VAT Gap in the EU

Report 2021

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CASE	Center for Social and Economic Research (Warsaw)
COICOP	Classification of Individual Consumption according to Purpose
CPA	Statistical Classification of Products by Activity in accordance with Regulation (EC) No 451/2008 of the European Parliament and of the Council of 23 April 2008 establishing a new statistical classification of products by activity
EC	European Commission
ESA	European System of Accounts
EU	European Union
EU-28	Member States of the European Union, UK inclusive
FE	Fixed Effects
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
IC	Intermediate Consumption
KMO	Kaiser-Meyer-Olkin test for sampling adequacy
NPISH	Non-Profit Institutions Serving Households
OECD	Organisation for Economic Cooperation and Development
ORS	Own Resource Submissions
o/w	of which
PCA	Principal Component Analysis
pp	percentage points
SUT	Supply and Use Tables
TAXUD	Taxation and Customs Union Directorate-General of the European Commission
VAT	Value Added Tax
VTTL	VAT Total Tax Liability

Executive Summary

This Report has been prepared for the European Commission, DG TAXUD, for the project TAXUD/2019/AO-14, "Study and Reports on the VAT Gap in the EU-28 Member States", and is a follow-up to the eight reports published between 2013 and 2020.

The report provides yearly Value Added Tax (VAT) Gap estimates for the EU-28 covering the 2015-2019 period. We calculate the VAT Gap as the difference between the VAT due and the actual VAT revenues. As such, it represents the VAT revenues lost compared to a theoretical VAT calculation. The underlying reasons for this VAT Gap can be grouped into four broad categories: (1) VAT fraud and VAT evasion, (2) VAT avoidance practices and optimisation, (3) bankruptcies and financial insolvencies, and (4) administrative errors. While each of these reasons calls for a different policy response, even under the best circumstances the VAT Gap could not be completely eliminated, for instance as regards foregone VAT due to bankruptcies and financial insolvencies.

To calculate the VAT Gap, we follow a consumption-side top-down approach, developed under the 2013 VAT Gap Study and agreed with Member States' authorities to ensure that the VAT Gap is estimated in a consistent way across time and Member States. However, the consumption-side top-down approach does not allow for a further breakdown of the VAT Gap into the causes listed above. A more targeted analysis of the components and reasons for the VAT Gap is therefore outside the scope of this report. However, DG TAXUD announced that it foresees launching more targeted studies in the future, which should allow segmenting the overall VAT Gap into separate elements that could be quantified and further analysed. This additional work might then help design targeted policy measures to reduce the overall VAT Gap.

In addition, based on the updated set of estimates, we analyse econometrically the VAT Gap determinants. In order to improve the explanatory power of the models presented in the 2020 Study, we use the principal component analysis (PCA) and extend the set of "tax administration" variables. This Report also presents the overall collection efficiency (the "C-efficiency" ratio), updates of the Policy Gap estimates for 2019, and the contributions that reduced rates and exemptions made to the theoretical VAT revenue losses.

In 2019, conditions for improving compliance were rather favourable. Overall, growth of EU GDP amounted to approximately 3.5 percent in nominal and 1.6 percent in real terms, respectively. The core component of the base, final consumption, inclined by over 1 percent in the vast majority of Member States. In addition, 2019 was a relatively stable year in terms of tax regime changes affecting the effective rates and the VAT Total Tax Liability (VTTL).

The EU-wide VAT Gap, which covers all sources of VAT non-compliance, amounted to EUR 134 billion in nominal terms and 10.3 percent expressed as a share of the VAT Total Tax Liability in 2019. VAT revenue increased by 3.8 percent whereas the VAT Total Tax Liability increased by 2.9 percent, leading to a decline in the VAT Gap in both relative and nominal terms. Compared to 2018, the Gap went down by approximately 0.8 percentage points and EUR 6.6 billion. The smallest Gaps were observed in Croatia (1 percent), Sweden (1.4 percent), and Cyprus (2.7 percent), the largest – in Romania (34.9 percent), Greece (25.8 percent), and Malta (23.5 percent). Half of the EU-28 Member States recorded a Gap above

8.6 percent. In most Member States, the absolute year-over-year change in the VAT Gap was less than 2 percentage points). Overall, the VAT Gap share decreased in 18 Member States. In addition to Croatia and Cyprus, the most significant decreases in the VAT Gap occurred in Greece, Lithuania, Bulgaria, and Slovakia (recording reductions in the VAT Gap by between 3.2 and 2.2 (-3 percentage points). In Sweden, Finland, and Estonia, the loss in VAT revenues for years already has been consistently measured at less than 5 percent of the VAT due. The biggest increases in the VAT Gap, apart from Malta, were observed for Slovenia (+3 percentage points) and Romania (+2.3 percentage points). Because of significant changes in the tax regimes and structures of the economies observed in 2020, we report fast estimates for 2020 only for selected Member States.

Separate from the estimates of the VAT Gap and their descriptive analysis, the report also provides an analysis of the overall collection efficiency (C-efficiency) and the Policy Gap. The Policy Gap is decidedly not part of the VAT Gap, but a separate indicator: where the VAT Gap is an estimate of the Compliance Gap, the Policy Gap stands for theoretical revenue losses due to the application of exemptions and reduced rates. For the EU overall, the average Policy Gap level was 44.7 percent, which is similar to the previous year. Of this, in 2019, about 9.8 percentage points were due to the application of various reduced and super-reduced rates (the Rate Gap) and 34.9 percentage points were due to non-taxability and the application of exemptions without the right to deduct to some tax base components (the Exemption Gap). Finally, the measure of collection efficiency (C-efficiency) is an indicator of the departure of the VAT system from a perfectly enforced tax levied at a uniform rate on all consumption. In 2019, the average C-efficiency in the EU amounted to 55.5 percent of final consumption.

The results of the econometric analysis confirmed that the VAT Gap is influenced by a group of factors relating to the current economic conditions, institutional environment, and economic structure as well as to the measures and actions of tax administrations. Out of a broad set of tested variables, GDP growth and general government balance appeared to explain a substantial set of VAT Gap variation. Within the control of tax administrations, the share of IT expenditure and the application of additional information obligations for taxpayers proved to have the highest statistical significance in explaining the size of the VAT Gap.

Kurzfassung

Dieser Bericht wurde im Auftrag der Europäischen Kommission, Generaldirektion TAXUD, für das Projekt TAXUD/2019/AO-14 "Studie und Berichte über die Mehrwertsteuerlücke in den 28 Mitgliedstaaten der EU" verfasst. Der Bericht ist eine Fortsetzung der acht zwischen 2013 und 2020 veröffentlichten Berichte.

Der Bericht enthält jährliche Schätzungen der Mehrwertsteuerlücke für die EU-28 für den Zeitraum 2015-2019. Wir berechnen die Mehrwertsteuerlücke als Differenz zwischen den fälligen und den tatsächlichen Mehrwertsteuereinnahmen Damit stellt die Mehrwertsteuerlücke eine Schätzung verlorene Mehrwertsteuereinnahmen in Bezug zu einer theoretischen Berechnung der Mehrwertsteuer dar. Die Gründe für diese Mehrwertsteuerlücke lassen sich in vier grobe Kategorien einteilen: (1) Mehrwertsteuerbetrug und -hinterziehung, (2) Praktiken der Mehrwertsteuerumgehung und -optimierung, (3) Konkurse und finanzielle Insolvenzen und (4) Verwaltungsfehler. Obwohl jeder dieser Gründe eine andere politische Antwort erfordert, könnte die Mehrwertsteuerlücke selbst unter den besten Umständen nicht vollständig beseitigt werden, z.B. in Bezug auf entgangene Mehrwertsteuer aufgrund von Konkursen und finanziellen Insolvenzen.

Zur Berechnung der Mehrwertsteuerlücke folgen wir einem Top-down-Ansatz auf der Verbrauchsseite. Der Ansatz wurde im Rahmen der Studie zur Mehrwertsteuerlücke von 2013 entwickelt und mit den Behörden der Mitgliedstaaten vereinbart um sicherzustellen, dass die Mehrwertsteuerlücke im Zeitverlauf und in den Mitgliedstaaten einheitlich geschätzt wird. Der Top-down-Ansatz auf der Verbrauchsseite lässt jedoch keine weitere Aufschlüsselung der Mehrwertsteuerlücke in die oben genannten Ursachen zu. Eine gezieltere Analyse der Komponenten und Gründe für die Mehrwertsteuerlücke ist daher nicht Gegenstand dieses Berichts. Die GD TAXUD kündigte jedoch an, dass sie künftig gezieltere Studien in Auftrag geben wolle. Diese Studien würden es voraussichtlich ermöglichen, die gesamte Mehrwertsteuerlücke in einzelne Elemente zu unterteilen, die quantifiziert und weiter analysiert werden könnten. Diese zusätzlichen Arbeiten könnten dann dazu beitragen, gezielte politische Maßnahmen zur Verringerung der Mehrwertsteuerlücke insgesamt zu konzipieren.

Darüber hinaus analysieren wir auf der Grundlage der aktualisierten Schätzungen ökonometrisch die Bestimmungsfaktoren der Mehrwertsteuerlücke. Um die erläuternde Aussagekraft der in der Studie von 2020 vorgestellten Modelle zu verbessern, verwenden wir die Hauptkomponentenanalyse (PCA) und erweitern das Variablenset für die Steuerverwaltung. In diesem Bericht werden auch die Gesamteffizienz der Erhebung (die „C-Effizienzquote"), Aktualisierungen der Schätzungen der politischen Lücke für 2019 und die Beiträge, die ermäßigte Steuersätze und Steuerbefreiungen zu den theoretischen Mehrwertsteuereinnahmeverlusten geleistet wurden, dargestellt.

Im Jahr 2019 waren die Bedingungen für eine bessere Einhaltung recht günstig. Insgesamt belief sich das Wachstum des BIP der EU nominal auf etwa 3,5 Prozent und real auf 1,6 Prozent. Die Kernkomponente der Basis, der Endverbrauch, stieg in der überwiegenden Mehrheit der Mitgliedstaaten um über 1Prozent. Darüber hinaus war 2019 ein relativ stabiles Jahr im Hinblick auf Änderungen des Steuersystems, die sich auf die effektiven Steuersätze und die Mehrwertsteuer insgesamt auswirkten.

Die EU-weite Mehrwertsteuerlücke, die alle Ursachen für die Nichteinhaltung der Mehrwertsteuervorschriften abdeckt, belief sich im Jahr 2019 nominal auf EUR 134 Mrd. und als Anteil an der Mehrwertsteuergesamtsteuerschuld auf 10,3 Prozent. Die Mehrwertsteuereinnahmen stiegen um 3,8 Prozent, während die Mehrwertsteuergesamtsteuerschuld um 2,9 Prozent zunahmen, was zu einer Verringerung der Mehrwertsteuerlücke sowohl in relativen als auch in nominalen Zahlen führte. Im Vergleich zu 2018 verringerte sich die Lücke um etwa 0,8 Prozentpunkte bzw. EUR 6,6 Mrd. Die geringsten Mehrwertsteuerlücken wurden in Kroatien (1 Prozent), Schweden (1,4 Prozent) und Zypern (2,7 Prozent) beobachtet, die größten in Rumänien (34,9 Prozent), Griechenland (25,8 Prozent) und Malta (23,5 Prozent). Die Hälfte der Mitgliedstaaten der 28 Mitgliedsstaaten der EU verzeichnete eine Lücke von über 8,6 Prozent. In den meisten Mitgliedstaaten lag die absolute Veränderung der Mehrwertsteuerlücke gegenüber dem Vorjahr bei unter 2 Prozentpunkten. Insgesamt verringerte sich der Anteil der Mehrwertsteuerlücke in 18 Mitgliedstaaten. Neben Kroatien und Zypern verringerte sich die Mehrwertsteuerlücke am stärksten in Griechenland, Litauen, Bulgarien und der Slowakei (wo eine Reduktion der Mehrwertsteuerlücke um zwischen 3,2 und 2,2 Prozentpunkte gemessen wurde). In Schweden, Finnland und Estland wird der Verlust an Mehrwertsteuereinnahmen bereits für mehrere Jahre durchgehend auf weniger als 5 Prozent der geschuldeten Mehrwertsteuer geschätzt. Die größte Zunahme der Mehrwertsteuerlücke wurde mit Ausnahme von Malta in Slowenien (+ 3 Prozentpunkte) und Rumänien (+ 2,3 Prozentpunkte) verzeichnet. Aufgrund signifikanter Änderungen in den Steuersystemen und Strukturen der Volkswirtschaften im Jahr 2020 werden Schnellschätzungen für dieses Jahr nur für ausgewählte Mitgliedstaaten angegeben.

Unabhängig von den Schätzungen der Mehrwertsteuerlücke und ihrer beschreibenden Analyse enthält der Bericht auch eine Analyse der Gesamteffizienz der Steuererhebung (C-Effizienz) und der politischen Lücke. Es ist wichtig zu betonen, dass die politische Lücke ist nicht Teil der Mehrwertsteuerlücke, sondern ein gesonderter Indikator ist: Handelt es sich bei der Mehrwertsteuerlücke um eine Schätzung der Erfüllungslücke, so steht die politische Lücke für theoretische Einnahmeausfälle aufgrund der Anwendung von Steuerbefreiungen und ermäßigten Umsatzsteuersätzen. Für die EU insgesamt lag die durchschnittliche politische Lücke bei 44,7 Prozent und damit ähnlich wie im Vorjahr. Davon waren im Jahr 2019 etwa 9,8 Prozentpunkte auf die Anwendung verschiedener ermäßigter und stark ermäßigter Steuersätze (Differenzsatz) und 34,9 Prozentpunkte auf die Nichtbesteuerung und die Anwendung von Steuerbefreiungen ohne Recht auf Vorsteuerabzug bei einigen Komponenten der Steuerbemessungsgrundlage (Steuerlücke) zurückzuführen. Die Messung der Gesamteffizienz der Steuererhebung (C-Effizienz) ist ein Indikator für das Maß, zu dem das Mehrwertsteuersystem von einer perfekt durchgesetzten und erhobenen Steuer abweicht, die zu einem einheitlichen Satz auf den gesamten Verbrauch erhoben würde. Im Jahr 2019 belief sich die durchschnittliche C-Effizienz in der EU auf 55,5 Prozent des Endverbrauchs.

Die Ergebnisse der ökonometrischen Analyse bestätigten, dass die Mehrwertsteuerlücke von einer Reihe von Faktoren beeinflusst wird, die mit den aktuellen wirtschaftlichen Bedingungen, dem institutionellen Umfeld und der Wirtschaftsstruktur sowie den Maßnahmen und Aktionen der Steuerverwaltungen zusammenhängen. Von einer breiten Palette getesteter Variablen schienen das BIP-Wachstum und der gesamtstaatliche Haushaltssaldo einen wesentlichen Teil der Schwankungen der Mehrwertsteuerlücke zu erklären. Innerhalb der Kontrolle der Steuerverwaltungen erwiesen sich der Anteil der IT-Ausgaben und der Einsatz zusätzlicher

Informationspflichten für Steuerzahler als die statistisch bedeutendsten Erklärungen für das Ausmaß der Mehrwertsteuerlücke.

Résumé

Ce rapport a été rédigé pour la Commission européenne, DG TAXUD, pour le projet TAXUD/2019/AO-14, "Etude et rapports sur l'écart de TVA dans l'UE-28", et il fait suite aux huit rapports publiés entre 2013 et 2020.

Le rapport fournit des estimations annuelles sur l'écart de la taxe sur la valeur ajoutée (TVA) pour les 28 États membres, sur une période allant de 2015 à 2019. Nous calculons l'écart de TVA comme résultant de la différence entre la TVA due et les recettes de TVA réellement perçues. Dès lors le dit écart est obtenu en calculant les recettes de TVA perdues par rapport à un indicateur théorique de TVA. Les raisons derrière cet écart de TVA peuvent être regroupées en quatre principales catégories : (1) la fraude et le contournement de la TVA, (2) les pratiques d'évitement de la TVA et l'optimisation fiscale, (3) les faillites et insolvabilités financières et (4) les erreurs administratives. Chacune de ces raisons appelle une réponse politique différente; mais même dans les meilleures circonstances possibles, l'écart de TVA ne pourrait pas être complètement éradiquée, par example en ce qui concerne les pertes de TVA à cause des faillites et insolvabilités financières.

Pour calculer cet écart de TVA, nous utilisons une approche descendante axée sur la consommation développée dans le cadre de l'étude de 2013 sur l'écart de TVA et approuvée par les responsables des Etats membres, afin de s'assurer que l'écart de TVA est estimé de manière cohérente dans le temps et parmi ces mêmes Etats. Cependant, l'approche descendante axée sur la consommation ne permet pas de décomposer davantage l'écart de TVA en fonction des causes énumérées ci-dessus. Pour cette raison, une analyse précise des éléments et des raisons de l'écart de TVA n'entre donc pas dans le champ d'application de ce rapport. Cependant, la DG TAXUD a annoncé qu'elle lancerait, prochainement, des études plus ciblées, qui devraient permettre de segmenter l'écart global de TVA en éléments distincts pouvant être quantifiées et analysées plus en détail. Ce travail complémentaire pourrait aider à concevoir des mesures politiques ciblées pour réduire l'écart global de TVA.

Par ailleurs, en prenant en compte l'ensemble actualisé des estimations, nous analysons de manière économétrique les déterminants de l'écart de TVA. Dans le but d'affiner la cohérence explicative des modèles présentés dans l'étude de 2020, nous utilisons l'analyse en composantes principales (ACP) et élargissons l'ensemble des variables « administration fiscale ». Ce rapport présente aussi l'efficacité globale de la collecte (le ratio « C-efficiency »), met à jour les estimations pour l'écart de TVA discrétionnaire en 2019 et les contributions qui ont réduit les taux et exonérations apportées aux pertes théoriques de recettes de TVA.

En 2019, les conditions pour améliorer la compatibilité étaient plutôt favorables. Dans l'ensemble, la croissance du PIB de l'UE s'est élevée respectivement à environ 3,5 pour cent en termes nominaux et 1,6 pour cent en termes réels. Élément essentiel, la consommation finale a diminué de plus de 1 pour cent dans l'immense majorité des États membres. Par ailleurs, l'année 2019 a été relativement stable concernant les changements de régime fiscal affectant les taux effectifs et la TVA totale exigible théorique (VTTL).

L'écart de TVA global dans l'EU, qui est une mesure de toutes les sources de non-conformité à la TVA, s'est élevé à 134 milliards d'euros en termes nominaux et 10,3 pour cent exprimés en part de VTTL. Le revenu de la TVA a augmenté de 3,8 pour cent tandis que la VTTL a augmenté de 2,9 pour cent, conduisant à un déclin, dans l'écart de TVA, des termes relatifs et nominaux. Comparé à 2018, l'écart a diminué d'environ 0,8 en points de pourcentage et de

6,6 milliards d'euros. Les plus faibles écarts ont été observés en Croatie (1 pour cent), Suède (1,4 pour cent) et Chypres (2,7 pour cent) et les plus importants en Roumanie (34,9 pour cent), Grèce (25,8 pour cent) et Malte (23,5 pour cent). La moitié des 28 États membres de l'UE ont enregistré un écart supérieur à 8,6 pour cent. Dans la plupart des États membres, la variation absolue en glissement annuel concernant l'écart de TVA était en dessous de 2 en points de pourcentage. Dans l'ensemble, l'écart de TVA a diminué dans 18 États membres. Outre la Croatie et Chypre, les plus importantes diminutions concernant l'écart de TVA ont eu lieu en Grèce, Lituanie, Bulgarie et Slovaquie (ces quatre pays ont réduit l'écart de TVA entre 3,2 et 2,2; -3 points de pourcentage). En Suède, Finlande et Estonie, la perte de recettes de TVA est estimée, depuis des années déjà, à moins de 5 pour cent de la TVA due. Les plus fortes augmentations de l'écart de TVA, à part de Malte, ont été observées en Slovénie (+3 points de pourcentage) et en Roumanie (+2,3 points de pourcentage). En raison des changements importants dans les régimes fiscaux et les structures des économies observées en 2020, nous présentons des estimations rapides pour certains Etats membres seulement.

