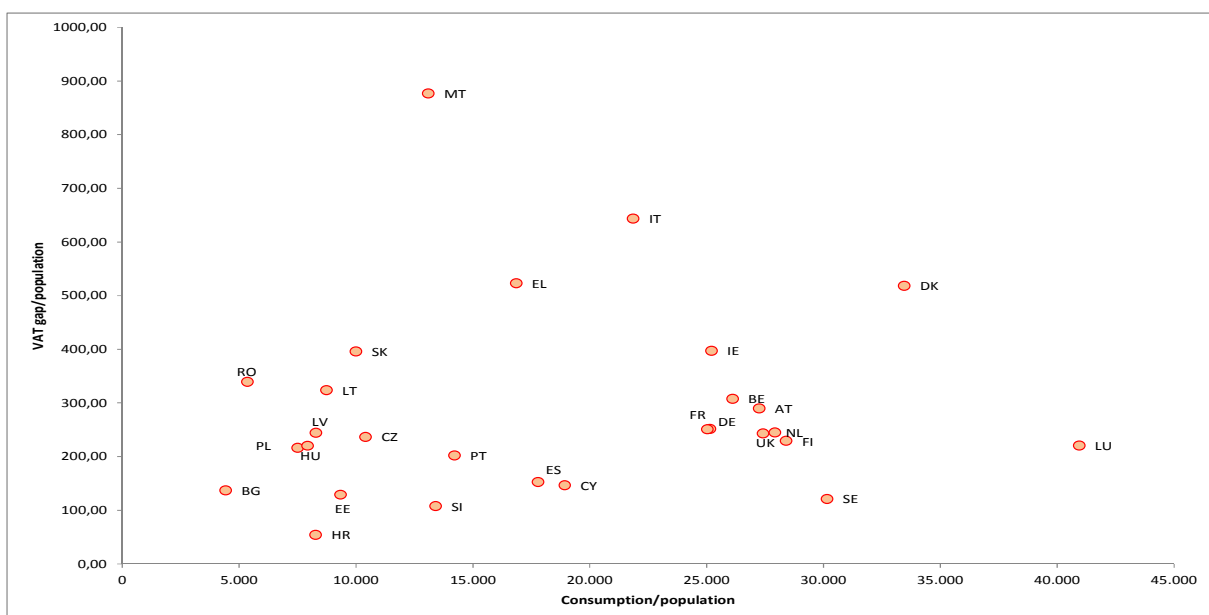
<sup>9</sup> European Union (2016a), p. 14.

**Figure 2.1 UE propensity to VAT gap (VAT gap/VTTL) – average 2008-2016.**



In order to verify whether the VAT gap is related with the per capita income, we report in Figure 2.2 the VAT gap per capita and the consumption per capita, as a proxy of the permanent income. The average values (2008-2016) show that there is no clear univocal relationship between the two quantities for all the countries considered (correlation index (0.09) is very close to 0).

**Figure 2.2 UE countries VAT gap and CONSUMPTION per capita – average 2008-2016.**



What emerges from this introductory analysis is that some countries have a high per capita value for both indicators (Malta, Italy, Denmark, Greece), while others have high per capita VAT gap values against relatively smaller values of consumption per inhabitant (Croatia, Bulgaria, Estonia) and others are in the opposite position, i.e. low VAT gap per inhabitant and high per capita consumption per capita (Sweden, Luxembourg).

By definition, VAT is a consumption tax charged on goods and services traded for use of consumption. The practical application of the general rule is much more complex because it suffers from considerable exceptions such as the exemption of certain categories of goods, the introduction of turnover thresholds below which taxpayers do not have to pay VAT, the existence of differentiated VAT rates, etc. These exceptions are the result of political choices made to take account of national specificities and differ between Member States. In the literature, it is proposed to calculate the policy gap, that is the difference between the actual VAT revenues and the theoretical VAT that would be collected if the country imposed a standard VAT rate on all the consumption<sup>10</sup>, to summarize these differences.

The final consumption of national accounts includes the part of transactions hidden from the tax authorities. If the standard rate in force in each country is applied to the latter, an estimate of the potential VAT that would be collected if the country imposed a standard VAT rate on all the consumption is obtained (PVATp). Moreover, given that, in order to calculate the VAT gap it is necessary to estimate the potential VAT, VTTL, the VAT that would be collected in a system of perfect compliance according to legislation in force; if you compare VTTL with PVATp you can get a proxy of how much the policy gap weighs in each Member State. A regression plot between VTTL and PVATp is reported in figure 2.3. If the policy gap had the same influence in all countries considered, then all Member States should be on the same regression line.

CASE (2019) underlines that policy gap and VAT compliance are not independent elements, in fact the presence of reduced VAT regime, exemptions or thresholds of the VAT, make tax compliance more difficult for the presence of greater legislative complications and increase the effort to determine the exact VAT liability.