Indépendamment des estimations de l'écart de TVA et de leur analyses descriptives, le rapport fournit également une analyse de l'efficacité globale de la collecte (C-efficiency) et le/du Policy Gap. Le Policy Gap ne fait résolument pas partie de l'écart de TVA, mais c'est un indicateur : là ou l'écart de TVA est une estimation des écarts de conformité, le Policy Gap représente les pertes de revenues théoriques dues à l'application d'exonérations et de taux réduits. Pour l'ensemble de l'UE, la moyenne du niveau de l'écart de TVA discrétionnaire était de 44,7 pour cent. De cela, en 2019, environ 9,8 en points de pourcentage étaient dus à l'application de divers taux réduits et super réduits (l'écart de taux) et 34,9 en points de pourcentage étaient dus à la non-imposition et à l'application d'exonérations sans le droit de déduction de certains éléments de l'assiette fiscale (l'Ecart d'Exemption). Finalement, l'efficacité globale de la collecte (C-efficiency) est un indicateur de l'écart du régime de TVA par rapport à une taxe parfaitement appliquée et prélevée sur l'ensemble de la consommation a un taux uniforme. En 2019, La moyenne C-efficiency dans l'UE s'élevait à 55,5 pour cent de la consommation finale.

Les résultats des analyses économétriques confirment que l'écart de TVA est influencé par un ensemble de facteurs en lien avec les conjonctures économiques, l'environnement institutionnel et la structure économique aussi bien que les mesures et actions entreprises par les administrations fiscales. Sur un large éventail de variables testées, la croissance du PIB et le solde des administrations publiques semblent expliquer un ensemble substantiel de variation de l'écart de TVA. Sous le contrôle des administrations fiscales, le partage des dépenses informatiques et l'application d'obligations supplémentaires pour les contribuables se sont avérées avoir l'influence statistique la plus importante pour expliquer l'ampleur d'écart de la TVA.

Introduction

This Report presents the findings of the 2021 "Study to quantify the VAT Gap in the EU Member States", which is the eighth publication following the seminal Study conducted by Barbone et al. in 2013.[1]

This report provides yearly Value Added Tax (VAT) Gap estimates for the EU-28 covering the five-year period of 2015-2019. Similar to the past Studies, we also include estimates using a simplified methodology – "fast estimates" – for the year immediately preceding the publication date. However, due to significant changes in the tax regimes and structures of the economies observed after the outbreak of the pandemic, fast estimates for 2020 are reported only for 18 Member States (see Annex B).[2]

Based on the updated set of VAT Gap estimates, we analyse econometrically the VAT Gap determinants using the methodology and the set of explanatory variables already presented in the 2020 Study. In order to improve the explanatory power of the model, as a methodological novelty, we operationalise principal component analysis (PCA) and extend the set of "tax administration" variables. In addition to the VAT non-compliance analysis, this Report also presents the overall collection efficiency (the "C-efficiency" ratio), updates the Policy Gap estimates for 2019, and the contributions that reduced rates and exemptions made to the theoretical VAT revenue losses.

The VAT Gap, which is addressed in detail by the core of this Report, shall be understood as the Compliance Gap. It is the difference between the expected and actual VAT revenues and represents more than just fraud and evasion. The VAT Gap also covers VAT lost due to, for example, insolvencies, bankruptcies, administrative errors, and legal tax optimisation. It is defined as the difference between the amount of VAT collected and the VAT Total Tax Liability (VTTL) – namely, the tax liability according to tax law. The VAT Gap can be expressed in absolute or relative terms, commonly as a ratio of the VTTL or gross domestic product (GDP). In this Report, we refer to the VAT Gap as the ratio of the VTTL.

Chapter 1 of the Report presents the economic developments and policy changes that affected the tax base and effective rates in European Union (EU) Member States during the course of 2019. In addition, the first chapter also presents a decomposition of the sources of the VTTL and revenue growth in 2019. The estimates of the VAT Gap for 2019 for the EU as a whole and for individual Member States are presented and briefly described in Chapter 2. Chapter 3 provides detailed results and outlines trends for individual countries coupled with analytical insights. In Chapter 4, we analyse the C-efficiency, the Policy Gap, and the role of its components. Chapter 5 is devoted to the econometric analysis. It summarises the literature and methodological background described in more detail in the 2020 Study, highlights the most important novelties introduced with this update, and discusses and visualises the results.

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[1] The first study of the VAT Gap in the EU was conducted by Reckon (2009); however, due to differences in methodology, it cannot be directly compared to these latter studies.

[2] 2020 estimates will be presented in the next update of the Study, when sufficient data allowing to precisely control for the effects of the changes in tax regimes and economies become available.

Annex A contains the methodological considerations underlying all components of the analysis. Annex B provides statistical data and a set of comparative tables.

1. Background: Economic and Policy Context in 2019

a. Economic Conditions in the EU during 2019

In 2019, the pace of GDP growth continued to decline in most Member States. Overall, growth of EU GDP fell to 1.6 percent in 2019 in real terms, which was 0.4 pp. and 0.9 pp. lower than in 2018 and 2017, respectively. Ireland (GDP growth of 5.6 percent), Malta (5.5 percent growth), and Poland (4.7 percent) saw the most favourable economic conditions, whereas the lowest GDP growth rates were observed in Italy (0.3 percent) and Germany (0.6 percent).

As a consequence of the growing economy, the labour markets remained relatively stable. The unemployment rate fell in 25 EU Member States, by -0.5 pp. on average in the EU. The average general government balance amounted to -0.5 percent, with the majority of EU Member States observing a nominal surplus.

In nominal terms, GDP increased by 3.5 percent and consumer prices went up by 1.5 percent. Growth of GDP was largely driven by gross fixed capital formation (GFCF), in part a component of the VAT base, which increased by 7.6 percent. The core component of the base, final consumption, inclined by over 1 percent in all Member States with the exception of Italy. In a few Member States, nominal growth of final consumption exceeded the EU average of 3.2 percent. Its fastest incline was observed in Romania (10.9 percent), Hungary (9.9 percent), and Malta (9.2 percent).

As in previous years, the evolution of GFCF was volatile across countries and varied from -7.6 percent in Lithuania to 74.1 percent in Ireland, according to Eurostat. The main source of this volatility is non-taxable private investment. However, public investment and investment from exempt sectors and households are also relatively volatile. Due to this and frequent revisions of GFCF figures by Statistical Offices, GFCF is the main source of VAT Gap revisions. Whenever new information on the actual investment figures of exempt sectors becomes available, the estimates of the VAT Gap are revised backwards.

Table 1.1. Real and Nominal Growth in the EU-28 in 2019 (in national currencies

Member State	Real GDP Growth (%)	General Government Balance (%)	Change in Unemploy-ment Rate (pp)	Nominal Growth (%)		
				GDP	Final Consum-ption	GFCF
Belgium	1.8	-1.9	-0.6	3.5	3.0	1.4
Bulgaria	3.7	2.1	-1.0	9.1	8.4	8.4
Czechia	3.0	0.3	-0.2	7.0	6.3	8.7
Denmark	2.1	3.7	-0.1	2.9	2.0	0.0
Germany	0.6	1.4	-0.2	2.8	3.5	1.9
Estonia	5.0	-0.3	-1.0	8.4	6.8	12.2
Ireland	5.6	0.4	-0.8	8.9	6.2	74.1
Greece	1.9	1.5	-2.0	2.1	2.3	-2.9
Spain	2.0	-2.8	-1.2	3.4	2.6	4.9
France	1.8	-3.0	-0.5	3.1	2.4	5.3
Croatia	2.9	0.4	-1.9	4.4	4.7	0.9
Italy	0.3	-1.6	-0.6	1.1	0.6	-1.7
Cyprus	3.1	1.7	-1.3	4.0	5.8	11.0
Latvia	2.0	-0.2	-1.1	4.4	6.3	-1.7
Lithuania	4.3	0.3	0.1	7.3	6.5	-7.6
Luxembourg	2.3	2.2	0.0	5.8	6.1	5.0
Hungary	4.6	-2.0	-0.3	9.6	9.9	15.5
Malta	5.5	0.5	-0.3	7.9	9.2	9.7
Netherlands	2.0	1.7	-0.4	5.0	4.4	10.8
Austria	1.4	0.7	-0.4	3.2	3.0	2.9
Poland	4.7	-0.7	-0.6	8.1	7.2	2.7
Portugal	2.5	0.2	-0.6	4.3	3.5	8.0
Romania	4.1	-4.3	-0.3	11.2	10.9	15.8
Slovenia	3.2	0.5	-0.6	5.5	6.3	3.2
Slovakia	2.5	-1.3	-0.7	5.1	6.7	6.6
Finland	1.3	-1.1	-0.7	2.8	2.5	-1.3
Sweden	2.0	0.5	0.4	4.6	3.0	1.0
United Kingdom	1.4	-2.1	-0.2	3.5	3.3	5.7
EU-28 (EUR)	**1.6**	**-0.8**	**-0.5**	**3.5**	**3.2**	**5.0**

Source: Eurostat.

b. VAT Regime Changes

2019 was a relatively stable year in terms of tax regime changes affecting the effective rates and the VTTL. Only one Member State implemented significant changes to the structure of its

statutory rates. As of January 2019, the Netherlands increased from 6 percent up to 9 percent the rate applicable to approximately 25 percent of household final consumption.[3]

In addition, four Member States reclassified the rates applicable to significant categories of products and services. As of February 2019, the list of services covered by the 10 percent reduced rate in Czechia was extended by the inclusion of ground and water transport of passengers and their luggage. In Slovakia, the rate for accommodation services was reduced from the standard 20 percent to the reduced 10 percent rate. In Greece, as of 2019, selected food and drink services were reclassified from the standard 23 percent rate to the reduced 13 percent rate, whereas accommodation services, domestic gas, and electricity were reclassified from 13 percent to the lower reduced rate of 6 percent. In Croatia, the application of the 13 percent reduced rate was extended, among others, to certain agricultural products, foodstuffs, and pharmaceuticals.

In other Member States, the VAT regime changes were rather minor. As part of these changes, following the agreement of the Council in October 2018,[4] throughout 2019 a number of Member States introduced reduced VAT rates on e-books. In addition, a few Member States (e.g. Austria and Hungary) introduced changes to the VAT registration thresholds.

Overall, the average effective rate remained unchanged compared to 2018 and accounted for approximately 12 percent.[5]

Table 1.2. VAT Rate Structure as of 31 December 2018 and Changes during 2019 (%)

Member State	Standard Rate (SR)	Reduced Rate(s) (RR)	Super-Reduced Rate	Parking Rate	Changes during 2019	Effective Rate[6]
Belgium	21	6 / 12	-	12	-	10.2%
Bulgaria	20	9	-	-	-	13.9%
Czechia	21	10 / 15		-	-	12.6%
Denmark	25	-	-	-	-	15.1%
Germany	19	7	-	-	-	10.6%
Estonia	20	9	-	-	-	12.7%
Ireland	23	9 / 13.5	4.8	13.5	-	11.8%
Greece	24	6 / 13	-	-	-	12.2%
Spain	21	10	4	-	-	8.8%
France	19.6	5.5 / 10	2.1	-	-	9.7%
Croatia	25	5 / 13	-	-	-	15.6%
Italy	22	10	4 / 5	-	-	9.9%

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[3] Own calculations.

[4] See: https://www.consilium.europa.eu/en/policies/reduced-vat-epublications

[5] Changes in the effective rate compared to the 2020 Report also result from the revision of the VTTL estimates and the statistical data underlying the estimates.

[6] The effective rate is the ratio of the VTTL and the tax base. See methodological considerations in Section c in Annex A.

Member State	Standard Rate (SR)	Reduced Rate(s) (RR)	Super-Reduced Rate	Parking Rate	Changes during 2019	Effective Rate[6]
Cyprus	19	5 / 9	-	-		9.7%
Latvia	21	12	5	-	-	11.8%
Lithuania	21	5 / 9	-	-	-	13.1%
Luxembourg	17	8	3	14	-	11.8%
Hungary	27	5 / 18	-	-	-	14.7%
Malta	18	5 / 7	-	-	-	12.0%
Netherlands	21	9	-	-	Reduced rate from 6 up to 9 percent	10.6%
Austria	20	10 / 13	-	12	-	11.3%
Poland	23	5 / 8	-	-	-	12.1%
Portugal	23	6 / 13	-	13	-	11.4%
Romania	20	5 / 9	-	-	-	12.5%
Slovenia	22	9.5	-	-	-	11.7%
Slovakia	20	10	-	-	-	11.2%
Finland	24	10 / 14	-	-	-	12.1%
Sweden	25	6 / 12	-	-	-	13.4%
UK	20	5	-	-	-	9.3%

Source: TAXUD, VAT Rates Applied in the Member States of the European Union: Situation of 1st January 2019.

c. Sources of Change in VAT Revenue Components

The value of the actual VAT revenue can be decomposed into components, which is helpful in understanding the underlying sources of its evolution. Since revenue is a product of the VTTL and the compliance ratio,[7] VAT collection could be expressed as:

Actual Revenue = VTTL × Compliance Ratio,

where Compliance Ratio is: 1 - *VAT Gap* (%).

As the VTTL is a product of the base and the effective rate, the actual revenue could be further decomposed and expressed as:[8]

Actual Revenue = Net Base × Effective Rate × Compliance Ratio,

where Effective Rate is the ratio of the theoretical VTTL to the Net Base. The Net Base (which is the sum of the final consumption and investment by households, non-profit institutions

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[7] In other words, VAT collection efficiency.

[8] Decomposition of sources of VAT revenue changes based on the equation does not account for interlinkages between the equation factors. As an example, in case of changes to *Compliance Ratio*, *Net Base* would also be affected as it includes among others non-compliant supplies.

serving households [NPISH], and government), in turn, is calculated as the difference between the Gross Base, which includes VAT, and the VAT revenues actually collected.

Figure 1.1 and Table 1.3 present the decomposition of the total changes in nominal VAT revenues into these three components: change in net taxable base, change in the effective rate applied to the base, and change in the compliance ratio.

Figure 1.1. Change in VAT Revenue Components (2019 over 2018, %)
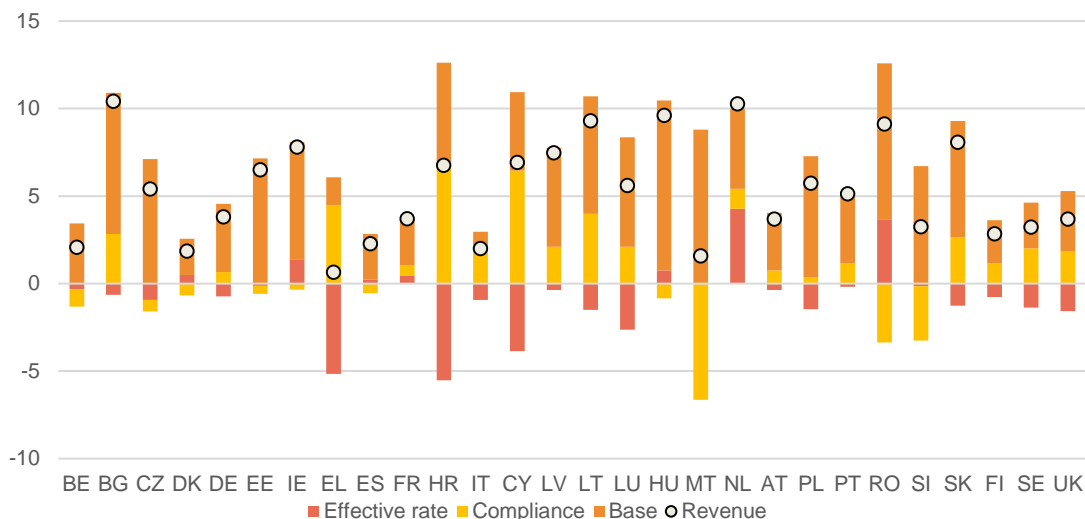
Source: own calculations.

As shown by Figure 1.1 and Table 1.3, and further discussed in the following section, the growth of revenue in 2019 was higher than the growth of the VTTL, which marks an improvement in VAT compliance. In the EU-28, the increase in the compliance or, in other words, efficiency of VAT collections, led to an increase of revenue by nearly one percent. The remaining growth of the receipts was driven by the increase of the VTTL. Overall, thanks to an increase in the VAT base, the VTTL went up by approximately three percent despite somewhat of a decrease of the effective rate (of approximately 0.4 percent).

For more than half of EU Member States, both the tax base and compliance effects were positive. In addition, in the majority of Member States, the effective rate went down. The shifts in the effective rates result from both changes in statutory VAT rules and changes in the structure of tax base.

Table 1.3. Change in VAT Revenue Components (2019 over 2018)

Member State	Change in Revenue	Change in the VTTL			Change in Compliance
			Change in Base	Change in Effective Rate	
Belgium	2.1%	3.1%	3.4%	-0.3%	-1.0%
Bulgaria	10.4%	7.4%	8.1%	-0.6%	2.8%
Czechia	5.4%	6.1%	7.1%	-0.9%	-0.7%
Denmark	1.9%	2.6%	2.1%	0.5%	-0.7%

Germany	3.8%	3.1%	3.9%	-0.7%	0.7%
Estonia	6.5%	7.0%	7.1%	-0.1%	-0.5%
Ireland	7.8%	8.2%	6.7%	1.4%	-0.3%
Greece	0.7%	-3.6%	1.6%	-5.2%	4.5%
Spain	2.3%	2.9%	2.6%	0.2%	-0.5%
France	3.7%	3.1%	2.6%	0.5%	0.6%
Croatia	6.8%	-0.1%	5.8%	-5.5%	6.8%
Italy	2.0%	-0.1%	0.9%	-0.9%	2.1%
Cyprus	6.9%	0.5%	4.5%	-3.9%	6.5%
Latvia	7.5%	5.3%	5.6%	-0.4%	2.1%
Lithuania	9.3%	5.1%	6.7%	-1.5%	4.0%
Luxembourg	5.6%	3.4%	6.2%	-2.6%	2.1%
Hungary	9.6%	10.5%	9.7%	0.8%	-0.8%
Malta	1.6%	8.8%	8.8%	0.0%	-6.6%
Netherlands	10.3%	9.0%	4.6%	4.3%	1.1%
Austria	3.7%	2.9%	3.3%	-0.4%	0.7%
Poland	5.7%	5.4%	6.9%	-1.5%	0.3%
Portugal	5.1%	3.9%	4.1%	-0.2%	1.2%
Romania	9.1%	12.9%	8.9%	3.7%	-3.4%
Slovenia	3.3%	6.6%	6.7%	-0.2%	-3.1%
Slovakia	8.1%	5.3%	6.7%	-1.3%	2.6%
Finland	2.9%	1.7%	2.5%	-0.8%	1.2%
Sweden	3.2%	1.2%	2.6%	-1.4%	2.0%
United Kingdom	3.7%	1.8%	3.4%	-1.6%	1.8%
EU-28 (average)	**3.9%**	**3.0%**	**3.4%**	**-0.4%**	**0.9%**

Source: own calculations.

2. The VAT Gap in 2019

The estimates of the VAT Gap presented in this section were derived using a top-down "consumption-side" approach, which hinges on calculating the expected VAT liability from the national accounts' supply and use tables (SUT) using parameters on the model derived mostly from household budget surveys and fiscal data. For this reason, the accuracy of estimates relies largely on the quality of national accounts figures and precise estimation of parameters.

In the approach taken, the VTTL is estimated for final household, government, and NPISH expenditures; non-deductible VAT from the intermediate consumption of exempt industries; and VAT from the GFCF of exempt sectors. We also account for country-specific tax regulations, such as exemptions for small businesses under the VAT thresholds (if applicable); non-deductible business expenditures on food, drinks, and accommodation; and restrictions to deduct VAT on leased cars, among others. The precise formula is given in Section c in Annex A.

Importantly, the results presented in this Report are not fully comparable with the results presented in the earlier Studies, as each year some figures are revised backwards. The main source of the revisions are the updates of national accounts and revenue figures compiled by

Member States. Moreover, in the course of our computations, some expenditure and investment figures that are not available for the most recent years are estimated. Thus, whenever actual national accounts data is published or new information on taxable investment becomes available, VAT Gap estimates need to be revised. A detailed discussion on the sources of the revisions is presented in Section a in Annex A. To allow for comparability between the estimates with past estimates outside the scope of this Study, Annex B presents the estimates corrected to large extent for the above-mentioned revisions.[9]

This section looks at the evolution of the VAT Gap in the time horizon of 2015-2019. As shown by Figure 2.1, the VAT Gap was gradually declining over the entire analysed time frame. In 2019, the Gap amounted to EUR 134 billion in nominal terms and 10.3 percent expressed as a share of the VTTL. Compared to 2018, the Gap went down by approximately 0.8 pp. and EUR 6.6 billion. Overall, between 2015 and 2019, the Gap declined by EUR 18 billion in spite of a significant increase in the tax base. In relative terms – that is, denoted as the share in the VTTL, it declined by 2.6 pp., which stands for more than 20 percent of the VAT Gap observed in 2015. In other words, more than one-fifth of the VAT Gap was reduced over a five-year period

Figure 2.1. Evolution of the VAT Gap in the EU, 2015-2019
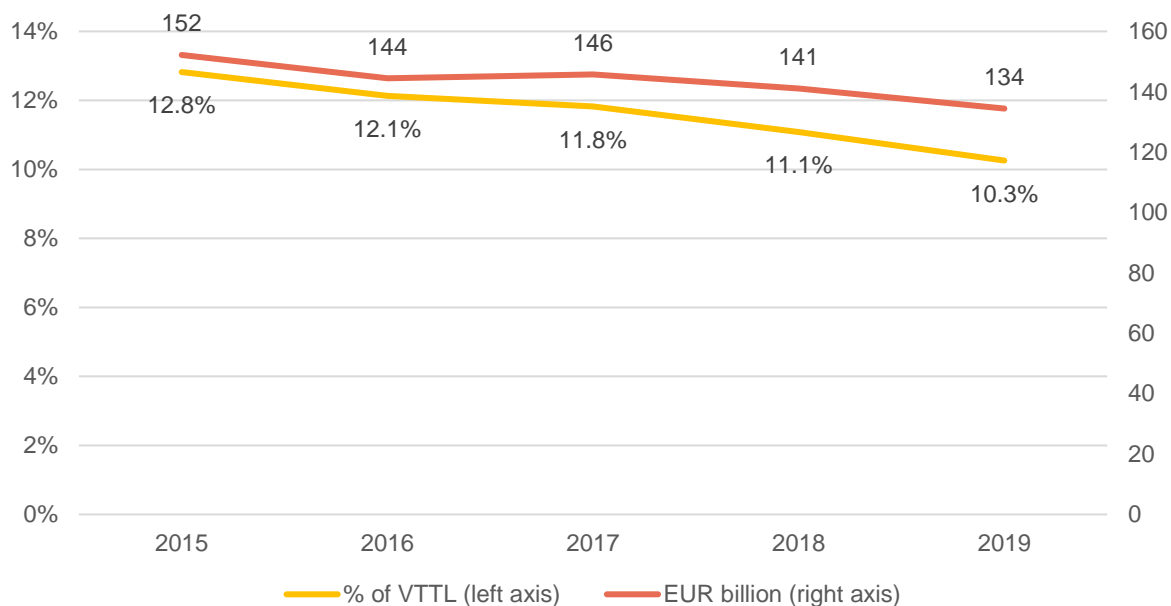
Source: own calculations.

In nominal terms, in 2019, the VTTL and VAT revenue amounted to EUR 1,311 billion and EUR 1,176 billion, respectively. As highlighted in the previous chapter, compared to 2018, VAT revenue increased by 3.8 percent whereas the VTTL increased by 2.9 percent, leading to a decline in the VAT Gap in both relative and nominal terms. The estimates for the majority of Member States lie in the range of 5 to 15 percent of the VTTL. The smallest Gaps were observed in Croatia (1 percent), Sweden (1.4 percent), and Cyprus (2.7 percent), the largest

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[9] The method used to rescale the results for past years is a "backcasting" procedure. The procedure is discussed in more detail in Chapter 5. Despite the corrections, the margin of error around these estimates is larger than for the results covering 2015-2019.

– in Romania (34.9 percent), Greece (25.8 percent), and Malta (23.5 percent). Half of the EU-28 Member States recorded a Gap above 8.6 percent (see Figure 2.2 and Table 2.1).

Figure 2.2. VAT Gap as a percent of the VTTL in EU-28 Member States, 2019 and 2018 (percent)
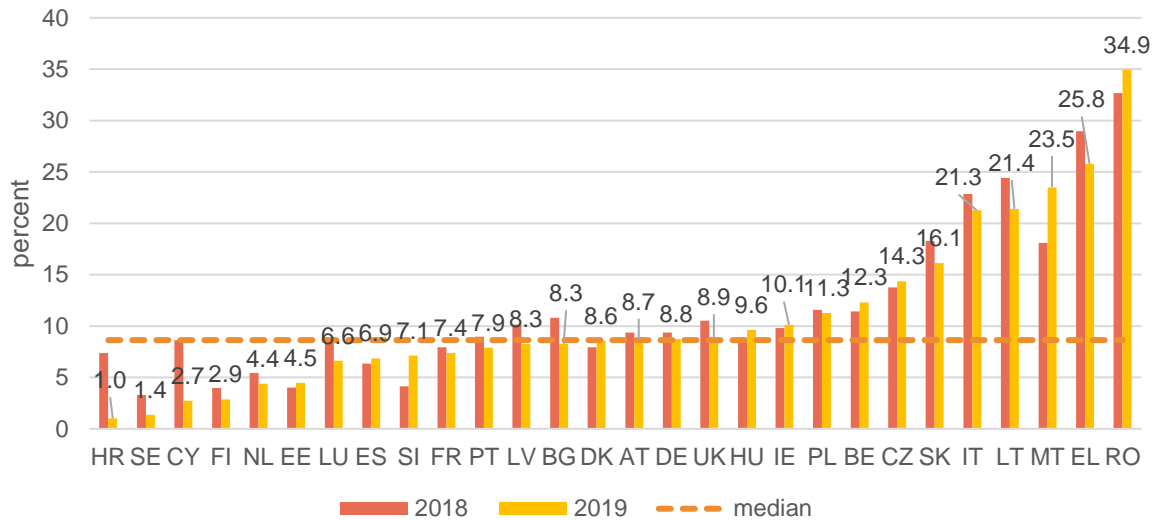
Source: own calculations.

In most Member States, the absolute year-over-year change in the VAT Gap was lower than 2 pp. However, in some Member States, the estimated shifts in the VAT Gap were relatively large, leading to a significant change compared to other countries. The largest changes in the VAT Gap were observed for Croatia, Cyprus, and Malta (decline by 6.3 pp., decline by 5.9 pp., and incline of 5.4 pp., respectively).[10] Overall, the VAT Gap share decreased in 18 countries. In addition to Croatia and Cyprus, the most significant decreases in the VAT Gap occurred in Greece (-3.2 pp.) and Lithuania (-3 pp). The biggest increases, apart from Malta, were observed for Slovenia (+3 pp.) and Romania (+2.3 pp.) (see Figure 2.3).

The fast estimates presented for 18 Member States in Annex B do not allow yet to judge whether the EU-wide VAT Gap will decline or incline in 2020. In about half of the Member States covered, the Gap as a percent of the VTTL was estimated to increase, and in the other half – to decrease. As described in the 2020 Study, the contraction of the EU economy was expected to worsen conditions for improving compliance. However, the financial support measures introduced by many Member States contingent on paying taxes, deferrals, temporary reduced rates, and increases in electronic payments could have prevented the growth of non-compliance, at least for the year 2020.

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[10] Large drop in the VAT Gap for Croatia, Cyprus and Malta will be further scrutinised when additional information on the growth of tax base in 2019 becomes available. In addition, the estimates for Cyprus could be subject to revisions after the publication by Eurostat of updated revenue figures.

Figure 2.3. Percentage Point Change in VAT Gap, 2019 over 2018
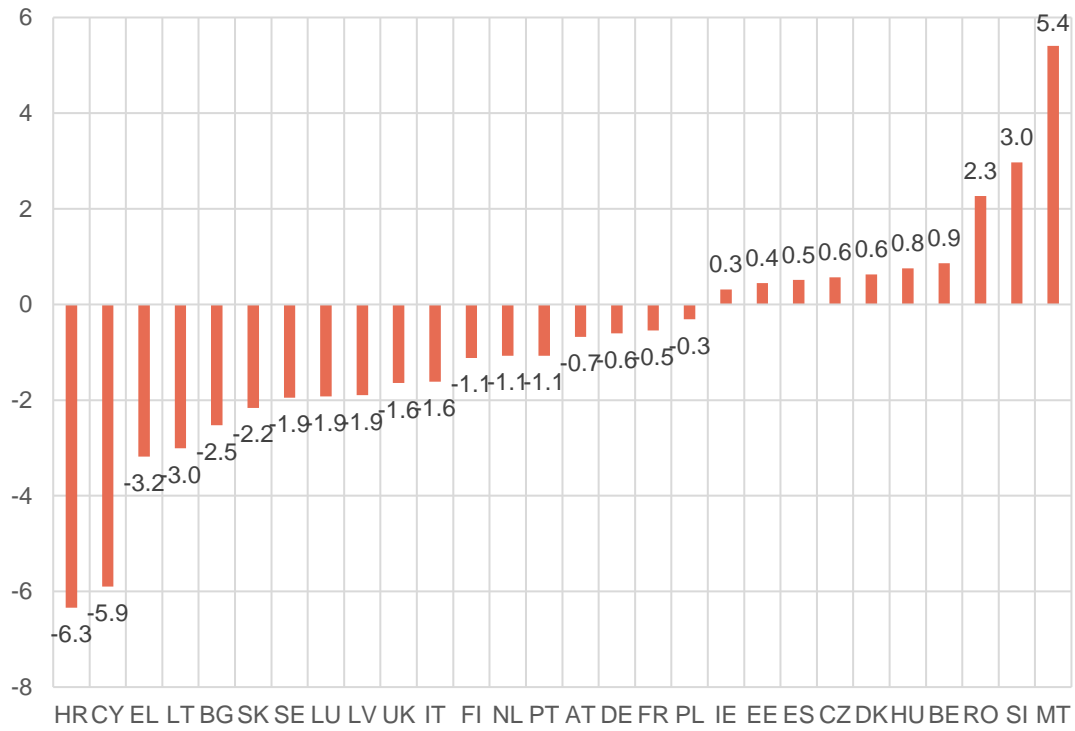
Source: own calculations.

Figure 2.4. VAT Gap in EU Member States, 2015-2019
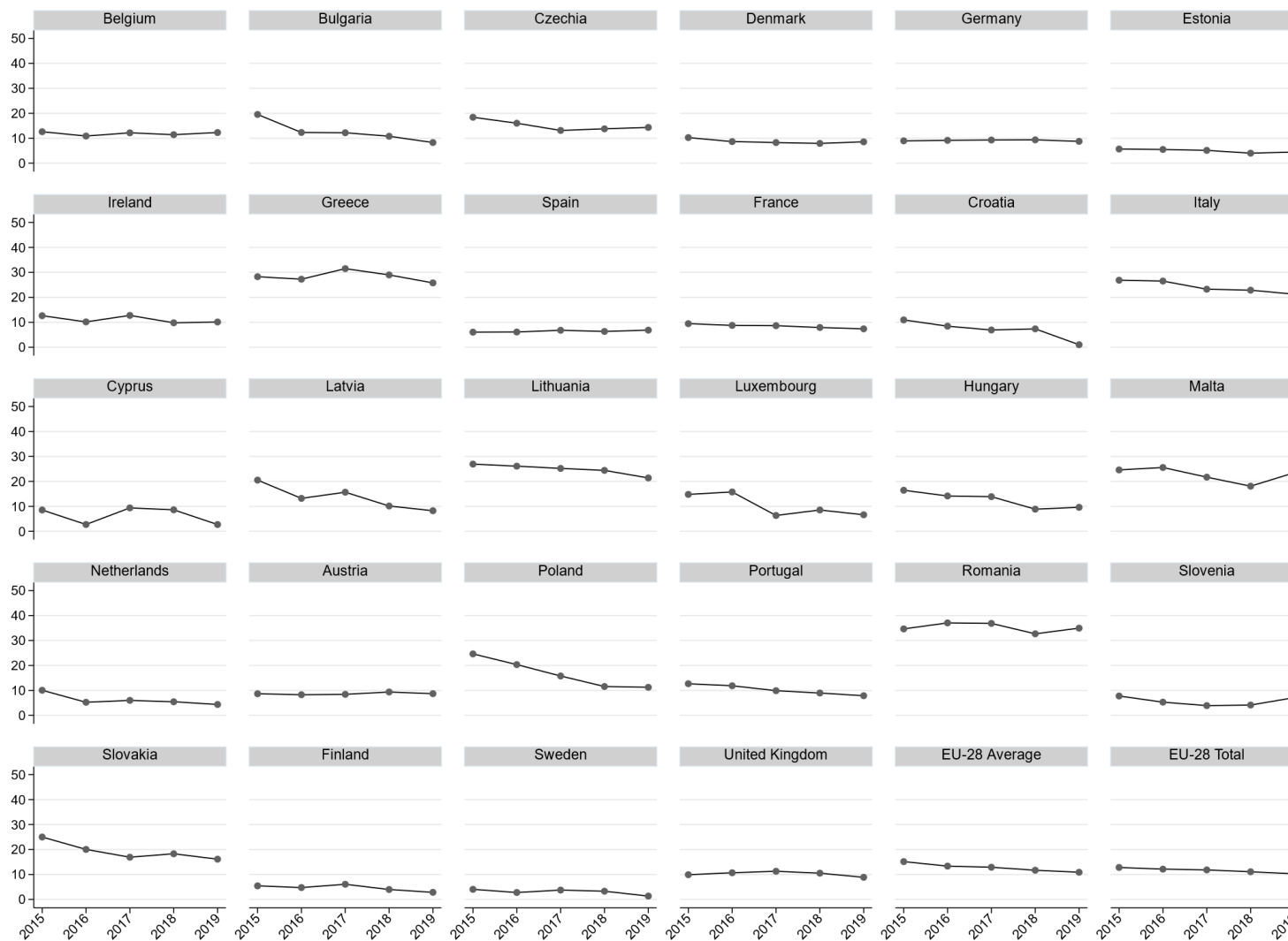
Source: own calculations.

Table 2.1. VAT Gap as a percent of the VTTL and in EUR million in EU-28 Member States, 2018 and 2019

MS	2018				2019				VAT Gap Change (pp.)
	Revenues	VTTL	VAT Gap	VAT Gap (%)	Revenues	VTTL	VAT Gap	VAT Gap (%)	
BE	31,053	35,060	4,007	11.4%	31,702	36,146	4,444	12.3%	0.9
BG	5,097	5,714	617	10.8%	5,628	6,136	508	8.3%	-2.5
CZ	16,075	18,642	2,567	13.8%	16,931	19,766	2,835	14.3%	0.6
DK	29,137	31,653	2,516	7.9%	29,632	32,410	2,778	8.6%	0.6
DE	235,130	259,421	24,291	9.4%	244,111	267,554	23,443	8.8%	-0.6
EE	2,331	2,428	98	4.0%	2,483	2,599	116	4.5%	0.4
IE	14,175	15,716	1,541	9.8%	15,281	17,002	1,721	10.1%	0.3
EL	15,288	21,525	6,237	29.0%	15,390	20,740	5,350	25.8%	-3.2
ES	77,536	82,788	5,252	6.3%	79,308	85,148	5,840	6.9%	0.5
FR	167,720	182,148	14,428	7.9%	173,953	187,811	13,858	7.4%	-0.5
HR	6,949	7,501	553	7.4%	7,419	7,497	77	1.0%	-6.3
IT	109,333	141,748	32,415	22.9%	111,533	141,639	30,106	21.3%	-1.6
CY	1,817	1,988	171	8.6%	1,943	1,998	54	2.7%	-5.9
LV	2,449	2,726	277	10.2%	2,632	2,869	237	8.3%	-1.9
LT	3,522	4,660	1,137	24.4%	3,850	4,898	1,048	21.4%	-3.0
LU	3,563	3,896	333	8.5%	3,763	4,030	267	6.6%	-1.9
HU	12,950	14,210	1,261	8.9%	13,916	15,398	1,483	9.6%	0.8
MT	920	1,123	203	18.1%	934	1,221	287	23.5%	5.4
NL	52,712	55,751	3,039	5.5%	58,131	60,791	2,660	4.4%	-1.1
AT	29,323	32,356	3,033	9.4%	30,405	33,301	2,895	8.7%	-0.7
PL	40,423	45,711	5,288	11.6%	42,383	47,762	5,379	11.3%	-0.3
PT	17,868	19,627	1,759	9.0%	18,786	20,395	1,609	7.9%	-1.1
RO	12,890	19,148	6,258	32.7%	13,795	21,206	7,411	34.9%	2.3
SI	3,765	3,928	163	4.1%	3,888	4,186	298	7.1%	3.0
SK	6,319	7,734	1,414	18.3%	6,830	8,143	1,313	16.1%	-2.2
FI	21,364	22,248	884	4.0%	21,974	22,620	646	2.9%	-1.1
SE	43,403	44,886	1,483	3.3%	43,412	44,009	597	1.4%	-1.9
UK	168,703	188,538	19,835	10.5%	176,317	193,493	17,176	8.9%	-1.6
Total EU-28	1,131,814	1,272,872	141,059	11.1%	1,176,331	1,310,768	134,436	10.3%	-0.8
Median				9.4%				8.6%	

Source: own calculations.

3. Individual Country Results

Table 3.1. Belgium: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**31,578**	**32,263**	**33,888**	**35,060**	**36,146**
o/w liability on household final consumption	**17,855**	**18,522**	**19,150**	**19,831**	**20,181**
o/w liability on government and NPISH final consumption	**1,435**	**1,272**	**1,401**	**1,451**	**1,493**
o/w liability on intermediate consumption	**6,697**	**7,017**	**7,331**	**7,652**	**7,952**
o/w liability on GFCF	**4,957**	**4,808**	**5,319**	**5,455**	**5,804**
o/w net adjustments	**634**	**644**	**688**	**672**	**716**
VAT Revenue	**27,594**	**28,750**	**29,763**	**31,053**	**31,702**
VAT GAP	**3,984**	**3,513**	**4,126**	**4,007**	**4,444**
VAT GAP as a percent of VTTL	**12.6%**	**10.9%**	**12.2%**	**11.4%**	**12.3%**
VAT GAP change since 2015					**-0.3 pp**
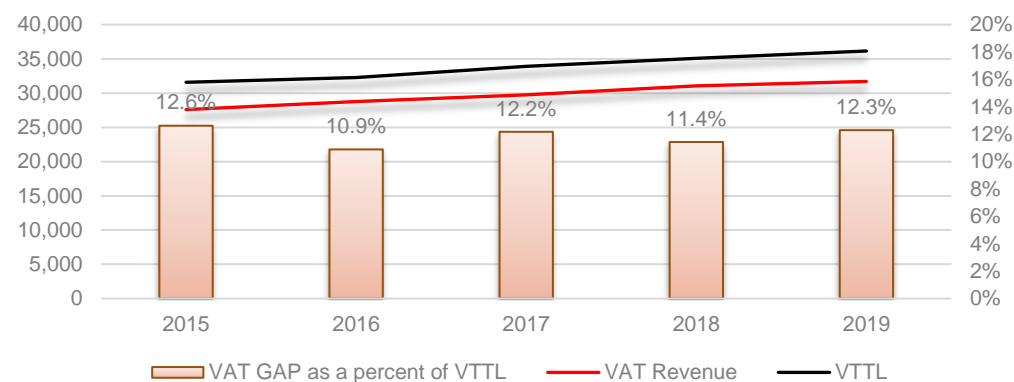
Highlights

- In 2019, the VAT Gap accounted for 12.3 percent of the VTTL (an incline of 0.9 pp. compared to 2018).

- The VAT revenue reported for Belgium by Eurostat contains *VAT assessed but unlikely to be collected*. This component ranging from EUR 357 million in 2015 to EUR 492 million 2018 was removed from the reference figures to ensure comparability with other EU Member States.