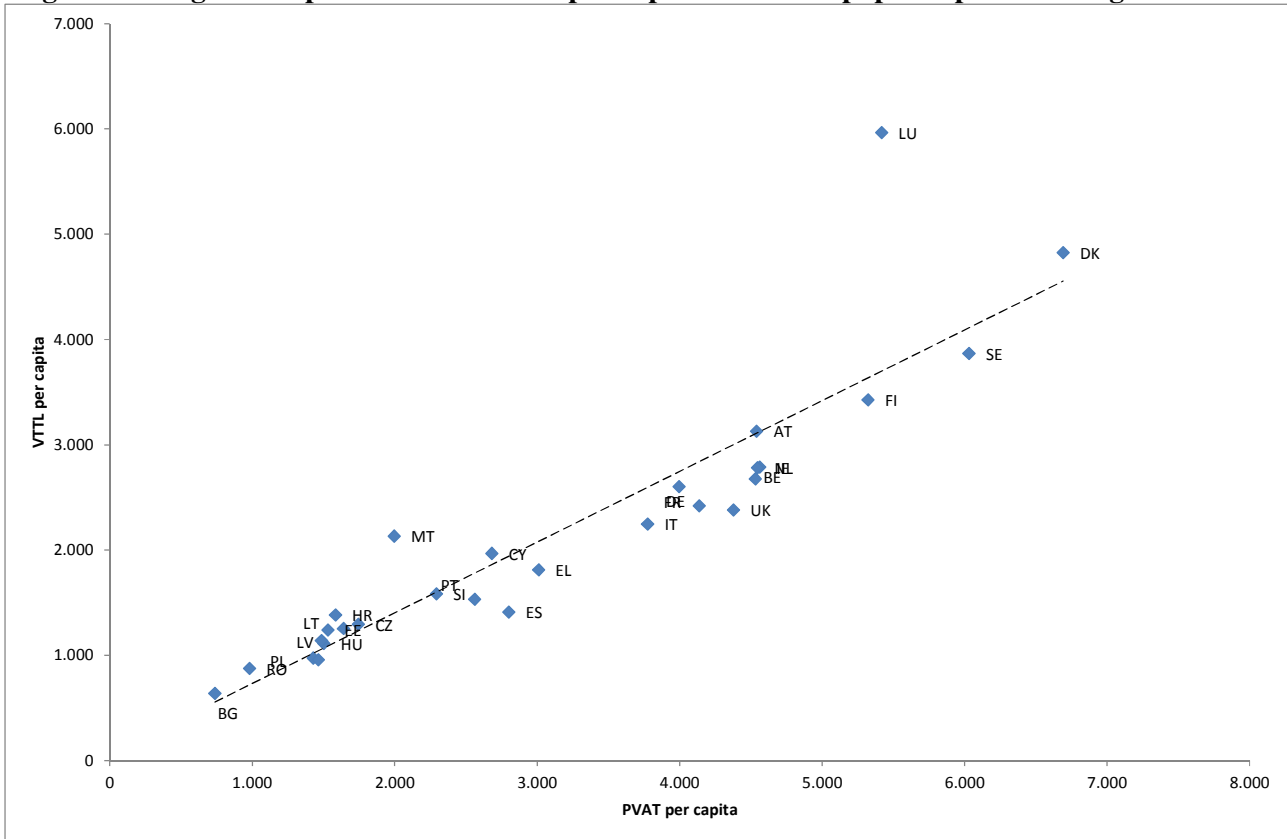
Indeed, the figure shows that there are significant differences between countries, but these do not seem to correlate with the size of the VAT gap. The case of Luxembourg, Denmark and Malta, which are significantly above the regression line despite being characterized by a significantly different VAT gap propensity, respectively 3.0%; 10.5% and 34.9% (average 2008-2016), is emblematic.

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<sup>10</sup> For more information see D'Agosto, Santoro (2019).



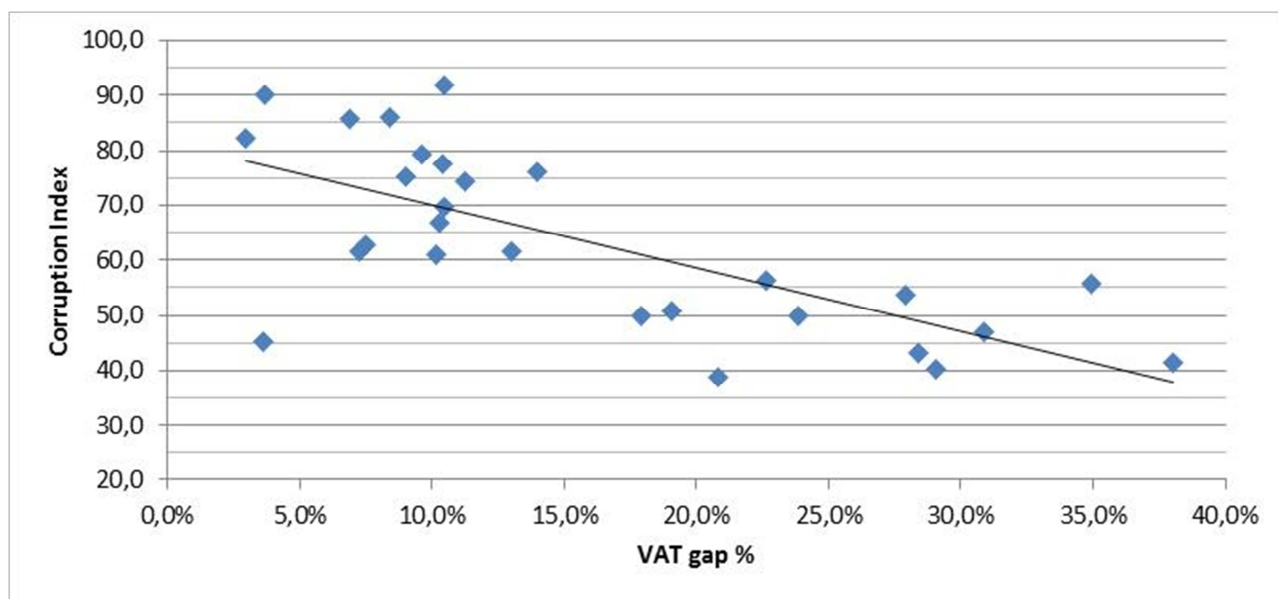
**Figure 2.3 Regression plot between VTTL per capita and PVATp per capita – average 2008-2016**



The review of the literature, see par. 1, has shown that some scholars have identified tax morale as one of the factors that can influence the VAT gap. In this way in order to give a measure of the feelings about local dishonesty in each country the Corruption Perception Index (CPI) can be used. This is a statistical indicator published by Transparency International, since 1995, on an annual basis. It is used to create a ranking of countries in the world ordered by "their levels of perceived corruption, as determined by expert evaluations and opinion polls". The organization defines corruption as "abuse of public office for private gain". The Corruption Perception Index currently ranks 176 countries "on a scale ranging from 100 (not at all corrupt) to 0 (highly corrupt). In the 2016 report, 69% of the 176 countries surveyed in the Perception Index of Corruption in the Public and Political Sector scored less than 50, showing that "corruption in the public sector and in politics is still perceived as one of the worst evils infecting the world" (Transparency International).