Table 3.2. Bulgaria: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (BGN million)

	2015	2016	2017	2018	2019
VTTL	**9,867**	**9,853**	**10,388**	**11,175**	**12,000**
o/w liability on household final consumption	**7,071**	**7,258**	**7,780**	**8,286**	**8,885**
o/w liability on government and NPISH final consumption	**275**	**284**	**298**	**341**	**383**
o/w liability on intermediate consumption	**1,110**	**1,151**	**1,256**	**1,413**	**1,503**
o/w liability on GFCF	**1,328**	**1,143**	**1,041**	**1,110**	**1,213**
o/w net adjustments	**82**	**16**	**14**	**24**	**17**
VAT Revenue	**7,940**	**8,639**	**9,121**	**9,968**	**11,007**
VAT GAP	**1,927**	**1,214**	**1,267**	**1,207**	**994**
VAT GAP as a percent of VTTL	**19.5%**	**12.3%**	**12.2%**	**10.8%**	**8.3%**
VAT GAP change since 2015					**-11.3 pp**
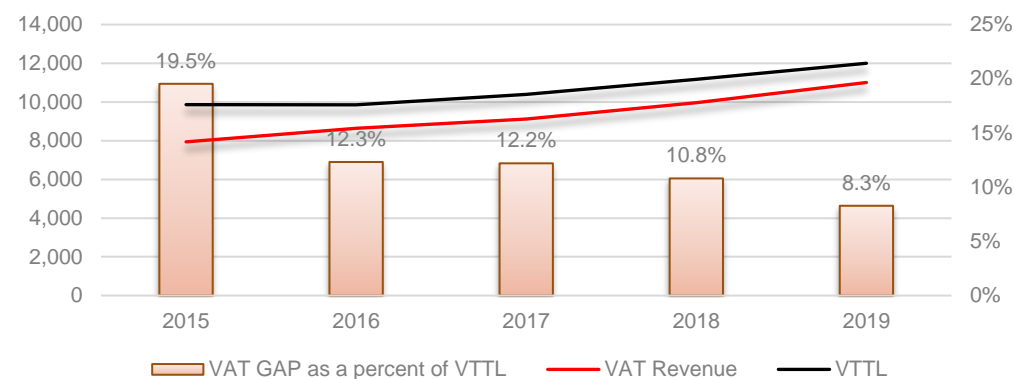
Highlights

- The VAT Gap in Bulgaria in 2019 amounted to 8.3 percent of the VTTL (decline of 2.5 pp. year-over-year), which is slightly below the EU median.

- Over the entire analysed period from 2015 to 2019, Bulgaria recorded one of the most remarkable decreases of the VAT Gap (of 11.3 pp.).

Table 3.3. Czechia: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (CZK million)

	2015	2016	2017	2018	2019
VTTL	**414,003**	**421,750**	**445,597**	**478,111**	**507,390**
o/w liability on household final consumption	**257,709**	**267,630**	**280,660**	**293,848**	**306,333**
o/w liability on government and NPISH final consumption	**21,056**	**21,601**	**20,740**	**22,969**	**25,750**
o/w liability on intermediate consumption	**76,083**	**79,469**	**84,390**	**89,868**	**98,878**
o/w liability on GFCF	**59,799**	**53,287**	**59,904**	**69,897**	**75,035**
o/w net adjustments	**-645**	**-238**	**-97**	**1,529**	**1,396**
VAT Revenue	**337,774**	**354,181**	**387,074**	**412,271**	**434,627**
VAT GAP	**76,229**	**67,569**	**58,523**	**65,840**	**72,763**
VAT GAP as a percent of VTTL	**18.4%**	**16.0%**	**13.1%**	**13.8%**	**14.3%**
VAT GAP change since 2015					**-4.1 pp**
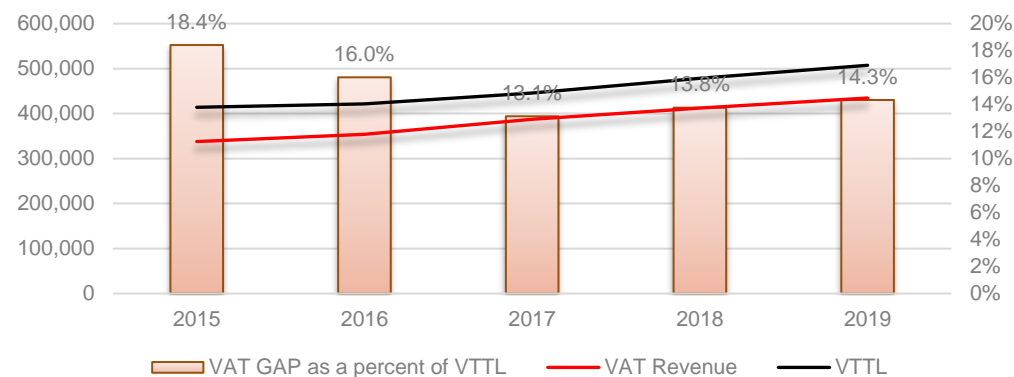
Highlights

- The VAT Gap in Czechia accounted for 14.3 percent of the VTTL in 2019 (incline of 0.5 pp. compared to 2018).

- The revenue was amended to more accurately reflect tax accrued to taxation period on the basis of information received from the Tax Authorities. For 2019, VAT revenue reported by Eurostat was revised downwards by approximately CZK 0.8 billion.

- By February 2019, the list of services covered by the 10 percent reduced rate was extended by the inclusion of certain transportation services.

Table 3.4. Denmark: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (DKK million)

	2015	2016	2017	2018	2019
VTTL	**213,396**	**218,207**	**227,450**	**235,914**	**241,980**
o/w liability on household final consumption	**123,843**	**128,717**	**134,280**	**139,146**	**142,246**
o/w liability on government and NPISH final consumption	**5,395**	**5,114**	**5,309**	**5,421**	**5,477**
o/w liability on intermediate consumption	**53,321**	**51,615**	**53,627**	**55,196**	**57,029**
o/w liability on GFCF	**25,372**	**27,095**	**28,457**	**30,334**	**31,320**
o/w net adjustments	**5,465**	**5,668**	**5,776**	**5,817**	**5,908**
VAT Revenue	**191,479**	**199,306**	**208,643**	**217,164**	**221,237**
VAT GAP	**21,917**	**18,901**	**18,807**	**18,750**	**20,743**
VAT GAP as a percent of VTTL	**10.3%**	**8.7%**	**8.3%**	**7.9%**	**8.6%**
VAT GAP change since 2015					**-1.7 pp**
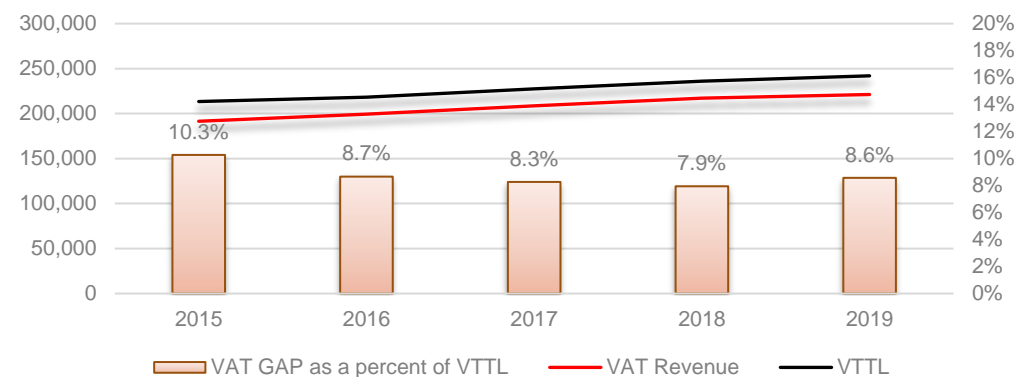
Highlights

- The VAT Gap in Denmark went slightly up to 8.6 percent of the VTTL in 2019. In 2020, the Gap is expected to decline (see Annex B).

- The VAT Gap was relatively stable between 2016-2019. Compared to 2015, the VAT Gap went down by approximately 1.7 pp.

Table 3.5. Germany: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**232,436**	**240,870**	**249,909**	**259,421**	**267,554**
o/w liability on household final consumption	**140,938**	**145,822**	**149,860**	**154,352**	**158,305**
o/w liability on government and NPISH final consumption	**6,553**	**6,823**	**6,924**	**7,255**	**7,625**
o/w liability on intermediate consumption	**44,879**	**46,974**	**49,403**	**51,383**	**52,928**
o/w liability on GFCF	**37,843**	**39,483**	**41,422**	**44,163**	**46,582**
o/w net adjustments	**2,223**	**1,768**	**2,300**	**2,268**	**2,113**
VAT Revenue	**211,616**	**218,779**	**226,697**	**235,130**	**244,111**
VAT GAP	**20,820**	**22,091**	**23,212**	**24,291**	**23,443**
VAT GAP as a percent of VTTL	**9.0%**	**9.2%**	**9.3%**	**9.4%**	**8.8%**
VAT GAP change since 2015					**-0.2 pp**
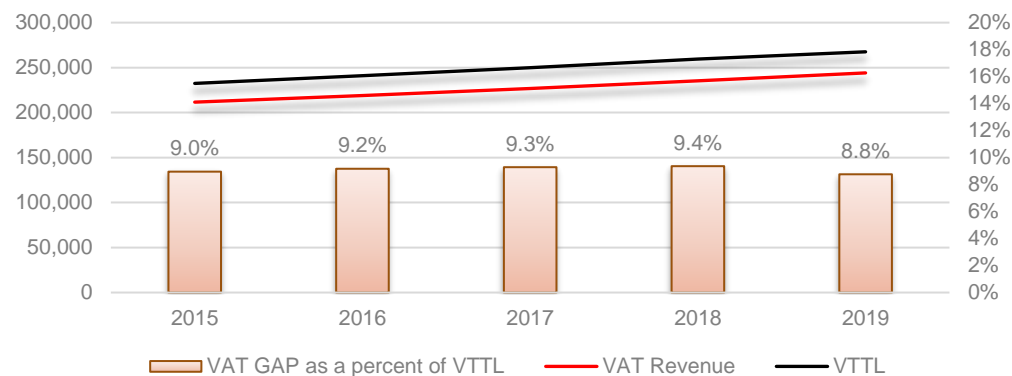
Highlights

- Over the period 2015-2019, the VAT Gap in Germany was more stable than in any other EU Member State, amounting on average to approximately 9.1 percent of the VTTL.

- In 2019, the estimate was approximately 8.8 percent of the VTTL (decline of 0.6 pp. year-over-year).

Table 3.6. Estonia: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**1,986**	**2,090**	**2,265**	**2,428**	**2,599**
o/w liability on household final consumption	**1,374**	**1,436**	**1,525**	**1,652**	**1,746**
o/w liability on government and NPISH final consumption	**35**	**64**	**68**	**76**	**82**
o/w liability on intermediate consumption	**244**	**262**	**281**	**299**	**322**
o/w liability on GFCF	**323**	**318**	**381**	**398**	**443**
o/w net adjustments	**9**	**11**	**11**	**4**	**5**
VAT Revenue	**1,873**	**1,975**	**2,149**	**2,331**	**2,483**
VAT GAP	**113**	**115**	**117**	**98**	**116**
VAT GAP as a percent of VTTL	**5.7%**	**5.5%**	**5.2%**	**4.0%**	**4.5%**
VAT GAP change since 2015					**-1.2 pp**
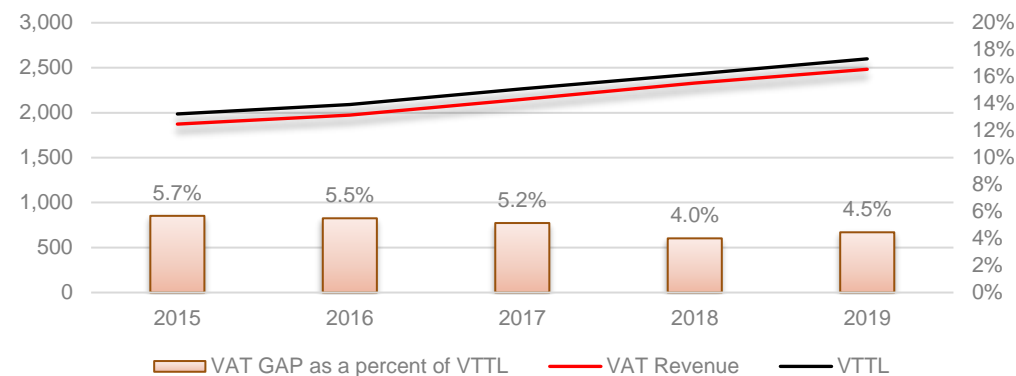
Highlights

- Over the period 2015-2019, the VAT Gap in Estonia has remained one of the lowest and most stable in the EU ranging between 4 and 5.7 percent of the VTTL.

- In 2019, the Gap amounted to 4.5 percent of the VTTL and EUR 116 million.

Table 3.7. Ireland: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**13,543**	**14,028**	**14,970**	**15,716**	**17,002**
o/w liability on household final consumption	7,732	7,816	8,786	8,655	9,708
o/w liability on government and NPISH final consumption	183	202	171	148	157
o/w liability on intermediate consumption	3,808	3,820	3,960	4,428	4,081
o/w liability on GFCF	1,649	1,995	1,839	2,301	2,787
o/w net adjustments	172	195	214	184	269
VAT Revenue	**11,831**	**12,603**	**13,060**	**14,175**	**15,281**
VAT GAP	**1,712**	**1,426**	**1,910**	**1,541**	**1,721**
VAT GAP as a percent of VTTL	**12.6%**	**10.2%**	**12.8%**	**9.8%**	**10.1%**
VAT GAP change since 2015					**-2.5 pp**
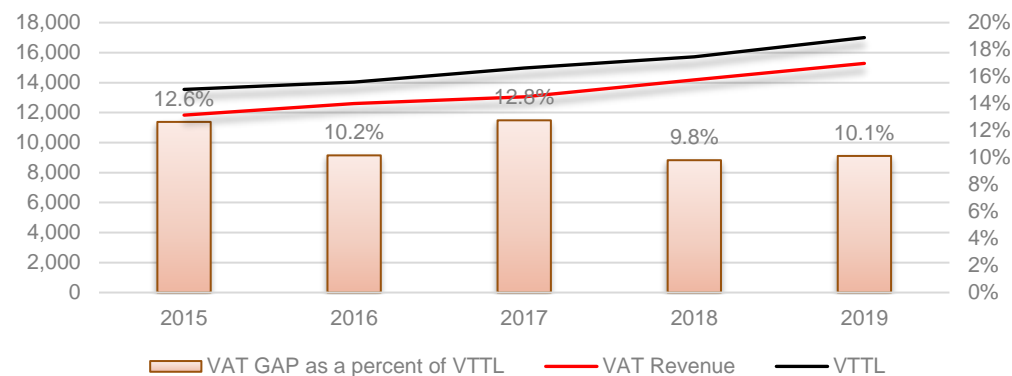
Highlights

- The VAT Gap in Ireland was approximately 10.1 percent of the VTTL.

- The Gap went up by approximately 0.3 pp. year-over-year and was approximately 2.5 pp. lower than in 2015.

Table 3.8. Greece: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**17,965**	**19,707**	**21,372**	**21,525**	**20,740**
o/w liability on household final consumption	**13,459**	**15,268**	**16,396**	**16,830**	**16,391**
o/w liability on government and NPISH final consumption	**615**	**698**	**746**	**738**	**747**
o/w liability on intermediate consumption	**1,988**	**2,105**	**2,315**	**2,336**	**2,150**
o/w liability on GFCF	**1,641**	**1,355**	**1,605**	**1,332**	**1,135**
o/w net adjustments	**263**	**281**	**310**	**288**	**317**
VAT Revenue	**12,885**	**14,333**	**14,642**	**15,288**	**15,390**
VAT GAP	**5,080**	**5,374**	**6,730**	**6,237**	**5,350**
VAT GAP as a percent of VTTL	**28.3%**	**27.3%**	**31.5%**	**29.0%**	**25.8%**
VAT GAP change since 2015					**-2.5 pp**
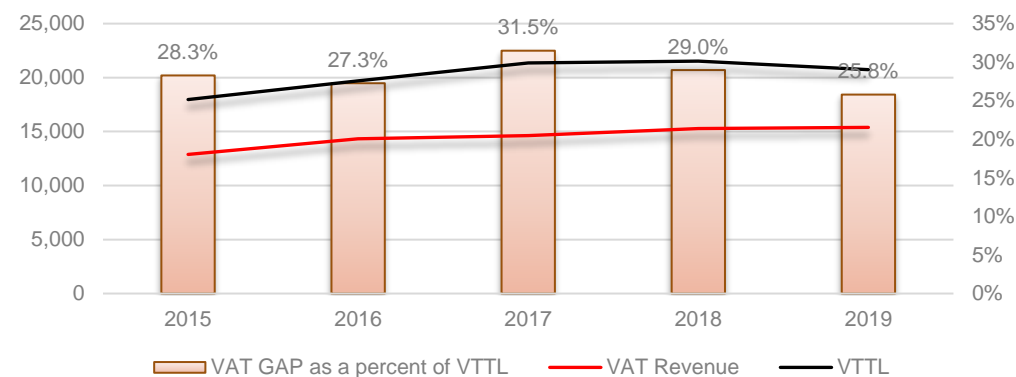
Highlights

- VAT compliance in Greece showed a significant improvement since 2017.

- The Gap decreased to 25.8 percent of the VTTL (3.2 pp. down from 2018 and 5.7 pp. down from 2017).

- As of 2019, selected food and drink services were reclassified from the standard 24 percent rate to the reduced 13 percent rate, whereas accommodation services, domestic gas, and electricity were reclassified from 13 percent to the lower reduced rate of 6 percent.

Table 3.9a. Spain: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**72,283**	**74,791**	**79,381**	**82,788**	**85,148**
o/w liability on household final consumption	**52,864**	**55,178**	**58,695**	**60,507**	**61,919**
o/w liability on government and NPISH final consumption	**2,433**	**2,494**	**2,715**	**2,834**	**3,003**
o/w liability on intermediate consumption	**8,451**	**8,552**	**9,244**	**9,880**	**10,340**
o/w liability on GFCF	**7,777**	**7,891**	**7,981**	**8,751**	**9,044**
o/w net adjustments	**759**	**675**	**746**	**816**	**841**
VAT Revenue	**67,913**	**70,214**	**73,970**	**77,536**	**79,308**
VAT GAP	**4,370**	**4,577**	**5,411**	**5,252**	**5,840**
VAT GAP as a percent of VTTL	**6.0%**	**6.1%**	**6.8%**	**6.3%**	**6.9%**
VAT GAP change since 2015					**+0.9 pp**
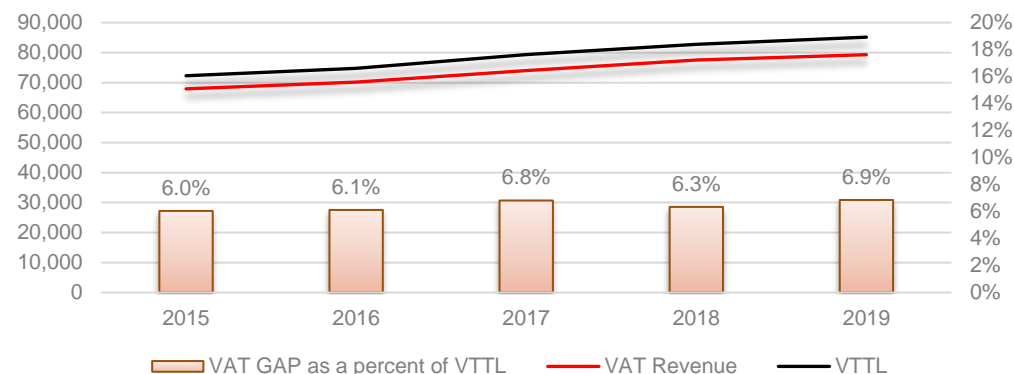
Highlights

- Between 2015 and 2019, the VAT Gap has remained relatively stable, ranging from 6 to 6.9 percent of the VTTL.

- In 2019, the Gap went slightly up (by 0.6 pp.).

Table 3.9b. Spain: Alternative Estimates

Spain	2015	2016	2017	2018	2019
VTTL based on alternative data	70,887	72,803	76,419	79,726	81,958
VAT Gap based on alternative data	2,177	2,076	189	662	42
VAT Gap based on alternative data, as a percent of VTTL	3.1%	2.9%	2.5%	0.8%	0.1%

Note: Adjusting VAT revenue to an accrual recording criteria based on tax form information and adjusting the VTTL for the difference between national accounting and tax conventions in the construction sector based on the data received from Spanish Tax Authorities led to a downward revision of the VAT Gap for the entire period 2015-2019 with the largest discrepancy compared to headline estimates observed for 2019.