Regression plot between Transparency International Corruption index and VAT gap % is showed in figure 2.4. The graph demonstrates the possible presence of a negative correlation between the two aggregates. From a descriptive point of view, therefore, it can be observed that countries with a lower rate of corruption also have a lower VAT gap %.

**Figure 2.4 Regression plot between Transparency International Corruption index and VAT gap % (average 2008 - 2016)**



In order to catch as much as possible the circumstances that influence the difference in the propensity to VAT gap, we adopt a panel econometric study, see par. 4, based on the following explanatory variables, that can be grouped in five clusters<sup>11</sup>:

- 1) macroeconomic indicators such as GDP (expressed both at current and constant prices), an index price (understood as the implicit deflator of GDP), imports and exports (both within and outside the EU), the total level of taxes collected, the average VAT rates, household consumption (expressed at current and constant prices) and the currency (monetary aggregate M1);
- 2) socio-economic-demographic variables, such as the resident population, the total number of employees, the total number of self-employed, the total number of enterprises with the specification of the small and medium-sized ones (i.e. those with less than 50 employees);
- 3) tax enforcement indicators such as the number of employees of the tax agency of each country, the available budget of tax agencies;
- 4) tax morale indices such as the Corruption Perception Index (PCI, which measures the level of perception of corruption within a system-country by its citizens) and corruption perception index published by Transparency International;

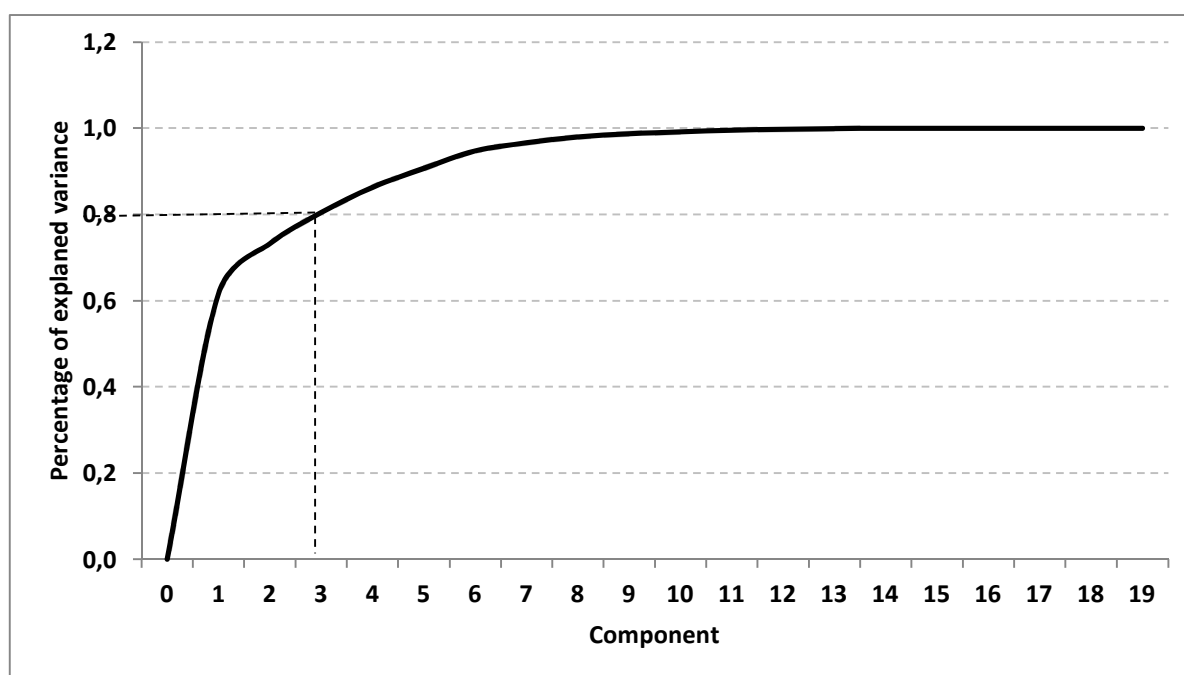
<sup>11</sup>The variables and the data sources are listed in the Statistical Annex.

5) the electronic money diffusion calculated as the share of payments for commercial transactions carried out by means of e-money.

Before proceeding with the econometric estimates, a descriptive analysis was carried out in order to summarize the main characteristics that contribute to explaining the heterogeneity of the propensity to VAT gap between the different EU Member States. In order to summarize the information, Principal Components Analysis (PCA) has been carried out based on the average values recorded by the variables in the period 2008-2016 (see table A.2 of the Statistical Annex).

The results of the PCA show that the first three Principal Components (PC) extracted explain about 80% of the total variability of the data under investigation (see figure 2.5), and therefore provide a representative summary of the 19 variables considered in Table A.1 (20 variables, minus VAT gap, which is the dependent variable of the analysis)<sup>12</sup>.

**Figure 2.5: Total variance explained and number of components**



The first component is positively correlated with all the monetary quantities and negatively correlated with the dimensionless ones, such as the deflators and the VAT percentage rates; moreover, a negative sign also appears in correspondence of the monetary aggregate used in the study (the currency variable), therefore the first PC can be defined as a summary of the state of the “monetary economy” of the various countries, with relatively higher correlation coefficients in

<sup>12</sup> The matrix of the weights of the first three principal components is shown in the table A.5, and in table A.3 it is possible to find a correlation matrix between each variable.

correspondence with the most important dimensional variables.