Table 3.10. France: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**167,521**	**169,342**	**177,340**	**182,148**	**187,811**
o/w liability on household final consumption	**98,826**	**100,505**	**102,950**	**105,752**	**108,530**
o/w liability on government and NPISH final consumption	**1,631**	**1,695**	**1,737**	**1,755**	**1,783**
o/w liability on intermediate consumption	**30,159**	**30,503**	**31,778**	**32,404**	**33,123**
o/w liability on GFCF	**31,667**	**31,450**	**35,807**	**36,965**	**38,560**
o/w net adjustments	**5,238**	**5,189**	**5,067**	**5,272**	**5,815**
VAT Revenue	**151,680**	**154,490**	**162,011**	**167,720**	**173,953**
VAT GAP	**15,841**	**14,852**	**15,329**	**14,428**	**13,858**
VAT GAP as a percent of VTTL	**9.5%**	**8.8%**	**8.6%**	**7.9%**	**7.4%**
VAT GAP change since 2015					**-2.1 pp**
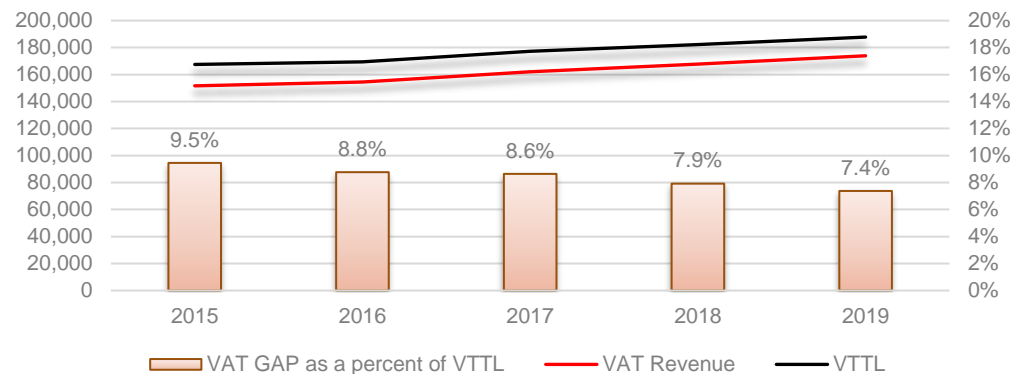
Highlights

- Between 2015 and 2019, the VAT Gap in France followed a downward sloping trend.

- In 2019, the Gap went down to 7.4 percent of the VTTL and EUR 13.9 billion (decline of approximately 0.5 pp. and EUR 570 million).

Table 3.11. Croatia: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (HRK million)

	2015	2016	2017	2018	2019
VTTL	**48,731**	**49,308**	**51,845**	**55,647**	**55,609**
o/w liability on household final consumption	**35,120**	**36,107**	**38,267**	**40,334**	**40,506**
o/w liability on government and NPISH final consumption	**1,617**	**1,469**	**1,631**	**1,436**	**1,262**
o/w liability on intermediate consumption	**6,826**	**7,307**	**7,468**	**7,646**	**7,858**
o/w liability on GFCF	**4,508**	**4,274**	**4,377**	**6,080**	**5,824**
o/w net adjustments	**660**	**151**	**102**	**151**	**159**
VAT Revenue	**43,387**	**45,143**	**48,251**	**51,546**	**55,036**
VAT GAP	**5,344**	**4,165**	**3,594**	**4,102**	**574**
VAT GAP as a percent of VTTL	**11.0%**	**8.4%**	**6.9%**	**7.4%**	**1.0%**
VAT GAP change since 2015					**-9.9 pp**
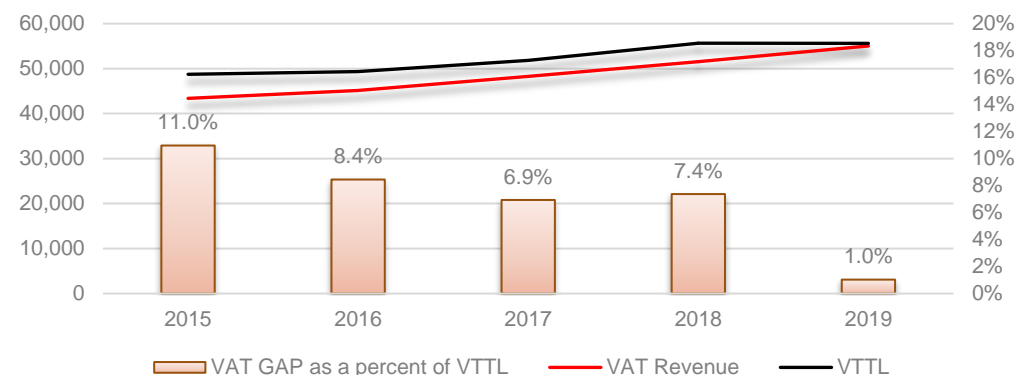
Highlights

- In 2019, the VAT Gap in Croatia decreased significantly from 7.4 percent to 1 percent of the VTTL.

- Additionally, revenue increased significantly despite a far-reaching extension of the application of the reduced rate. As of 2019, the 13 percent reduced rate was extended, among others, to certain agricultural products, foodstuffs, and pharmaceuticals.

- Very low estimates for 2019 and a large drop between 2019 and 2018 will be further scrutinised when additional information on the growth of tax base components becomes available.

Table 3.12a. Italy: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**137,201**	**138,938**	**140,187**	**141,748**	**141,639**
o/w liability on household final consumption	**98,134**	**99,321**	**100,323**	**101,726**	**103,285**
o/w liability on government and NPISH final consumption	**2,207**	**2,343**	**1,689**	**1,729**	**1,671**
o/w liability on intermediate consumption	**21,250**	**21,634**	**22,324**	**22,325**	**22,896**
o/w liability on GFCF	**13,318**	**13,883**	**14,342**	**14,560**	**15,085**
o/w net adjustments	**2,292**	**1,757**	**1,509**	**1,407**	**-1,297**
VAT Revenue	**100,345**	**102,086**	**107,576**	**109,333**	**111,533**
VAT GAP	**36,856**	**36,852**	**32,611**	**32,415**	**30,106**
VAT GAP as a percent of VTTL	**26.9%**	**26.5%**	**23.3%**	**22.9%**	**21.3%**
VAT GAP change since 2015					**-5.6 pp**
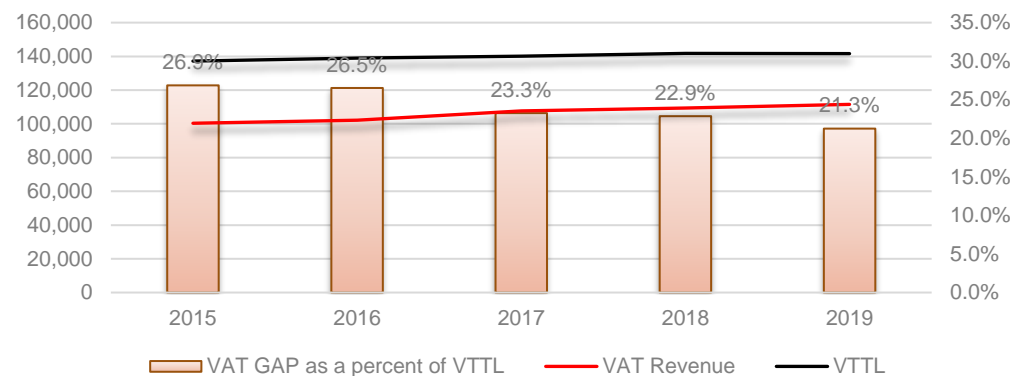
Highlights

- Over the analysed period, the VAT Gap in Italy has followed a downward sloping trend, reaching 21.3 percent of the VTTL in 2019 (5.6 pp. improvement since 2015).

- In 2019, the VAT registration threshold increased from EUR 35,000 up to EUR 65,000.

Table 3.12b. Italy: Alternative Estimates

Italy	2015	2016	2017	2018	2019
VTTL based on alternative data	135,839	137,657	138,416	140,013	139,906
VAT Gap based on alternative data	36,347	36,423	35,361	29,937	26,150
VAT Gap based on alternative data, as a percent of VTTL	26.8%	26.5%	25.6%	21.4%	18.7%

Note: The estimates above are based on adjusted revenues for the changes in outstanding stocks of net reimbursement claims (to better approximate accrued revenues) and Italy's own estimates of illegal activities, namely illegal drugs and prostitution activities.

Table 3.13. Cyprus: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2018 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**1,647**	**1,701**	**1,804**	**1,988**	**1,998**
o/w liability on household final consumption	**1,084**	**1,121**	**1,196**	**1,282**	**1,325**
o/w liability on government and NPISH final consumption	**28**	**27**	**26**	**26**	**32**
o/w liability on intermediate consumption	**398**	**402**	**406**	**446**	**473**
o/w liability on GFCF	**108**	**134**	**153**	**211**	**161**
o/w net adjustments	**28**	**16**	**21**	**24**	**6**
VAT Revenue	**1,506**	**1,654**	**1,634**	**1,817**	**1,943**
VAT GAP	**141**	**47**	**169**	**171**	**54**
VAT GAP as a percent of VTTL	**8.5%**	**2.7%**	**9.4%**	**8.6%**	**2.7%**
VAT GAP change since 2015					**-5.8 pp**
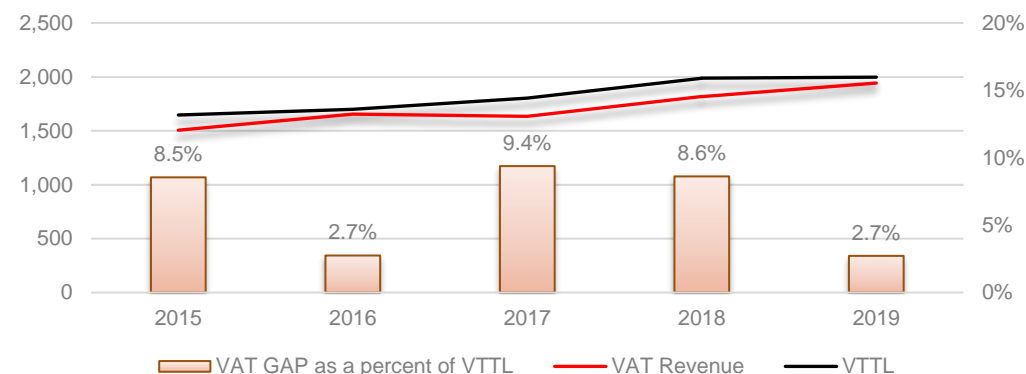
Highlights

- The estimated VAT Gap in Cyprus was relatively volatile in the analysed period.

- In 2019, the Gap went significantly down compared to 2018 and 2017 and reached 2.7 pp. of the VTTL and EUR 54 million.

- Thanks to information from the tax authorities, revenue figures were corrected to account for the expected backward revisions of Eurostat's figures. The figures will be adjusted in the future studies, when updated figures are published by Eurostat.

Table 3.14. Latvia: VAT Revenue VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**2,361**	**2,341**	**2,566**	**2,726**	**2,869**
o/w liability on household final consumption	**1,801**	**1,847**	**1,980**	**2,051**	**2,166**
o/w liability on government and NPISH final consumption	**49**	**53**	**66**	**73**	**82**
o/w liability on intermediate consumption	**317**	**316**	**348**	**368**	**401**
o/w liability on GFCF	**238**	**175**	**217**	**280**	**269**
o/w net adjustments	**-44**	**-49**	**-45**	**-46**	**-48**
VAT Revenue	**1,876**	**2,032**	**2,164**	**2,449**	**2,632**
VAT GAP	**484**	**309**	**402**	**277**	**237**
VAT GAP as a percent of VTTL	**20.5%**	**13.2%**	**15.7%**	**10.2%**	**8.3%**
VAT GAP change since 2015					**-12.3 pp**
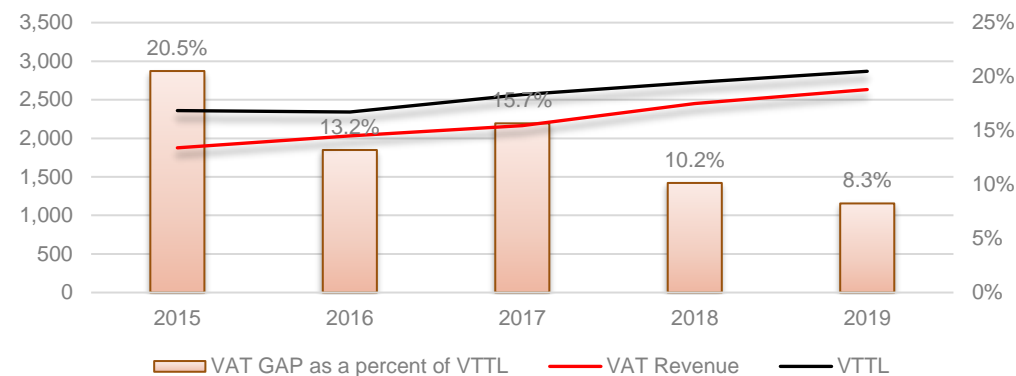
Highlights

- In 2019, the VAT Gap in Latvia fell below the EU median (from 10.2 down to 8.3 percent of the VTTL).

- Over the analysed period, the improvement in VAT compliance in Latvia was one pf the most pronounced in the EU-28.

Table 3.15. Lithuania: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**3,954**	**4,097**	**4,426**	**4,660**	**4,898**
o/w liability on household final consumption	3,233	3,394	3,664	3,878	4,093
o/w liability on government and NPISH final consumption	43	44	46	44	49
o/w liability on intermediate consumption	410	409	439	449	475
o/w liability on GFCF	461	470	526	571	621
o/w net adjustments	-192	-220	-249	-283	-338
VAT Revenue	**2,889**	**3,028**	**3,310**	**3,522**	**3,850**
VAT GAP	**1,065**	**1,070**	**1,116**	**1,137**	**1,048**
VAT GAP as a percent of VTTL	**26.9%**	**26.1%**	**25.2%**	**24.4%**	**21.4%**
VAT GAP change since 2015					**-5.5 pp**
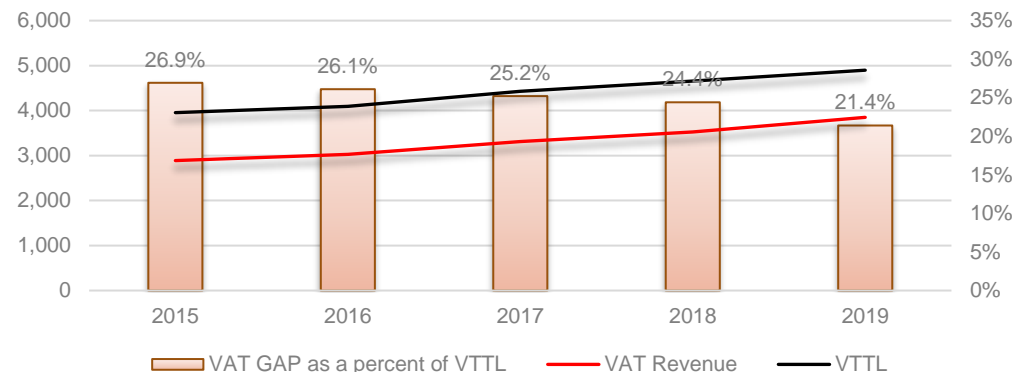
Highlights

- Over the period 2015-2019, the VAT Gap in Lithuania followed a downward trend.

- In 2019, the Gap decreased by approximately 3 pp. to 21.4 percent of the VTTL and approximately EUR 1 billion.

Table 3.16. Luxembourg: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**3,510**	**3,736**	**3,564**	**3,896**	**4,030**
o/w liability on household final consumption	1,289	1,331	1,361	1,469	1,560
o/w liability on government and NPISH final consumption	32	33	44	89	43
o/w liability on intermediate consumption	1,070	1,138	1,160	1,215	1,261
o/w liability on GFCF	411	625	580	694	737
o/w net adjustments	709	608	419	429	429
VAT Revenue	**2,991**	**3,147**	**3,338**	**3,563**	**3,763**
VAT GAP	**519**	**589**	**226**	**333**	**267**
VAT GAP as a percent of VTTL	**14.8%**	**15.8%**	**6.3%**	**8.5%**	**6.6%**
VAT GAP change since 2015					**-8.2 pp**
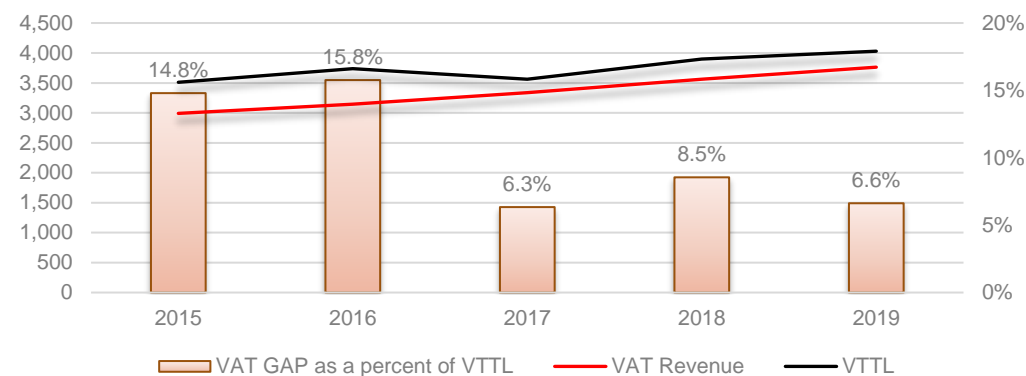
Highlights

- In 2019, the VAT Gap was estimated at 6.6 percent of the VTTL.

- The Gap was relatively volatile during the analysed period, with a very large decline in the VTTL and VAT Gap observed in 2017.

- The estimates of the VTTL in Luxembourg were adjusted for the liability from e-commerce, financial intermediation and tank-tourism using fiscal figures.

Table 3.17. Hungary: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (HUF million)

	2015	2016	2017	2018	2019
VTTL	3,961,407	3,844,312	4,211,330	4,531,571	5,009,093
o/w liability on household final consumption	2,667,644	2,813,223	2,948,457	3,066,373	3,356,676
o/w liability on government and NPISH final consumption	121,681	112,677	127,253	134,621	143,125
o/w liability on intermediate consumption	529,845	527,076	564,127	623,240	708,835
o/w liability on GFCF	587,267	342,194	512,717	666,517	779,055
o/w net adjustments	54,969	49,142	58,776	40,820	21,402
VAT Revenue	3,309,540	3,299,838	3,626,566	4,129,537	4,526,757
VAT GAP	651,868	544,473	584,764	402,034	482,336
VAT GAP as a percent of VTTL	16.5%	14.2%	13.9%	8.9%	9.6%
VAT GAP change since 2015					-6.8 pp
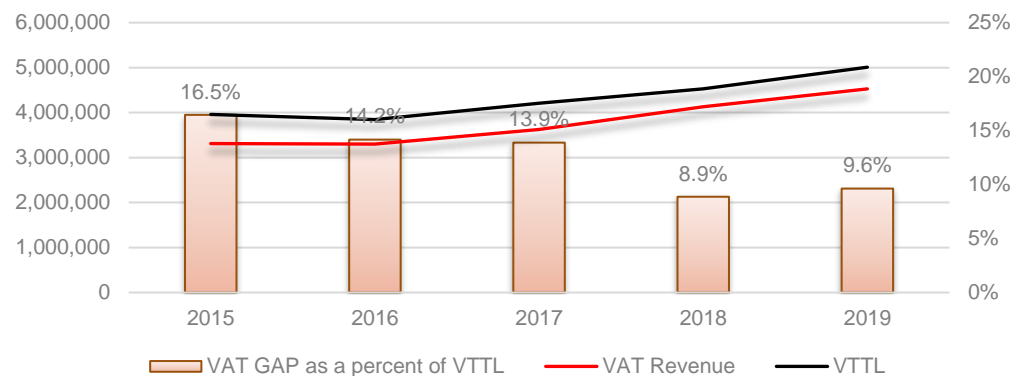
Highlights

- In 2019, the VAT Gap in Hungary was approximately 9.6 percent of the VTTL, which was a slight incline compared to 2019.

- Over the five-year period, VAT compliance improved significantly (a drop in the VAT Gap of approximately 6.8 pp.).

Table 3.18. Malta: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**893**	**956**	**1,035**	**1,123**	**1,221**
o/w liability on household final consumption	**521**	**542**	**565**	**618**	**658**
o/w liability on government and NPISH final consumption	**15**	**47**	**52**	**57**	**64**
o/w liability on intermediate consumption	**262**	**280**	**325**	**343**	**399**
o/w liability on GFCF	**82**	**58**	**71**	**84**	**92**
o/w net adjustments	**13**	**28**	**22**	**21**	**9**
VAT Revenue	**673**	**712**	**810**	**920**	**934**
VAT GAP	**220**	**244**	**225**	**203**	**287**
VAT GAP as a percent of VTTL	**24.6%**	**25.6%**	**21.7%**	**18.1%**	**23.5%**
VAT GAP change since 2015					**-1.1 pp**
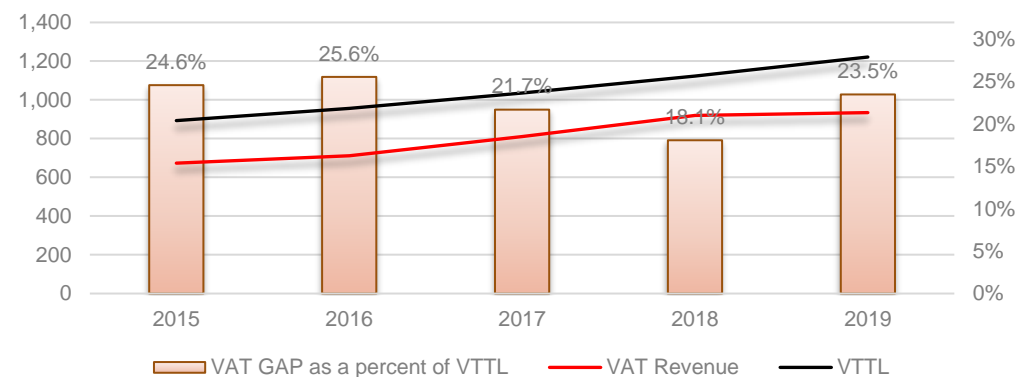
Highlights

- The VAT Gap in Malta inclined by approximately 5.4 pp. in 2019 up to 23.5 percent of the VTTL and EUR 287 million.

- The VTTL in Malta was revised thanks to the availability of new SUT.

Table 3.19. The Netherlands: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**49,756**	**50,500**	**53,023**	**55,751**	**60,791**
o/w liability on household final consumption	**25,953**	**26,218**	**27,204**	**28,397**	**31,430**
o/w liability on government and NPISH final consumption	**595**	**571**	**568**	**598**	**771**
o/w liability on intermediate consumption	**13,718**	**13,687**	**14,220**	**15,195**	**16,052**
o/w liability on GFCF	**8,962**	**9,481**	**10,487**	**11,004**	**11,882**
o/w net adjustments	**528**	**543**	**545**	**556**	**656**
VAT Revenue	**44,746**	**47,849**	**49,833**	**52,712**	**58,131**
VAT GAP	**5,010**	**2,651**	**3,190**	**3,039**	**2,660**
VAT GAP as a percent of VTTL	**10.1%**	**5.3%**	**6.0%**	**5.5%**	**4.4%**
VAT GAP change since 2015					**-5.7 pp**
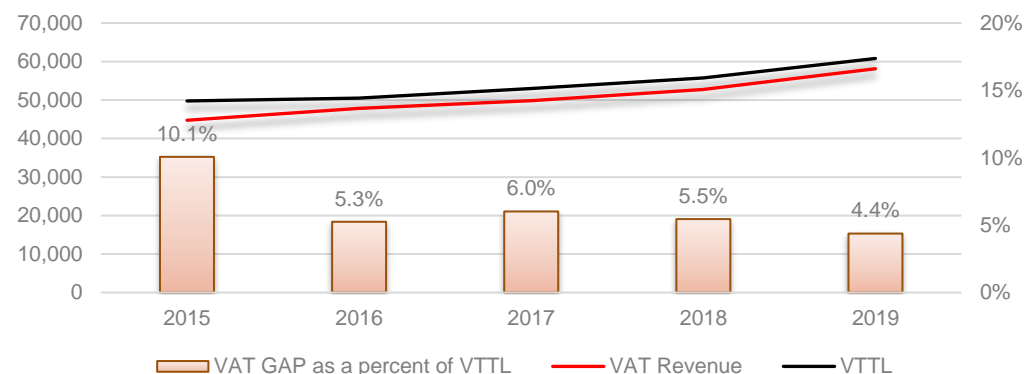
Highlights

- The VAT Gap fell by approximately 1.1 pp. down to nearly 4.4 percent of the VTTL in 2019.

- Over the entire analysed period, the Gap remained below the EU median.

- In 2019, the Netherlands increased from 6 percent up to 9 percent the reduced rate applicable to approximately 25 percent of household final consumption.

Table 3.20. Austria: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**28,736**	**29,768**	**30,909**	**32,356**	**33,301**
o/w liability on household final consumption	**19,259**	**19,885**	**20,658**	**21,334**	**21,908**
o/w liability on government and NPISH final consumption	**943**	**947**	**958**	**1,489**	**1,568**
o/w liability on intermediate consumption	**4,188**	**4,183**	**4,317**	**4,352**	**4,523**
o/w liability on GFCF	**2,890**	**3,284**	**3,437**	**3,641**	**3,866**
o/w net adjustments	**1,456**	**1,469**	**1,539**	**1,541**	**1,436**
VAT Revenue	**26,247**	**27,301**	**28,304**	**29,323**	**30,405**
VAT GAP	**2,488**	**2,466**	**2,605**	**3,033**	**2,895**
VAT GAP as a percent of VTTL	**8.7%**	**8.3%**	**8.4%**	**9.4%**	**8.7%**
VAT GAP change since 2015					**+0.0 pp**
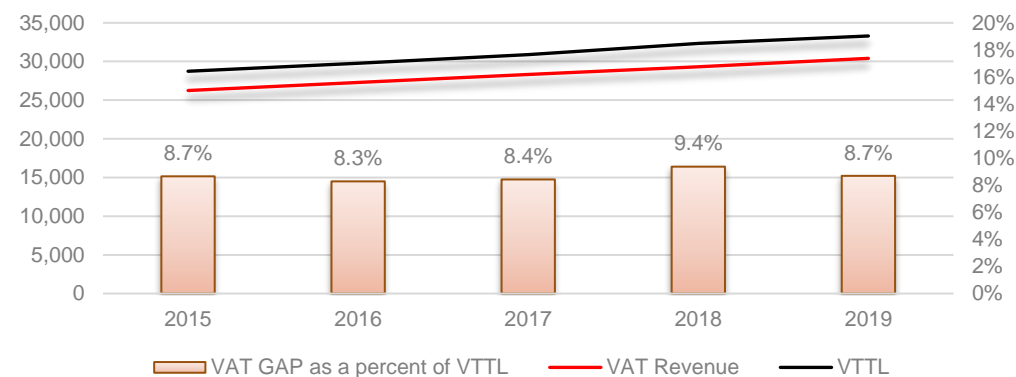
Highlights

- Over the period 2015-2019, the VAT Gap in Austria remained relatively stable.

- In 2019, the VAT Gap decreased by about 0.7 pp. down to 8.7 percent of the VTTL.

Table 3.21. Poland: VAT Revenue VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (PLN million)

	2015	2016	2017	2018	2019
VTTL	**167,049**	**169,005**	**183,686**	**194,798**	**205,262**
o/w liability on household final consumption	**115,503**	**119,700**	**129,709**	**135,375**	**143,541**
o/w liability on government and NPISH final consumption	**7,356**	**7,605**	**7,737**	**8,340**	**9,199**
o/w liability on intermediate consumption	**24,790**	**25,512**	**27,161**	**28,670**	**29,699**
o/w liability on GFCF	**17,038**	**13,695**	**16,562**	**19,822**	**20,164**
o/w net adjustments	**2,362**	**2,494**	**2,517**	**2,590**	**2,659**
VAT Revenue	**125,894**	**134,623**	**154,695**	**172,264**	**182,147**
VAT GAP	**41,154**	**34,382**	**28,991**	**22,534**	**23,115**
VAT GAP as a percent of VTTL	**24.6%**	**20.3%**	**15.8%**	**11.6%**	**11.3%**
VAT GAP change since 2015					**-13.4 pp**
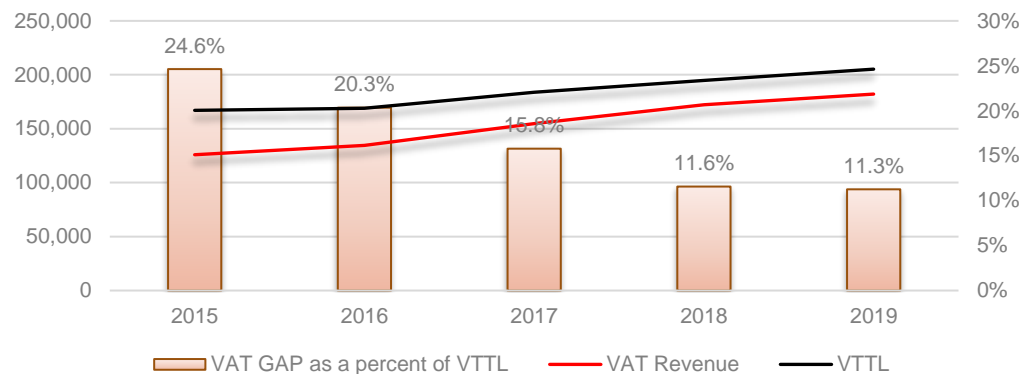
Highlights

- Poland recorded the most significant decline of the VAT Gap between 2015 and 2019 (13.4 pp.) in the EU.

- In 2019, the Gap reached 11.3 percent of the VTTL, which was slightly above the EU average.

Table 3.22. Portugal: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**17,598**	**17,890**	**18,656**	**19,627**	**20,395**
o/w liability on household final consumption	**13,190**	**13,345**	**13,791**	**14,455**	**14,976**
o/w liability on government and NPISH final consumption	**444**	**487**	**535**	**550**	**578**
o/w liability on intermediate consumption	**2,433**	**2,732**	**2,928**	**3,056**	**3,237**
o/w liability on GFCF	**1,170**	**941**	**1,031**	**1,151**	**1,235**
o/w net adjustments	**361**	**385**	**372**	**415**	**369**
VAT Revenue	**15,368**	**15,767**	**16,810**	**17,868**	**18,786**
VAT GAP	**2,230**	**2,123**	**1,847**	**1,759**	**1,609**
VAT GAP as a percent of VTTL	**12.7%**	**11.9%**	**9.9%**	**9.0%**	**7.9%**
VAT GAP change since 2015					**-4.8 pp**
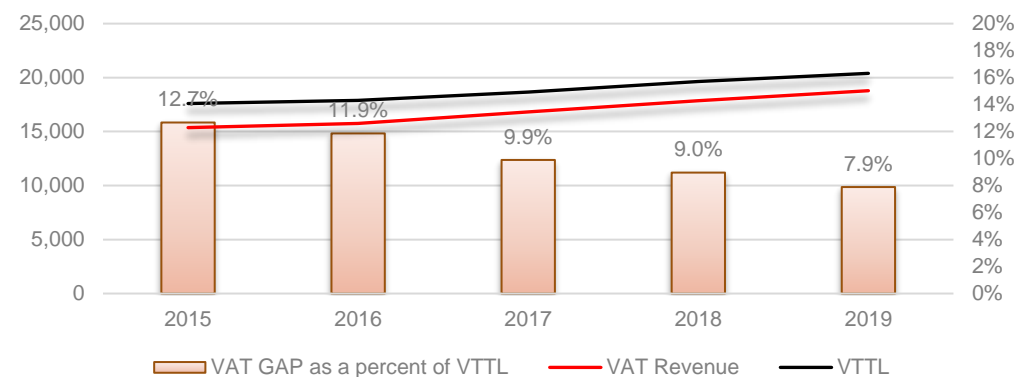
Highlights

- The VAT Gap in Portugal in 2019 was about 7.9 percent of the VTTL, which was an improvement compared to 2018.

- Over the entire analysed period, the Gap declined gradually by approximately 1 pp. a year, on average.

Table 3.23. Romania: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (RON million)

	2015	2016	2017	2018	2019
VTTL	88,006	78,228	84,281	89,113	100,628
o/w liability on household final consumption	54,024	49,143	53,371	57,413	62,350
o/w liability on government and NPISH final consumption	3,976	3,560	3,377	3,843	4,613
o/w liability on intermediate consumption	9,477	7,765	8,365	9,157	10,316
o/w liability on GFCF	18,640	16,338	18,048	18,069	22,380
o/w net adjustments	1,888	1,422	1,119	631	969
VAT Revenue	57,520	49,253	53,229	59,990	65,461
VAT GAP	30,486	28,975	31,053	29,123	35,166
VAT GAP as a percent of VTTL	34.6%	37.0%	36.8%	32.7%	34.9%
VAT GAP change since 2015					**+0.3 pp**
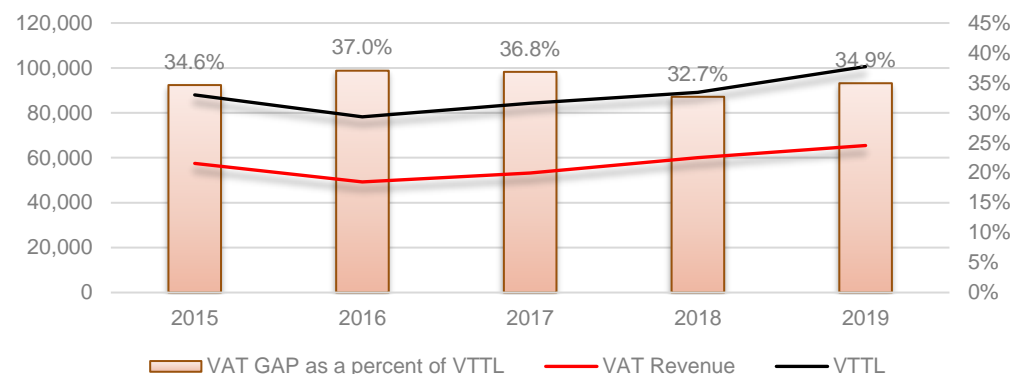
Highlights

- In 2019, the VAT Gap in Romania was estimated at 34.9 percent of the VTTL, which was about a 2.2 pp. incline compared to 2018.

- In relative, terms the VAT Gap in Romania was the largest in the EU over the entire period.

Table 3.24. Slovenia: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**3,491**	**3,504**	**3,623**	**3,928**	**4,186**
o/w liability on household final consumption	**2,448**	**2,573**	**2,682**	**2,843**	**3,016**
o/w liability on government and NPISH final consumption	**76**	**85**	**83**	**97**	**103**
o/w liability on intermediate consumption	**468**	**469**	**461**	**519**	**561**
o/w liability on GFCF	**419**	**303**	**329**	**393**	**423**
o/w net adjustments	**79**	**74**	**68**	**77**	**82**
VAT Revenue	**3,220**	**3,318**	**3,481**	**3,765**	**3,888**
VAT GAP	**271**	**186**	**142**	**163**	**298**
VAT GAP as a percent of VTTL	**7.8%**	**5.3%**	**3.9%**	**4.1%**	**7.1%**
VAT GAP change since 2015					**-0.6 pp**
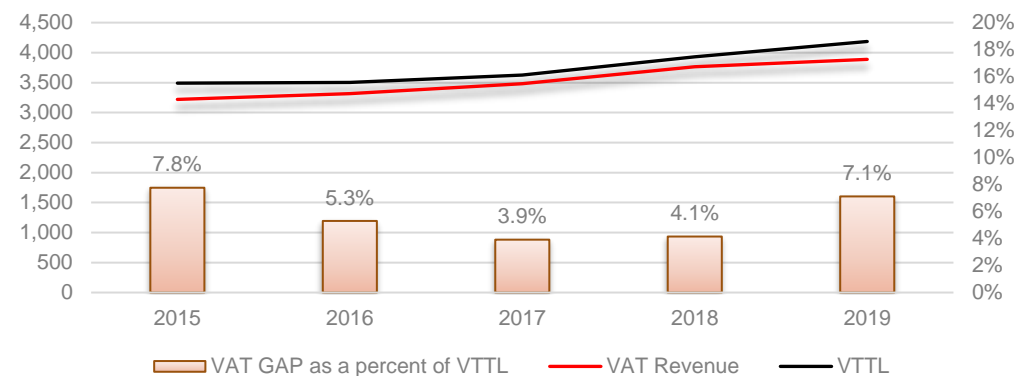
Highlights

- After a gradual decline between 2015 and 2017, the VAT Gap in Slovenia has followed an upward trend since 2017.

- Despite increasing somewhat, the VAT Gap in Slovenia remains considerably lower than the EU median.

Table 3.25. Slovakia: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**7,230**	**6,783**	**7,125**	**7,734**	**8,143**
o/w liability on household final consumption	**5,007**	**5,054**	**5,437**	**5,759**	**6,099**
o/w liability on government and NPISH final consumption	**96**	**98**	**98**	**103**	**115**
o/w liability on intermediate consumption	**931**	**877**	**908**	**1,036**	**1,063**
o/w liability on GFCF	**1,206**	**763**	**680**	**815**	**865**
o/w net adjustments	**-10**	**-9**	**2**	**20**	**0**
VAT Revenue	**5,423**	**5,424**	**5,919**	**6,319**	**6,830**
VAT GAP	**1,808**	**1,360**	**1,206**	**1,414**	**1,313**
VAT GAP as a percent of VTTL	**25.0%**	**20.0%**	**16.9%**	**18.3%**	**16.1%**
VAT GAP change since 2015					**-8.9 pp**
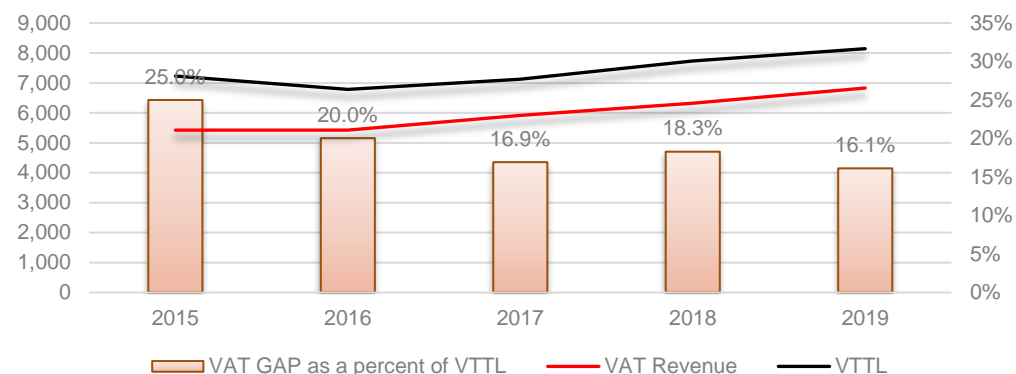
Highlights

- In 2019, the VAT Gap in Slovakia was approximately 16.1 percent of the VTTL.

- Year-over-year, it fell by approximately 2.2 percent of the VTTL. Over the 2015-2019 period, the Gap fell by approximately 9 pp.

- In 2019, the rate for accommodation services was reduced from the standard 20 percent to the reduced 10 percent rate.