The second PC shows a negative sign with most of the economic variables now described, in particular those relating to the degree of commercial opening from and to abroad, both within and outside the EU; it would seem to be a synthetic index linked more to taxation, since the PC shows a positive relationship with the VAT gap and with the average VAT rate of the individual EU countries, as well as with the budget dedicated to fiscal agencies.

The third component, on the other hand, shows positive signs in terms of correlation with all the variables of import-export, with those relating to fiscal agencies, the average VAT rate and commercial transactions carried out with electronic money, so it seems to be an index of synthesis of the degree of openness to extra domestic trade of the countries considered.

In order to graphically represent the three components, two components were represented at a time on some Cartesian diagrams, the first of which was always on the horizontal axis.

The projection on a plane, obtained using PC1 and PC2, shows that the country points tend to lie along a clear decreasing line indicating that the latent variables captured by the first two components show a negative correlation, as can be seen from the results shown in tables A.6 and figure 2.6.

Indeed, from the Cartesian diagram it can be seen how the points are distributed almost perfectly along a decreasing line, even if this diagonal is slightly decentralized upwards with respect to the origin of the axes.

The "strong" countries in economic terms are almost all concentrated in the first quadrant, whereas other countries like Lithuania, Czech Republic, Latvia and Cyprus are located in the fourth quadrant.

Some exceptions are Luxembourg, the only country to be placed in the third quadrant (i.e. with a negative correlation with both identified PCs) and, secondly, Malta, which appears in the second quadrant. Italy is located in the first quadrant, with a moderate positive correlation with the first and second PCs.

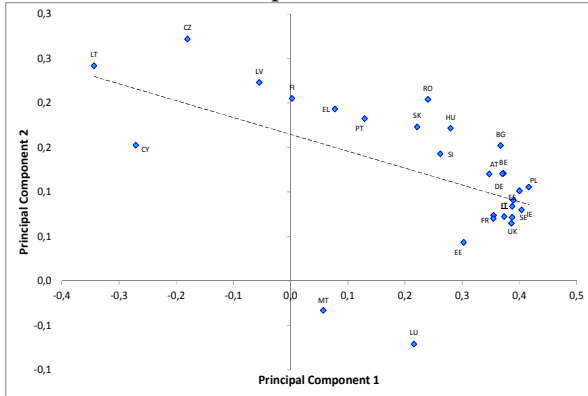
A different way of interpreting the results is to express the correlation between each of the variables used in the analysis and the Main Components.

The resulting representation, the "circle of correlations", shows, within the circle of unitary radius, in which directions they "push" each of the analyzed variables. In the case of the relationship between PC1 and PC2, it can be seen that the variables connected to import-export (intra-extra EU) are more connected to PC1, in contrast to variables such as consumption and GDP that seem to be more related to the PC2.

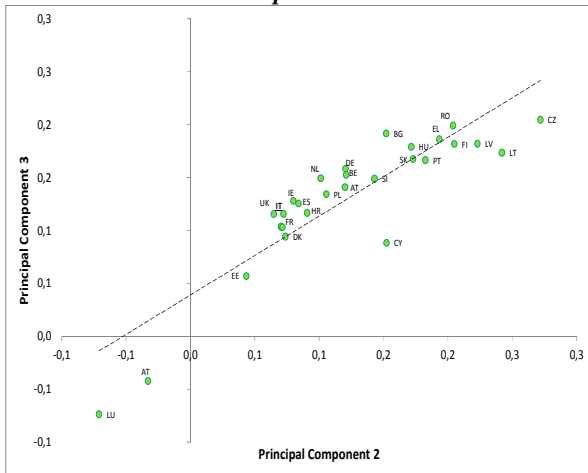
In the same way, we proceeded to represent component 1 and component 3. In this case, the

arrangement of the points in the Cartesian plane takes the form of a positive correlation, with the intersection of an interpolating line close to the origin and with a certain thickening of the countries in the first quadrant.

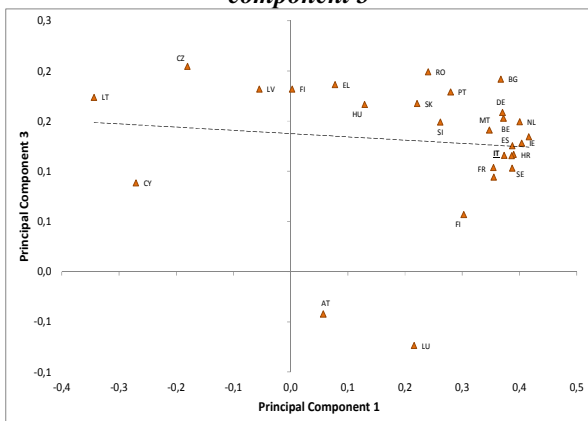
**Figure 2.6a: Principal component 1 and Principal component 2**



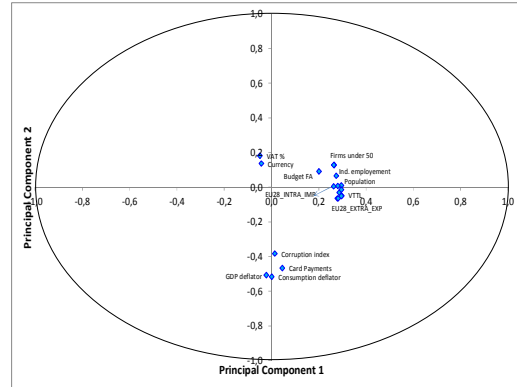
**Figure 2.7a Principal component 2 and Principal component 3**



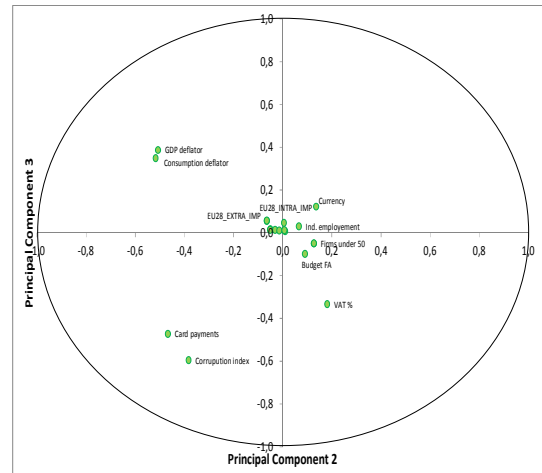
**Figure 2.8a Principal component 1 and Principal component 3**



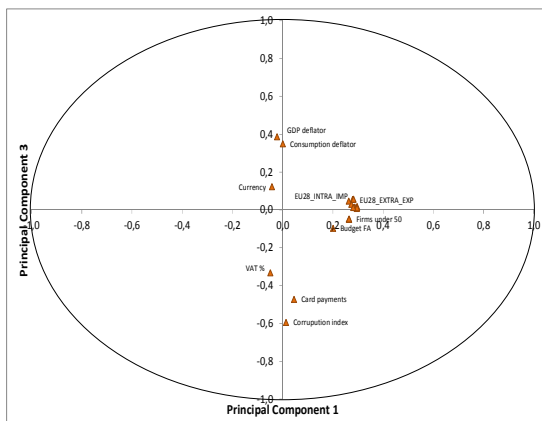
**Figure 2.6b: Circle of correlation**



**Figure 2.7b Circle of correlation**



**Figure 2.8b Circle of correlation**



The countries, such as Germany, Hungary, Lithuania, which were placed in the fourth quadrant of the diagram given by the representation of the first two PCs are now in the third quadrant, while the

countries that mainly thickened in the first quadrant have remained in the same Cartesian space but have changed relative position; Luxembourg continues to be an anomalous case as it now stands alone in the fourth quadrant, while Ireland has moved from the second quadrant to the first, together with Italy, Finland, Latvia, Bulgaria.

In a similar way, representing in the circle of correlations the quantitative links between PC2 and PC3 with the single variables analyzed, we notice how card payments and corruption index are strongly linked with both variables in a negative sense (indeed, these variables "push" down to the left, in the third quadrant of the diagram), while the two deflators of GDP and consumption are positioned specularly, up to the fourth quadrant. The other variables are distributed almost uniformly between the first and second quadrant but do not seem to be particularly strongly correlated with the two PCs being studied, except for VAT%, which has a significant negative link with PC3. Even the PC1 and PC3 components were represented, with the PC1 shown on the horizontal axis. The observations, i.e. the individual countries, tend to be almost entirely displaced in the first and fourth quadrants, with Luxembourg continuing to remain in its outlier condition together with Austria (second quadrant). Most countries are located in the first quadrant and their distribution does not seem to follow an unequivocal logic or some regularity, but only a certain thickening around a hypothetical trend line that minimizes the distance from that line and each observation.

The circle of correlations between the PC1 and PC3 and the variables shows that the purely monetary variables (consumption, currency, card payments) are significantly correlated with the PC3, while the variables mainly concerning foreign trade are related to the PC1. The correlation analysis has highlighted the presence of some trends and links that connect the different variables, which will be well investigated in the next sections with an econometric approach.

### **3. The role of trade relationships in influencing VAT gap**

The current VAT system is vulnerable to fraud and evasion committed in various ways, ranging from a simple under-declaration of sales to sophisticated cross border fraud schemes, defined as Missing Trader Intra Community (*MTIC*) fraud. The MTIC scheme provides that VAT is stolen from a government by organized criminal activity, which exploits cross border trading where the movement of goods between jurisdictions is VAT-free. This allows the fraudster (the person who commits fraud) to charge VAT on the sale of goods and then, instead of paying it to the

government's collection authority, simply disappear, taking the VAT with him<sup>13</sup>.

A large stream of literature focuses on VAT fraud schemes: Ainsworth (2013), Buskhsh and Weigand (2014); Walpole (2014) explains in detail the VAT fraud problem (including MTIC) and proposes different tax regulations to prevent fraud. Sergiou (2012) emphasizes the nature, extent and cost of MTIC within the EU.

For this reason, the analysis of the determinants of VAT evasion within the EU cannot disregard the consideration of trade between Member States as an explanatory factor.

From a theoretical point of view, we use the simplified model on the firm's indirect tax evasion developed by Marrelli and Martina (1988) concerning the separability of production and evasion decisions. It can be illustrated in a simple model of a competitive firm that produces a single output in the amount  $x$ , sells it at a tax-inclusive price  $Q$  and pays a specific tax  $t$  per unit of output. It reports sales of  $x-e$ , where  $e$  is the amount of underreporting. Assuming that the firm is risk neutral, the expected profit is

$$ep = (1-p)[Qx-c(x)-t(x-e)]+p[Qx-c(x)-t(x-e)-s(e)] \quad [3.3]$$

where  $t$  is the VAT tax rate,  $c(x)$  is the cost function,  $p$  is the probability of detection and  $s(e)$  is the penalty to be paid by the company if detected.

Taking the derivatives of expected profit with respect to  $x$  and  $e$ , the first order conditions for this problem can be written as

$$Q=c'(x)+t \quad [3.2]$$

$$ps'e=t \quad [3.3]$$

by aggregating the theoretical model for all the firms of a country, the fact that the firms' optimum output decision is independent from the probability of detection and the penalty function comes to light: they set marginal cost, inclusive of tax, equal to the consumer price, so to determine output considering only the costs (eq. 3.2), while evasion should be controlled by the probability of detection and the penalty function (eq. 3.3). Only the level of risk-aversion modifies the expected profits, so the risk-averse firm evades less than its risk neutral counterpart for any given level of output. The authors' opinion is that in a system of international trade relationships,  $p$  is mixture of the firm's risk-aversion and of that of its trade partners. If a company that is risk-averse has relations

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<sup>13</sup> For a detailed description of the scheme see European Union (2018).

with a company that is not risk-averse, it will tend to adapt to its attitude and vice versa. The influence of trade partners on tax-evasion behaviors must to be taken into account in an empirical analytic model. Although specific data covering all European countries are not available, given the existence of MTIC fraud and the possibility of evading VAT using international IT platforms, which is a well-funded consideration that arises by the findings of international cooperation of tax administrations, a variable expressing the spatial correlation between Member States should also be included in the model.