Table 3.26. Finland: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (EUR million)

	2015	2016	2017	2018	2019
VTTL	**20,069**	**20,679**	**21,724**	**22,248**	**22,620**
o/w liability on household final consumption	**11,386**	**11,575**	**11,830**	**12,198**	**12,281**
o/w liability on government and NPISH final consumption	**478**	**504**	**489**	**520**	**536**
o/w liability on intermediate consumption	**4,276**	**4,396**	**4,651**	**4,711**	**4,797**
o/w liability on GFCF	**3,316**	**3,513**	**3,987**	**4,116**	**4,212**
o/w net adjustments	**613**	**691**	**768**	**703**	**794**
VAT Revenue	18,974	19,694	20,404	21,364	21,974
VAT GAP	1,095	985	1,320	884	646
VAT GAP as a percent of VTTL	**5.5%**	**4.8%**	**6.1%**	**4.0%**	**2.9%**
VAT GAP change since 2015					**-2.6 pp**
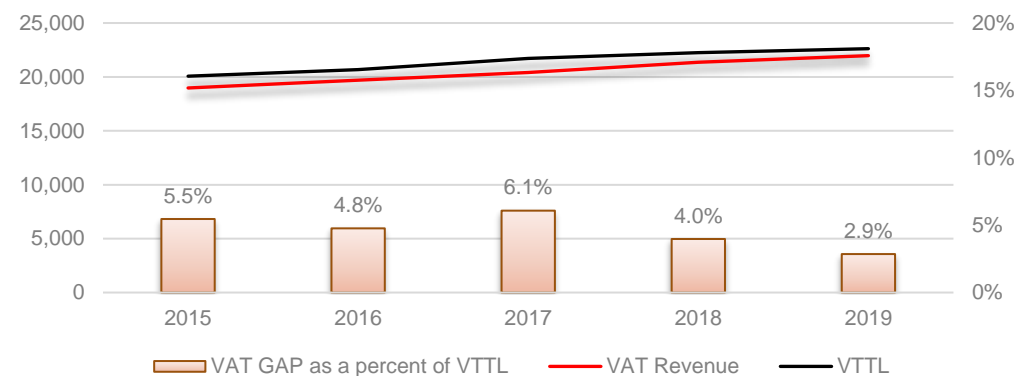
Highlights

- The VAT Gap in Finland has been one of the lowest in the EU during the entire analysed period.

- In 2019, the Gap fell by approximately 1.1 pp. down to 2.9 percent of the VTTL.

Table 3.27. Sweden: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (SEK million)

	2015	2016	2017	2018	2019
VTTL	395,131	416,790	441,389	460,457	466,016
o/w liability on household final consumption	206,163	214,033	224,754	234,683	240,719
o/w liability on government and NPISH final consumption	16,971	16,742	17,542	18,744	15,922
o/w liability on intermediate consumption	96,330	100,077	104,203	108,994	111,174
o/w liability on GFCF	70,346	80,354	89,676	92,424	92,384
o/w net adjustments	5,321	5,584	5,215	5,613	5,817
VAT Revenue	379,119	405,160	424,886	445,241	459,699
VAT GAP	16,012	11,630	16,503	15,216	6,317
VAT GAP as a percent of VTTL	4.1%	2.8%	3.7%	3.3%	1.4%
VAT GAP change since 2015					**-2.7 pp**
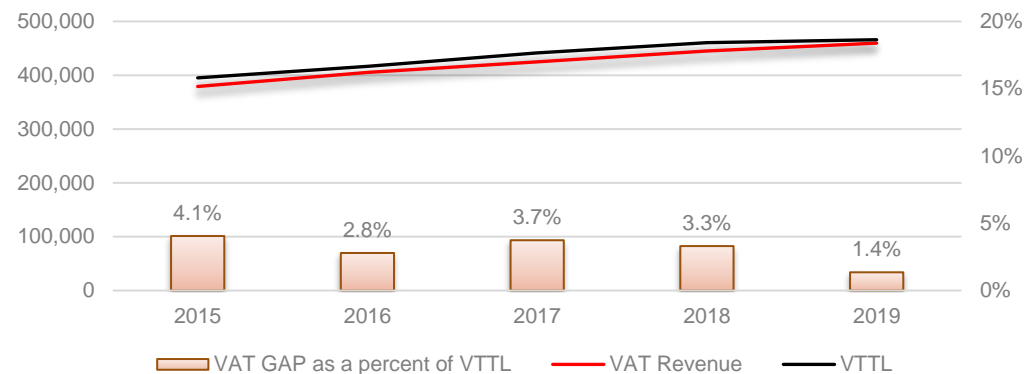
Highlights

- Sweden recorded the second lowest VAT Gap in the EU in 2019 of about 1.4 percent of the VTTL. Similarly, in the preceding years, the VAT Gap in Sweden was substantially lower than the EU median.

Table 3.28. United Kingdom: VAT Revenue, VTTL, Composition of VTTL, and VAT Gap, 2015-2019 (GBP million)

	2015	2016	2017	2018	2019
VTTL	**147,575**	**154,004**	**160,814**	**166,801**	**169,843**
o/w liability on household final consumption	97,218	102,311	107,854	112,375	114,301
o/w liability on government and NPISH final consumption	3,416	3,059	3,092	3,033	3,198
o/w liability on intermediate consumption	32,634	33,275	33,700	34,333	35,181
o/w liability on GFCF	13,468	14,255	14,901	15,520	16,511
o/w net adjustments	839	1,104	1,267	1,540	652
VAT Revenue	**132,948**	**137,531**	**142,655**	**149,253**	**154,766**
VAT GAP	**14,627**	**16,473**	**18,159**	**17,548**	**15,077**
VAT GAP as a percent of VTTL	**9.9%**	**10.7%**	**11.3%**	**10.5%**	**8.9%**
VAT GAP change since 2015					**-1.0 pp**
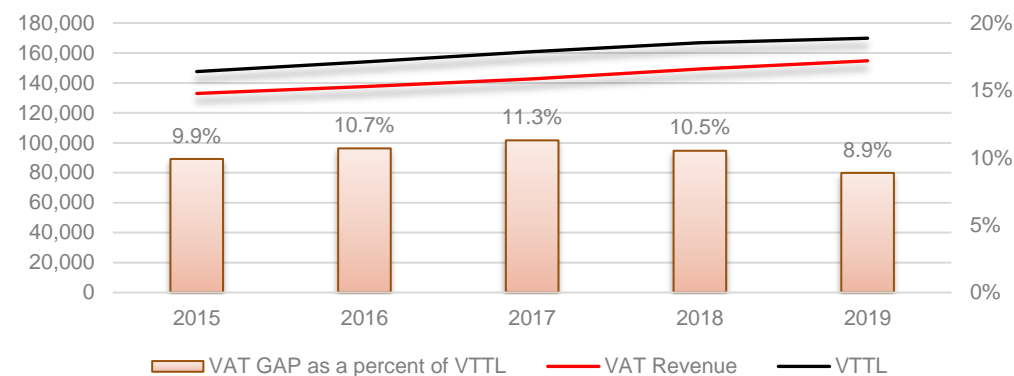
Highlights

- In 2019, the VAT Gap in the UK fell by 1.6 pp. down to 8.9 percent of the VTTL, which was about the EU median.

- The VAT Gap in the UK remained relatively stable over the 2015-2019 period.

4. Policy Gap Measures for 2019

In this chapter, we present an update of the series of estimates of the Policy Gap and its components as well as overall collection efficiency, the "C-efficiency ratio".[11]

The Policy Gap captures the effects of applying multiple rates and exemptions on the theoretical revenue that could be levied in a given VAT system. In other words, the Policy Gap is an indicator of the additional VAT revenue that could theoretically (i.e. under the assumption of perfect tax compliance) be generated if a uniform VAT rate is applied to the final domestic use of all goods and services. Such a measure, which is a reference point for calculating the Policy Gap, is named Notional Ideal Revenue (Barbone et al., 2013).

Due to the idealistic assumption of perfect tax compliance and a very broad base that captures entire final consumption and households' GFCF, the term of Notional Ideal Revenue and the practical interpretation of the Policy Gap draw criticism. Nonetheless, the assumption of perfect VAT collectability is indispensable, as interdependencies between tax compliance and rate structure are not straightforward.

In order to learn how different components contribute to revenue losses, we decompose the Policy Gap into different components of revenue loss. As we show in Section e in Annex A, such elements are, for instance, the Rate Gap and the Exemption Gap, which capture the loss in VAT liability due to the application of reduced rates and the loss in liability due to the implementation of exemptions, respectively.

Moreover, following Barbone et al. (2013), the Policy Gap and its components could be further adjusted to address the issue of the extent to which the loss of theoretical revenue depends on the decisions of policymakers. These measures exclude liability from the final consumption of "imputed rents" (the notional value of home occupancy by homeowners), the provision of public goods and services, and financial services. For these specific groups of services, charging VAT is impractical or currently goes beyond the control of national authorities.

A measure that could be used as a proxy of both the Compliance and the Policy Gap is C-efficiency. C-efficiency could be regarded as an indicator of the departure of the VAT system from a perfectly enforced tax levied at a uniform rate on all consumption. The values of the measure could range from zero to one. The higher the value, the more efficient the system is.[12]

The estimates of the Policy Gap, Rate Gap, Exemption Gap, Actionable Policy Gap, Actionable Exemption Gap, and C-efficiency for the EU-28 Member States for 2019 are presented in Table 4.1.

For the EU overall, the average Policy Gap level was 44.69 percent. This means that the VAT that could currently be levied in the case of full compliance generates 55.31 percent of what could have been generated if all the exemptions and reduced rates were abolished and all final use according to the definitions of national accounts were taxed. Of the 44.69 percent Policy Gap, in 2019, 9.83 pp. were due to the application of various reduced and super-reduced rates

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[11] See Keen (2013) for discussion of indicators of VAT efficiency.

[12] See Section e Annex A.

(the Rate Gap) and 34.86 were due to the application of exemptions without the right to deduct and the non-taxability of some tax base components (the Exemption Gap). The large value of the Exemption Gap, as shown by its large deviation from the Actionable Exemption Gap, results mostly from the impacts of non-taxable consumption on the VTTL.

According to the Rate Gap estimates, reduced rates are least applied in Denmark (0.75 percent), Estonia (2.69 percent), and Slovakia (2.45 percent). On the other side of the spectrum are Cyprus (16.99 percent) and Malta (15.96 percent). The Member States with the highest values of the Exemption Gap are the United Kingdom (44.45 percent) and Spain (43.98 percent) due to the application of other than VAT indirect taxes in the Canary Islands, Ceuta, and Melilla. The lowest value of the Exemption Gap was observed in Malta (17.01 percent).

The largest part of the Exemption Gap is composed of exemptions on services that cannot be taxed in principle, i.e. imputed rents and the provision of public goods (26.22 percent). The remaining amount of the Exemption Gap is financial services (2.13 percent) and the "Actionable" Exemption Gap, which is 6.51 percent, on average.

The Actionable Policy Gap – a combination of the Rate Gap and the Actionable Exemption Gap – is 16.34 percent on average. This figure shows the combined reduction of Ideal Revenue due to reduced rates (9.83 percent) and exemptions (6.51 percent) which could possibly be removed.

In some cases, i.e. the financial services Gaps in Cyprus, Ireland, Malta and Romania, and Actionable Exemption Gap in Bulgaria and Malta, negative gaps were observed. Although theoretically possible, this may also result from a measurement error.[13]

Overall, collection efficiency ranged from 39.28 percent in Italy up to 76.28 percent in Luxembourg and amounted to 55.5 percent of net final consumption on average. The high efficiency of VAT collection in Luxembourg has a specific source. It results from relatively high liability from the intermediate consumption of financial services sold cross-border. The relatively low C-efficiency, as in Italy and Greece, results from a combination of relatively high Policy and Compliance Gaps in these Member States.

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[13] The Exemption Gap and its components could become negative if respective goods and services are used mostly as intermediates inputs or in periods when input VAT exceeds potential output VAT, like periods of increased investment or when losses are incurred. The measurement error may result from difficulties in decomposing the components of the base, such as sectoral GFCF and net adjustments, and inaccuracies in the underlying data and parameters.

Table 4.1. Policy Gap, Rate Gap, Exemption Gap, and Actionable Gaps

	A	B	C	D	E	F	G	H	I
	Policy Gap (%)	Rate Gap (%)	Exemption Gap (%)	o/w Imputed Rents (%)	o/w Public Services (%)	o/w Financial Services (%)	Actionable Exemption Gap (C - D - E - F) (%)	Actionable Policy Gap (G + B) (%)	C-efficiency (%)
BE	52.11	11.68	40.43	7.28	25.36	3.99	3.80	15.48	47.79
BG	30.14	3.89	26.25	10.11	15.73	1.75	-1.33	2.56	68.30
CZ	39.23	6.18	33.06	8.57	16.78	2.24	5.46	11.64	59.60
DK	40.29	0.75	39.54	7.40	23.92	4.84	3.38	4.13	62.20
DE	44.40	6.71	37.69	6.69	21.55	2.61	6.84	13.55	57.78
EE	36.27	2.69	33.57	6.75	16.67	2.26	7.90	10.59	70.52
IE	48.72	11.19	37.53	9.66	27.85	-2.82	2.83	14.02	51.83
EL	49.55	10.42	39.13	9.47	17.03	1.72	10.91	21.33	39.68
ES	57.94	13.96	43.98	9.17	18.71	2.67	13.42	27.38	42.16
FR	52.48	13.03	39.46	9.27	21.51	3.03	5.65	18.67	50.91
HR	36.86	12.16	24.69	6.89	12.90	1.94	2.97	15.13	69.07
IT	53.70	15.71	37.98	10.67	17.88	1.29	8.15	23.86	39.28
CY	48.62	16.99	31.63	6.57	17.14	-3.83	11.74	28.73	56.97
LV	42.68	3.09	39.59	9.63	16.65	2.19	11.13	14.22	57.77
LT	32.94	3.43	29.51	4.45	15.06	1.63	8.37	11.81	54.60
LU	38.17	13.85	24.31	8.47	-1.53	-0.17	17.55	31.40	76.28
HU	45.48	7.84	37.64	8.13	16.20	3.18	10.13	17.97	57.64
MT	32.97	15.96	17.01	4.48	16.58	1.27	-5.32	10.64	57.28
NL	49.56	9.03	40.53	7.04	25.79	5.77	1.93	10.96	55.91
AT	45.08	15.18	29.90	7.34	18.87	2.74	0.96	16.14	58.22
PL	47.85	14.85	33.00	3.73	15.22	3.45	10.60	25.45	52.06
PT	51.17	14.05	37.13	8.10	19.28	3.24	6.50	20.55	48.91
RO	34.17	11.67	22.50	8.51	13.23	-0.20	0.94	12.62	47.64
SI	47.15	11.50	35.65	7.73	16.93	2.72	8.26	19.77	55.36
SK	43.49	2.45	41.04	9.32	18.69	2.71	10.33	12.77	52.43
FI	50.80	9.65	41.15	9.97	22.00	3.06	6.13	15.78	57.54
SE	46.40	8.84	37.56	4.71	26.21	2.89	3.75	12.59	59.97
UK	53.21	8.76	44.45	11.27	20.52	3.47	9.18	17.94	46.44
EU-28	**44.69**	**9.83**	**34.86**	**7.91**	**18.31**	**2.13**	**6.51**	**16.34**	**55.50**

Source: own calculations.

5. Econometric Analysis of VAT Gap Determinants

a. Introduction

This chapter discusses the econometric analysis of the VAT Gap determinants. The analysis presented herein is largely based on the methodology presented in the 2020 Study. For this reason, the literature review and methodological preliminaries are only briefly summarised in this update. The methodological descriptions focus on two main novelties. More specifically, the note discusses the application of the principal component analysis (PCA) and the inclusion of the new explanatory variable standing for reporting obligations in place.

It is worth noting that the econometric analysis outlined in this Study, is based, to the authors' knowledge, on the largest available set of standardised indicators of tax compliance from a group of countries with varying economic and institutional characteristics. The panel data derived from the EC VAT Gap Study have already been used in the past by a number of researchers – such as Barbone et al. (2013), Zídková (2017), Lešnik et al. (2018), Poniatowski et al. (2018, 2019, and 2020), Szczypińska (2019), and Carfora et al. (2020).

The 2020 Study extended the above-mentioned studies several-fold. The list of innovations in the Study included: 1) a novel data preparation procedure, "backcasting", that eliminated potential bias related to revisions in subsequent vintages of the Study; 2) a dummy variable adjustment to deal with the scarcity of observations of exogenous variables, and 3) the extended list of 65 covariates expected to be affecting VAT compliance.

The analysis presented in 2020 faced two important challenges. First, collinearity between the explanatory variables prevented the inclusion of many of the covariates in a single specification. Second, the final set of variables characterising tax administrations' actions included in the specifications was relatively narrow. The main reasons for this were the unavailability of standardised characteristics and the insufficient variability in time of some of the available ones.

The novelties introduced in this Study aim to meet these challenges. The PCA was introduced to allow us to account for the variability of more covariates in a single model specification. The inclusion of reporting obligations[14] aims to increase the explanatory power of the model by accounting for the measures taken suspected of having a significant impact on VAT compliance.

b. Data and variables

The endogenous variable is the VAT Gap of country i in year t taken from each of the European Commission's VAT Gap Studies (i.e. the 2013, 2014, 2015, 2016, 2017, 2018, and 2019 Studies). To ensure the comparability of vintages across time, the data was transformed using the "backcasting" method.[15]

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[14] See page 65 for the description of the information obligations' variable.

[15] "Backcasting" is a recursive procedure of updating information from subsequent vintages of the Study. See more in Poniatowski et al. (2020).

The wide set of covariates included in the analysis originates from the 2020 Study which included 65 explanatory variables overall. Due to the multiplicity of covariates and the enormous number of potential combinations of model specifications, we proceeded parsimoniously in selecting variables used in the model specifications. The approach consisted of three stages. In the first stage, we ran Bayesian Model Averaging to learn which variables are not significant in the majority of the specifications' variations. In the second stage, we created a correlation matrix of the remaining variables to learn which are collinear and cannot be presented in common specifications. Finally, we eliminated specifications on the basis of various specification tests. The narrow dataset obtained after the first stage consisted of 26 explanatory variables. After adding the principal components, variables included in the PCA, and a dummy variable standing for reporting obligations, the set contained 36 variables. A summary of the statistics of these variables including selected principal components is discussed in more detail in the following section, and "reporting obligations" is shown in Table 5.1.

Table 5.1. Summary Statistics of Explanatory Variables included in Econometric Specifications

Variable	n	Mean	Standard deviation	Minimum	Maximum
Macroeconomic variables					
Real GDP (growth in %)	493	0.02	0.03	-0.15	0.12
Real GDP per capita (growth in %)	493	0.05	0.06	-0.22	0.33
GDP at market prices (growth in %)	493	0.05	0.06	-0,23	0.31
Final consumption expenditure (growth in %)	493	0.05	0.06	-0.21	0.35
Final consumption expenditure of households (growth in %)	493	0.04	0.06	-0.19	0.33
General gov. surplus	493	-0.02	0.04	-0.32	0.07
Consumer Price Index (% change)	449	-0.00	0.02	-0.12	0.05
Unemployment rate	493	0.09	0.04	0.02	0.28
Macro component 1	485	0	2.19	-10.93	8.30
Macro component 2	485	0	1.13	-2.58	4.88
Structure of the economy					
Agriculture share	532	0.03	0.02	0.00	0.14
Manufacturing share	532	0.17	0.05	0.04	0.35
Construction share	532	0.06	0.02	0.01	0.13
Retail trade share	532	0.21	0.04	0.10	0.32
Communication share	532	0.05	0.01	0.03	0.12
Financial share	532	0.06	0.04	0.02	0.30
Real estate share	532	0.09	0.03	0.05	0.19
R&D share	532	0.09	0.03	0.02	0.15
Public administration share	532	0.17	0.03	0.10	0.24
Small-size companies (employees)	266	0.54	0.11	0.08	0.82
Medium-size companies (employees)	205	0.22	0.03	0.12	0.37
Micro-size companies (GVA)	191	0.08	0.01	0.03	0.11
Small-size companies (GVA)	191	0.11	0.01	0.06	0.16
Medium-size companies (GVA)	191	13.95	0.87	11.23	18.66

Variable	n	Mean	Standard deviation	Minimum	Maximum
Tax policy characteristics					
IT expenditure	246	0.09	0.05	0.00	0.28
Statutory Standard VAT rate	493	0.20	0.03	0.15	0.27
Effective VAT rate	474	0.09	0.02	0.05	0.14
Fiscal Rules Index	485	0.04	1.8	-12.73	14.85
Reporting obligations	532	0.08	0.26	0.00	1.00
Tax fraud proxies					
Intra-EU import at risk (share in GDP)	532	0.01	0.01	0.00	0.07
Frequency of Customs Procedure Code 42 and 63 used[16]	**527**	0.07	0.16	0.00	2.58
Importation of excise goods (% of GDP)	528	0	0	0	0.03
Total import (% of GDP)	432	0.44	0.18	0.19	0.90
Estimated trade value at risk	493	0.32	0.98	-0.99	3.07
Fraud component 1	439	0.06	1.54	-4.03	5.23
Fraud component 2	439	0.12	1.21	-3.18	5.53

Source: own elaboration. Rows describing covariates added to the analysis reported in 2020 Study are in grey.