#### **4. Econometric strategy**

Although the European territory is divided by many administrative borders, which define different political and legal systems, there are strong political, economic, cultural and social links that must be taken into account in a panel countries specification to correct possible distortive effects (i.e., the cross sectional correlation) caused by the similarities between them. Studying proximities correlations raises several econometric issues. In fact, if cross sectional correlation affects a phenomenon, a model that considers this type of dependence has to be used in a study on its determinants. The most popular literature in this field of analysis uses spatial modelling in the sense of geographic dependence to bring out the role of spatial dependence in influencing variables of interest.

The concept of proximity can be represented by different metrics that can be based either on the spatial proximity or on other measures that provide the degree of intensity of the existing relationship between two entities that are located in two different points of space. According to the above, part of the VAT gap stems from MTIC fraud that lurks within international trade flows. By their very nature, MTIC fraud leaves a trace that is recorded in official foreign trade statistics and is therefore accounted for in official statistics, even if the not identifiability is a problem even ex post. Therefore, in this study, we attempt to model the determinants of VAT evasion in a dynamic spatial panel framework, using traditional econometric spatial modelling, under the hypothesis that countries correlations are influenced by distances measured in terms of trade relations and not using geographical coordinates.

In the literature on spatial statistics (Anselin, 1988), the extent of cross-sectional correlation is measured with respect to a given “spatial matrix”  $W$  that is a non-negative  $N \times N$  matrix (where  $N$  is



the number of regions) of known constants describing the spatial arrangement of the units in the sample. The non-zero elements of the matrix indicate whether two locations can be considered as neighbors. As a consequence, the  $w_{ij}$  element indicates the intensity of the relationship between cross-sectional units  $i$  and  $j$ . A general spatial model in reduced form is:

$$y = B_n u + X\beta; B_n = (I_n - \lambda W_n)^{-1}$$

With such specifications, a random shock in a specific country  $i$  (*i.e.*, a shock in the residual  $u$  at any country  $i$ ) does not only affect the outcome  $y$  in the  $i$ -country but it will be transmitted to all other countries following the multiplier expressed in  $(\mathbf{I} - \lambda \mathbf{W})^{-1}$ .

By convention, the diagonal elements  $w_{ii}$  are all set to zero to exclude self-neighbours. This weighting spatial matrix is not symmetric and is generally used in a row-standardized form. The elements  $w_{ij}$  of spatial matrix ( $W$ ) are obtained by calculating proximities using several algorithms according to the geo-spatial coordinates of the regions. There are several alternative ways to calculate the proximities. The most commonly used ones are (see Arbia, 2005):

1. Contiguity weights matrix:  $d_{ij} = 1$  if regions  $i$  and  $j$  have a common boundary; otherwise  $d_{ij} = 0$ .
2. Distance-based binary weights matrix:  $d_{ij} = 1$  if the distance between regions  $i$  and  $j$  is less than a threshold cut-off distance; otherwise  $d_{ij} = 0$ .
3. K-nearest neighbor:  $d_{ij} = 1$  if the geographical center of region  $j$  is one of the nearest  $k$  to the center of region  $i$ , otherwise  $d_{ij} = 0$ .

Once these distances are row-standardized, they become the  $w_{ij}$  weights of  $W$ .

In this work, following the idea that spillover effects between nations in the diffusion of VAT gap, if exist, are represented by international trade, we have created an intra UE trade relationships matrix ( $W$ ) to analyze these occurrences. The  $W$ -matrix has been calculated on the mean values (years 2008-2016) of the trade flows between the UE countries; it is an expression of the intra UE trade proximities. For each  $i$ -country, we calculated the sum of the total imports and the total exports towards each  $j$ -country for the years between 2008 and 2016<sup>14</sup>. The 2008-2016 mean values of these sums represent the  $w_{ij}$  elements of the  $W$  spatial matrix that is squared (28x28) and row standardized.

To better understand the role of the trade matrix, we can consider an example: the  $w_{17,1}$  element of  $W$  measures the trade proximity between Italy and Austria and is equal to 0.0412 (that is: the intra

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<sup>14</sup> Source Eurostat: EU trade since 1988 by CN8 [DS-016890]

UE trade relationship of Italy with Austria represents 4.12% of the total Italian intra UE trade relationships); the  $w_{17,6}$  element measures the trade proximity between Italy and Germany and is equal to 0.2522 (that is: the intra UE trade relationship of Italy with Germany represents 25.22% of the total Italian intra UE trade relationships). With this example, we understand that the trade proximity between Italy and Germany is stronger than that between Italy and Austria despite the geographical proximity of the latter two being greater.

There are significant trade proximity correlations in VAT propensity gap for 8 of the 9 years analyzed. These proximity correlations have been measured in terms of spatial correlation measured by Moran index<sup>15</sup> weighted with the intra UE trade proximity matrix, in the years from 2008 to 2016 (Table 4.1).

**Table 4.1 Yearly Moran index on VAT rates tax evasions**

Year	Moran index	p-value*
2008	0.054	0.073
2009	0.093	0.012
2010	0.099	0.009
2011	0.096	0.010
2012	0.080	0.024
2013	0.076	0.029
2014	0.098	0.009
2015	0.054	0.077
2016	0.011	0.355

\*P value refers to the test on null Hypothesis of no proximities trade correlation between countries

The presence of proximity trade correlation may bias the traditional panel estimates and led us to use a spatial model specification. The  $w_{ij}$  weights of W matrix, capturing the presence of proximities dependence in the residuals of the model and the cross-sectional correlations between countries, have been used to estimate an econometric model following the Spatial panel fixed effects specification suggested by Mutl and Pfaffermayr (2011). This specification includes a spatially lagged dependent variable in the regression equation and allows the capturing of cross-sectional interactions across units and over time. The residuals spatial correlation applies to both the individual effects and the remainder error components.

$$y = \lambda W y + X \beta + \varepsilon;$$

$$\varepsilon = \rho W \varepsilon + u$$

<sup>15</sup> Moran P. A. P. (1950).

In structural form, the model can be written as:

$$y_{it} = \alpha_i + \lambda \sum_{j \neq i}^N w_{ij} y_{jt} + x'_{it} \beta + \rho \sum_{j \neq i}^N w_{ij} u_j + \epsilon_{it} \quad [4.1]$$

Coefficients of the model 4.1 are estimated using an iterative spatial feasible GLS (FGLS) estimator Millo and Piras (2012).

## 5 Results and discussion

The aim of this section is to investigate the factors driving VAT gap in the UE countries. To reach this aim, we will use a spatial panel model. This choice is based on the heterogeneity among UE countries (individual effects) regarding both the dependent variables (see Figure 2.1) and the control variables and on the presence of cross-sectional dependences.

The model estimates are reported in Table 5.1. All the coefficients have the expected signs and are significant (at 95%). In particular, the sign and the significance of the  $\lambda$  coefficient confirm the idea that trade relationships represent an appropriate exogenous control variable in such type of analysis both from the perspective of scholars analyzing the determinants of VAT evasion and from the perspective of tax administrations in defining the strategies to combat the phenomenon. This result shows that for a generic nation, the stronger the trade relations with countries with a high level of VAT propensity gap, the higher the internal VAT propensity gap (see Liu and other 2016; Balafoutas 2015). The VAT mechanism is susceptible to several types of fraud: some are domestic (VAT evasion), others include national and cross border transactions (VAT fraud and/or MTIC fraud); this latter component captured by  $\lambda$  coefficient is significant in assessing the total VAT evasion in each country.

The innovative result of this paper regards the average quantification of this evidence for a defined group of countries. Moreover, this result read in conjunction with the results of diagnostics of the model, confirms our choice of not considering appropriate a simple panel model and preferring the 4.1 specification. This specification is able to correct the bias effects deriving from the dependences among individuals (the countries) and to make the other coefficients more robust because to the extent that there are spatial effects, it captures them. Other than this, we expect there to be strong political, economic, cultural and social links that must be taken into account in such type of

analysis, and the results of the estimation of these covariates are shown below.

**Table 5.1 Coefficients of the model**

Variables	Estimate	p-value
$\Lambda$	0.503	0.000
GDP_pc	-0.004	0.013
Con_pc	0.014	0.001
GDP_def	-0.540	0.000
VAT rate	1.055	0.000
Share SE	0.116	0.000
<i>lag</i> (Card)	-0.015	0.022
Corruption	0.078	0.001
Enforcement (-2)	-6.958	0.000
<i>Serial Correlation (H<sub>0</sub>: No serial correlation)</i>		
Breusch–Godfrey	1.641	0.650
<i>Cross sectional correlation (H<sub>0</sub>: No cross sectional correlation)</i>		
Pesaran CD	0.456	0.648

The first three variables, Gross Domestic Product, per capita in thousands of euro, (GDP\_pc), Final Consumption, per capita in thousands of euro (Con\_pc) and GDP Price Index (GDP\_def), represent how the VAT gap is related with macroeconomic indicators.

The variable capturing the business cycle movement (*GDP\_pc*) is negatively correlated with VAT gap propensity. The review of the literature has shown that the link between tax evasion and the economic cycle is controversial, as some scholars have shown a positive correlation and others a negative one. The debate on the relationship between gdp and tax gap is widespread and unresolved (see, among others, Giles, 1999 and Chiarini et al., 2008). Two are the possible drivers behind our result: first, the reduction of demand for underground products as GDP increases; second, the fact that positive regional GDP growth can create more job opportunities in the regular economy leading to a reduction of the tax gap. Our explanation of the negative sign is twofold: on the one hand, in the recessionary phases of the cycle, the less structured units typical of the irregular economy tend to be expelled from the market and, therefore, the regularity rate of the economy tends to increase; on the other hand, it is possible that companies plan an *ex-ante* evasion amount compatible with the expected profits and, therefore, if the cycle tends to be more positive than expected, the propensity to the VAT gap, measured in percentage terms, tends to decrease. On the contrary, there is a positive sign for per capita consumption. This means that economies more oriented towards household consumption tend to have a larger VAT gap. Indeed, not all VAT revenue comes from transactions with final consumers, but there are also economic operators, both public and private, who have to

pay the tax. The latter have less chance of evading the tax than final consumers and, therefore, the greater the household consumption, the greater the propensity to VAT gap.

The result of the negative relationship between tax evasion and inflation (*GDP\_def*) is a well-established result in the literature because tax evasion is considered as an adjustment tactic during economic downturn. Fishlow and Friedman (1994) show, by empirically applying their theoretical model of intertemporal consumption to countries that have a long experience with tax evasion and inflation, that tax compliance declines when inflation rises. Bittencurt et al (2014), analyzing a larger panel dataset of 150 countries, confirm this empirical consistency.

To quantify the relationship between tax burden and tax gap, we insert in the model the standard *Vat rate* (source UE Commission). It seems that the excess burden yields a strong impact in terms of increase of VAT gap propensity; the standard VAT rate coefficient indicates that the higher the rate, the higher the tendency to evade. But this is a well-known result in many theoretical models on evasion (Clotfelter, 1983; Alm, Jackson and Mc Kee, 1992; Pommerehne and Hannelore, 1996). This variable is characterized by a strong difference among the within (countries) and between (countries) variances. Moreover, VAT gap creates horizontal inequity because equally well-off people end up with different tax burdens (Slemrod, 2007). Our idea is that the countries with low standard VAT rate have a lower number of differentiated rates and have a reduced impact on VAT gap of the policy gap, which is measured by the negative influence on the compliance derived by the applying of multiple rates and exemptions. Another expected result regards the coefficient for the variable of the share of self-employed (*Share SE*) that is positive and significant.

The characteristics of some production systems with a high proportion of small firms and self-employed professionals like Italy, Denmark and UK show that, *ceteris paribus*, tax-evading chances are clearly higher for taxpayers who self-certify their income (i.e. the self-employed) than those whose income is reported by a third party (i.e employees, see Carfora et al. 2018; Kleven et al. 2010); moreover the under-reporting among these self-employed appears to be much less prevalent respect to self-employed people with unincorporated businesses (Engstrom and Holmlund, 2009).

*Card* measures the relative importance of electronic payment services and it is calculated as the ratio between the value of electronic payments on total payments (source: ECB). We expect that the higher cash diffusion higher tax gap would entail. There is some empirical evidence supporting this claim (Carfora et al. 2018, Immordino and Russo, 2018) confirmed also by this study, thus the significant negative coefficient means that there is an indirect correlation in all the countries between the use of electronic payments tools and VAT gap. The variable has been lagged of one year because the liquidity assets of year  $t-1$  influence the business operation of year  $t$ . This decision is also supported by the statement that there is a time lag between the time when the transactions

take place and the time when the VAT due is reported.

Corruption and tax evasion can become intertwined and self-reinforcing: in the literature there are many papers which underline this evidence (see among those the seminal paper of Alm et al. 2016, or the review of Siddiqui, 2017 ). In the regression model, we introduce the World Bank Control of Corruption index<sup>16</sup> which is a country's score indicator, expressed in units of a standard normal distribution, i.e. ranging from approximately -2.5 (low corruption) to 2.5 (high corruption). Our opinion is that, beside it is a continuous and standardized variable and a perception index too, it is better able to adapt to our empirical model than the transparency index presented in paragraph 2 because it gives more guarantee of confrontation being calculated for the greatest part of the countries of the world. The result of the coefficient of the Control of Corruption index variable (*Corruption*) also confirms the evidence that came to light in the descriptive section of the paper: the countries most affected by the corruptive phenomenon are characterized by higher rates of evasion. This result is in line with the theoretical issues and the previous literature results and indicates that corruption largely drives evasion.

In line with the theoretical model, as enforcement variable, we use the scale of the tax administrations (Enforcement), constructed as the ratio between the total tax professional staff in the administration and the total population. As the impact of this variable on the VAT gap is nonlinear, because the positive results achieved in terms of combating VAT evasion start collecting at a later date after the staff has been properly trained, we introduce it in the model lagged for two years. It cannot be assumed that the staff recruited to combat evasion are promptly prepared to carry out the mission in the best available way. Therefore we believe that the choice of inserting the lagged variable is appropriate, following the example of what has been done in other empirical analyses on the theme (Case, 2019, page 56). Results show that the greater the scale of the tax administration, the lower the VAT Gap that results two years later. This is an expected result (Carfora et al. 2018, Alm, 1999; Yitzhaki, 1974, CASE 2019), which confirms that positive results are associated toward the countries' compliance rate when enforcement is exercised in a direct way. As diagnostic tests, we perform the Breusch-Goedfrey and Pesaran CD tests specification to test the presence of serial and cross sectional dependence in the residuals. Both the test lead us to reject the null of serial (between years) and cross section (between countries) correlation in the residuals confirming the consistency of the coefficients.

Finally, the cross sectional spatial correlations of the residuals of the models have been measured in

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<sup>16</sup> Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests (definition by world Bank <https://datacatalog.worldbank.org/control-corruption-estimate-0>.)

terms of Moran index weighted with the intra UE trade proximity matrix, in the years from 2008 to 2016: they are spatially uncorrelated in each of the years analyzed (Table 5.2).

**Table 5.2 Yearly Moran index on residuals of the model**

Year	Moran index	p-value*
2008	-0.027	0.840
2009	-0.050	0.807
2010	-0.108	0.159
2011	-0.101	0.211
2012	-0.022	0.770
2013	-0.038	0.986
2014	-0.028	0.853
2015	0.017	0.269
2016	-0.043	0.897

\*P value refers to the test on null Hypothesis of no proximities correlation between countries

## 6. Conclusions

The analysis of determinants of tax gap has always attracted large attention in theoretical and empirical research. A well-recognized opinion, indeed, is that the greater the knowledge of the factors that drive the evasive phenomenon, the higher the effectiveness of the actions that aim at contrasting it.

The results of the empirical analysis highlight how the significant differentials between VAT gaps in dissimilar European countries can be traced back to a multiplicity of economic and social factors as well as to the tax administration's enforcement.

In particular, the anti-cyclical nature of the VAT gap propensity, as well as a negative relationship with the rate of inflation, come to evidence.

The gap is also affected by the long-term characteristics of the economic sector: economies more oriented towards final consumption and characterized by a significant presence of small businesses show a greater VAT gap propensity.

The role played by the tax morale is also significant: a widespread perception of corruption, indeed, feeds the tax gap. The habit of using electronic payment instruments is equally important; where this use is more widespread, the VAT gap propensity is less pervasive.

As far as taxation aspects are concerned, there is a negative correlation with the level of VAT rates and there is also a positive relationship with the effort made by tax administrations to prevent and

contrast evasion.

Another remarkable finding regards the identification of an undetectable proximity factor: there are some spillover effects, arising from a combination of trade factors, that transcend geographical boundaries and facilitate the spread of evasion through commercial channels.

The results of this study overcome the classic approaches on the determinants of the VAT gap and highlight how there are more complex links that can lead us through the explanation of more complex occurrence. VAT evasion has not been concentrated in specific contiguous areas of the mainland, but it has spread as a patchwork among some southern and northern countries.

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