The newly added "Reporting obligations" variable is a "treatment dummy". In other words, this is the indicator variable that captures the timing and location of the existing reporting requirements. The variable includes all four types of reporting obligations (i.e. VAT listing, SAF-T, real-time, and e-invoicing). In cases when reporting obligations were introduced throughout the year, we used a value standing for the fraction of the year when the obligations were operational.

Similar to the previous Study, the covariates were grouped into four distinct categories, which are:

1) **tax policy characteristics** expected to show how the various efforts of tax administrations relate to the VAT Gap in each country;

2) **macroeconomic variables** that aim to explain the cyclical conditions that affect taxpayer behaviour;

3) variables describing the sectoral and company **structure of the economy**;

4) **tax fraud proxies** that are suspected to be a significant component of the VAT Gap but are difficult to explain by the three groups of above-mentioned factors.

As shown in Table 5.1, the explanatory variables are often available for only a subset of observations. The nature of the missing data varies across variables. Some data sources cover only specific Member States (e.g. OECD), other sources are available for the most recent

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[16] Code 42 and 63 stands for the customs procedures under which the VAT on imports is temporarily suspended, leaving some leeway for not remitting VAT.

years only (Surveillance database) or were discontinued (e.g. Verification actions). However, there is one important similarity – data is not missing at random in most instances.

The problem of the unavailability of observations markedly decreases the number of degrees of freedom in the models with numerous exogenous side variables introduced. This creates a trade-off between two econometric problems – omitted variables and insufficient degrees of freedom. To reduce the scale of the problem, we impute the values of the missing variables. We use a simple and intuitive method that partially controls the bias created by the non-random character of the missing data called the dummy adjustment method (Allison, 2001).[17]

c. Principal component analysis

PCA is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables. PCA's operation can be thought of as revealing the internal structure of the data in a way that best explains the variance in the entire dataset. For this reason, it is commonly used for dimensionality reduction. By these means, PCA can reveal information on the impact of unobservable factors and eliminate unnecessary information from the dataset. PCA is often used for explaining phenomena that are difficult to quantify. The multiple indicators, multiple causes estimation method (MIMIC), which is a well-established tool for estimating the underground economy as a factor-type analysis, shares many similarities with PCA (Schneider and Dell'Anno, 2006).

A disadvantage of factor analysis lies in the potential difficulty of interpreting the "parameters" of the model. It might be the case that principal components cannot be linked to any unobservable phenomenon and may yield signs conflicting with theory and become uninterpretable. There are also several challenges for its applicability, which relate to the trade-off between the number of dimensions and the share of information explained by the "new" variables, as well as to the missing values issue.

In order to be reliable, the variables that undergo PCA must be sufficiently correlated.[18] Together with pairwise correlation coefficients, the Kaiser-Meyer-Olkin (KMO) statistic is a measure commonly used for testing the correlation in the dataset. The statistic is based on the concept of "anti-image", known also as a measure of sampling adequacy (Kaiser, 1970). It shows whether the correlations between variables can be explained by the other variables in the dataset. The authors of the statistic recommended threshold values for KMO (<0.5 unacceptable, 0.5-0.59 miserable, 0.6-0.69 mediocre, 0.7-0.79 middling, 0.8-0.89 meritorious, ≥ 0.9 marvellous), which should be the indicator for the final decision whether the dataset is appropriate for PCA (Kaiser, 1970).

After examining if the dataset is suitable for PCA and executing the analysis, there is the need to determine how many extracted components should be considered. The most frequently used criterion to decide the number of components is called the Kaiser Criterion, which

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[17] See more in Poniatowski et al. (2020).

[18] A 0.3 pairwise correlation with all other variables is assumed to be an inclusion threshold (Shevlyakov and Oja, 2016).

suggests extracting all components with an eigenvalue greater than one (Kaiser, 1960). Eigenvalue describes how much variance is accounted for by a certain component, so extracted components with an eigenvalue greater than one account for more variance than a single variable, since all variables are standardised in the process in analysis and their variances are exactly one.

The interpretation of PCA results is based on the loadings which take values ranging from -1 to 1 and thus represent the correlations between components and variables. The higher is the loading, the better is the explanatory power of the component. The variable's factor loading with the extracted factor should lie above an acceptable level. Generally, there are two thresholds to facilitate the interpretation – loading above 0.5 with a few components designated or lower, namely loading above 0.3, if a high number of factors were extracted (Hair et al., 2010).

The objective of introducing PCA to the econometric analysis was the desire to account for the variability of a larger number of variables that could not be included in single model specification because of the collinearity issue. Due to this and other limitations, the number of variables included in a single specification that was reported in the 2020 Study was less than or equal to 12. At the same time, the shortlist of variables with a significant correlation with the VAT Gap was 27.[19]

To increase the explanatory power for the model, we aimed at estimating principal components for each variable group that could be characterised by high correlation within each group. More specifically, the objective was to estimate principal components separately for: (1) macroeconomic variables; (2) tax policy characteristics; (3) structural economic factors; and (4) tax fraud proxies. However, in the set of tax policy characteristics and structural economic factors, the significant problem of missing variables precluded the use of PCA. Finally, the principal components were estimated for two groups –macroeconomic variables and tax fraud proxies. Below we present the results of the estimates within each subgroup.

Macroeconomic variables

The group of macroeconomic variables included in the PCA analysis contained: GDP growth measures denoted in nominal and real terms and on a per capita basis. It also included growth of final consumption and household final consumption, specifically. In addition, general government balance surplus, unemployment rate, and CPI were included in the analysis (see Table 5.3).

The KMO statistic for this set is 0.79 (middling), which suggests that the PCA is a suitable method for this group. Two extracted components that have eigenvalues greater than one were included as explanatory variables in the econometric specifications presented in the following chapter (see Table 5.2).

Table 5.2. Eigenvalues for Macroeconomic Variables

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[19] The shortlist of 27 variables was constructed using Bayesian Model Averaging from the initial list containing 65 potential covariates.

Component	Eigenvalue	Difference in eigenvalue to following component	Proportion of variance explained	Cumulative variance explained
<u>Component 1</u>	<u>4.8173</u>	<u>3.5512</u>	<u>0.6022</u>	<u>0.6022</u>
<u>Component 2</u>	<u>1.2661</u>	<u>0.3849</u>	<u>0.1583</u>	<u>0.7604</u>
Component 3	0.8811	0.2880	0.1101	0.8706
Component 4	0.5931	0.2481	0.0741	0.9447
Component 5	0.3450	0.2677	0.0431	0.9878
Component 6	0.0773	0.0649	0.0097	0.9975
Component 7	0.0123	0.0046	0.0015	0.9990
Component 8	0.0078		0.0010	1.0000

Source: own estimates.

Table 5.3. Components Loadings for Macroeconomic Variables[20]

Variable	Component 1	Component 2
GDP at market prices (growth in %)	0.4451	0.1284
Real GDP (growth in %)	0.3847	-0.0150
Real GDP per capita (growth in %)	0.4392	0.1754
General gov. surplus	0.2064	**-0.5895**
Final consumption expenditure (growth in %)	0.4317	0.1280
Final consumption expenditure of households (growth in %)	0.4325	0.1557
Consumer Price Index (% change)	0.1715	-0.2350
Unemployment rate	-0.1248	**0.7136**

Source: own estimates.

Fraud proxies

In the set with fraud proxies, for PCA analysis we include various intensive measures of imports and imports at risk, specifically (see Table 5.5). The variable standing for the frequency of customs procedure codes 42 and 63 used was excluded due to the large number of missing observations (nearly 71 percent of all observations). The KMO statistic amounts to 0.73 (middling), which is substantially above the acceptable level. Two components have eigenvalues above two. These components with their loadings, presented in Table 5.4, were included as explanatory variables in the econometric specifications presented in the following chapter.

Table 5.4. Eigenvalues for Fraud Proxies

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[20] Loadings with an absolute value above 0.5 highly correlated with relevant components are in bold.

Component	Component	Eigenvalue	Difference in eigenvalue to following component	Proportion of variance explained
Component 1	2.4768	1.4429	0.4954	0.4954
Component 2	1.0339	0.2877	0.2068	0.7021
Component 3	0.7462	0.3337	0.1492	0.8514
Component 4	0.4125	0.0819	0.0825	0.9339
Component 5	0.3306		0.0661	1.0000

Source: own estimates.

Table 5.5. Components Loadings for Fraud Proxies[21]

Variable	Component 1	Component 2
Intra-EU import at risk (share in GDP)	**0.5324**	-0.0672
Trade-at-risk	-0.0922	**0.9148**
Import (only alcohol and tobacco)	0.4032	0.3335
Total import	**0.5259**	0.1385
Intra-EU export at risk (share in GDP)	**0.5186**	-0.1681

Source: own estimates.

d. Econometric methodology

In accordance with the *Data and variables* section, the basic regression takes the form:[22]

$$VG_{it} = \alpha_1 TAV_{it} + \alpha_2 MV_{it} + \alpha_3 ESV_{it} + \alpha_4 FP_{it} + a_t + a_i + u_{it}$$

The endogenous variable is the VAT Gap for country *i* in year *t*, VG_{it}, which might be explained by the variables related directly to the actions taken by tax administrations (TAV_{it}), control variables describing the current macroeconomic situation (MV_{it}), control variables describing the characteristics of specific Member States (economic structure variables - ESV_{it}), and fraud proxies (FP_{it}). These variables are characterised by a small variation over time and a relatively large variation across countries. Apart from these variables, we include fixed effects by country (a_i), such that the expression above is a fixed effects model, and year time effects (a_t) (within estimator). Finally, u_{it} is the error term with the classical statistical properties.

A fixed effects (FE) model seems particularly appropriate, as one could argue some explanatory factors like the efforts of the tax administration or institutional variables might be correlated with many other factors that are not included in the regressions. The drawback is that the estimates of the fixed effects are uninterpretable, meaning that part of the variation cannot be attributed to specific factors. We are also unable to estimate the impact of the

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[21] Loadings with an absolute value above 0.5 highly correlated with relevant components are in bold.

[22] We also tested the alternative structure of the equation, i.e. the logarithmic form. However, the measures of the model's fit pointed to selecting the non-log form of the model.

variables that show little within-country variation, as for example, level of VAT tax rates or firm size.

As some of the listed variables are significantly correlated with others, we bear in mind the potential collinearity and endogeneity problem, which is tackled by the careful selection of variables for each specification.

e. Results

The results of our regressions are shown in Table 5.6. The simplest model, the baseline specification, which is later used for predictions and robustness checks, is described in column (1). As can be seen in the Table, GDP growth, general government surplus, IT expenditure, and the shares of the agriculture, communication services, and financial sectors are all statistically significant at the 5 percent level of significance. According to the estimation results of the baseline specification, in order to decrease the VAT Gap by one percentage point, GDP needs to increase by 2.8 percentage points more, the general government balance needs to improve by 4.8 percentage points, or the share of IT expenditure in the overall expenditure of tax administrations needs to increase by roughly 5.7 percentage points.[23]

The alternative specifications (columns (2) to (12)) show that a number of variables that were suspected to be related to changes in the VAT Gap appeared to be statistically significant at the *p=0.05* level. This concerns: scale of the shadow economy (positive impact, see (2)), applicable rate (positive impact, see (3, 4)), share of small companies measured by the number of employees (positive impact, see (5)), and reporting obligations in place (negative impact, see (12)). Some variables, in contrast with the expectations, appeared not to be significant. This concerns some of the tax administration variables, i.e. the frequency of verification actions and the Fiscal Rules Index. The fraud proxies, namely discrepancies in Intrastat registers (see (8)) and the frequency of using CPCs 42 and 63 (see (7)) appeared to be more weakly inter-related with the Gap as compared to the cross-border importation of risky goods (see (12)). The alternative specifications also show that the share of small and medium-sized companies, if measured by their share in gross value added (GVA), are also statistically insignificant.

Which is important to note, out of all specifications included in Table 5.6, the model containing PCA components explains the largest share of the VAT Gap variation, with both components statistically significance and R-squared of ca. 42 percent. This underlines that the overall macroeconomic environment is a very important determinant of VAT compliance. On the contrary to the macroeconomic components, the inclusion of fraud components did not increase substantially the explanatory power of the econometric model.

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[23] The impact of changes in the value of exogenous variables is derived under *ceteris paribus* assumption, by dividing one over the respective coefficient value.

Table 5.6. Econometric Specifications[24]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FE (Baseline)	FE (Shadow economy)	FE (Standard Rate)	FE (Effective Rate)	FE (Firm-size(1))	FE (Firm-size(2))	FE (CPC)	FE (Trade discrepancies)	FE (Fiscal prudence)	FE (Macro components)	FE (Fraud components)	FE (Reporting Obligations)
Macroeconomic variables												
Real GDP growth	-0.359*** (0.086)	-0.344*** (0.086)	-0.314*** (0.087)	-0.252*** (0.087)	-0.342*** (0.088)	-0.338*** (0.089)	-0.343*** (0.086)	-0.364*** (0.086)	-0.359*** (0.086)		-0.352*** (0.089)	-0.247*** (0.090)
General gov. surplus	-0.212*** (0.075)	-0.196*** (0.075)	-0.247*** (0.077)	-0.327*** (0.079)	-0.189** (0.079)	-0.146* (0.079)	-0.219*** (0.075)	-0.246*** (0.076)	-0.218*** (0.076)		-0.361*** (0.085)	-0.273*** (0.076)
Macro component 1										-0.009*** (0.001)		
Macro component 2										0.014*** (0.002)		
Structure of the economy												
Small-size companies (employees)					0.061*** (0.023)							
Micro-size companies (GVA)						0.005 (0.100)						
Small-size companies (GVA)						0.546 (0.393)						
						-0.373						

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[24] For illustrative purposes, Table 5.6 does not report the coefficients of fixed effects as well as two dummies that were introduced to account for the shifts of the VTTL in Malta and Ireland unrelated to a change in actual tax compliance (i.e. to filter VAT Gap measurement errors). All specifications were tested using econometric tests described in Section f in Annex A.

	(1) FE (Baseline)	(2) FE (Shadow economy)	(3) FE (Standard Rate)	(4) FE (Effective Rate)	(5) FE (Firm-size(1))	(6) FE (Firm-size(2))	(7) FE (CPC)	(8) FE (Trade discrepancies)	(9) FE (Fiscal prudence)	(10) FE (Macro components)	(11) FE (Fraud components)	(12) FE (Reporting Obligations)
Medium-size companies (GVA)						(0.272)						
Agriculture share	0.835*** (0.225)	0.760*** (0.226)	0.861*** (0.224)	0.637*** (0.227)			0.878*** (0.22579)	0.842*** (0.223)	0.871*** (0.235)	0.647*** (0.237)	0.973*** (0.247)	-0.625* (0.341)
Communication share	-0.985*** (0.354)	-0.973*** (0.352)	-0.877** (0.357)	-0.382 (0.369)			-1.017*** (0.35404)	-1.020*** (0.354)	-0.977*** (0.354)	-0.792** (0.359)	-1.282*** (0.441)	-0.699 (0.447)
Finance share	-0.899*** (0.240)	-0.900*** (0.239)	-0.817*** (0.243)	-0.835*** (0.246)			-0.867*** (0.241)	-1.005*** (0.240)	-0.898*** (0.241)	-0.787*** (0.254)	-0.888*** (0.257)	-0.349 (0.341)
Manufacturing share												-0.603** (0.239)
Construction share												-0.710*** (0.256)
Retail trade share												-0.202 (0.234)
Real estate share												0.121 (0.321)
R&D share												-0.797* (0.434)
Public administration share												-1.343*** (0.337)
Tax policy characteristics												
Statutory standard VAT rate			0.442** (0.176)									
Effective VAT rate				1.861*** (0.340)								
Fiscal Rules Index									0.002 (0.004)			
Reporting obligations												-0.017** (0.009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FE (Baseline)	FE (Shadow economy)	FE (Standard Rate)	FE (Effective Rate)	FE (Firm-size(1))	FE (Firm-size(2))	FE (CPC)	FE (Trade discrepancies)	FE (Fiscal prudence)	FE (Macro components)	FE (Fraud components)	FE (Reporting Obligations)
IT expenditure	-0.172***	-0.154***	-0.160***	-0.143***	-0.128***	-0.138***	-0.166***	-0.186***	-0.173***	-0.157***	-0.232***	-0.185***
	(0.046)	(0.047)	(0.046)	(0.048)	(0.048)	(0.049)	(0.046)	(0.046)	(0.047)	(0.052)	(0.053)	(0.041)
Tax fraud proxies												
Shadow economy		0.161**										
		(0.070)										
Intra-EU import at risk												0.768**
												(0.355)
CPC							-0.003					
							(0.002)					
Estimated trade value at risk								0.009				
								(0.013)				
Fraud component 1											0.0002	
											(0.003)	
Fraud component 2											-0.003	
											(0.003)	
Constant	0.239***	0.203***	0.136***	0.044	0.148***	0.168***	0.307***	0.247***	0.238***	0.206***	0.251***	0.713***
	(0.026)	(0.030)	(0.048)	(0.044)	(0.018)	(0.031)	(0.043)	(0.026)	(0.026)	(0.027)	(0.028)	(0.223)
Observations	493	493	493	474	493	493	493	489	493	449	407	455
R-squared	0.342	0.352	0.353	0.391	0.283	0.274	0.349	0.355	0.343	0.417	0.323	0.361
Number of countries	26	26	26	25	26	26	26	26	26	25	26	24

Source: own elaboration, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

As a robustness check on the fixed effects specification, we show how the estimates of the model vary across time.[25] Table 5.7 shows the comparison of the baseline estimation with the estimation performed separately across different time periods: 2000-2011 (which were reported in the 2013 Study) and 2006-2018 (which were reported across subsequent studies).

Table 5.7. Robustness Check

	(1)	(2)	(3)
	FE (Baseline)	FE (2000-2011)	FE (2006-2018)
Macroeconomic variables			
Real GDP growth	-0.359***	-0.411***	-0.268***
General gov. surplus (deficit)	-0.212***	-0.443***	-0.038*
Tax administration variables			
IT expenditure	-0.172***	-0.231***	-0.122**
Economic structure and institutional variables			
Agriculture share	0.835***	1.034***	-0.299
Communication share	-0.985***	-1.044*	-1.086**
Financial share	-0.899***	-0.816***	-0.180
Constant	0.243***	0.238***	0.213***
Observations	493	312	311
R-squared	0.342	0.332	0.413
Number of id	26	26	26

Source: own elaboration, *** p<0.01, ** p<0.05, * p<0.1

Table 5.7 shows that the baseline model and the model estimated on the 2000-2011 period show very similar results in the values of the estimated effects. In the model estimated on the 2006-2018 time period only, the estimates of the macroeconomic and tax administration covariates remain similarly robust. Somewhat larger heterogeneity is observed for the economic structure and institutional variables. The shares of agricultural services and the financial sector were not statistically significant for the 2006-2018 period.

In addition to the robustness checks that were performed in order to assess the stability of the coefficients in time, we also look at the linear predictions for each Member State (see Figure 5.1). Although some hikes and declines of the Gap could be predicted with some delay, they show that the model is accurate in predicting trends in VAT Gap changes.

As depicted by Figure 5.2, the model is able to attribute the majority of shifts in the overall EU VAT Gap to specific factors despite the time-effects used in the model. The results yield an important conclusion – much of the variation in the VAT Gap, especially in periods of economic stress, comes from cyclical factors, which is mostly visible between 2008 and 2010. However,

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[25] See the 2020 Study for further checks, including full-time interaction and a verification of how the parameters react to changes in the countries included in the sample.

the decrease in the VAT Gap in more recent years is only partially related to positive economic changes. Most of the changes are attributed to year effects, which are likely related to efforts of tax administrations not captured by the baseline model specification.

Figure 5.1. Linear Predictions Broken Out by Member State
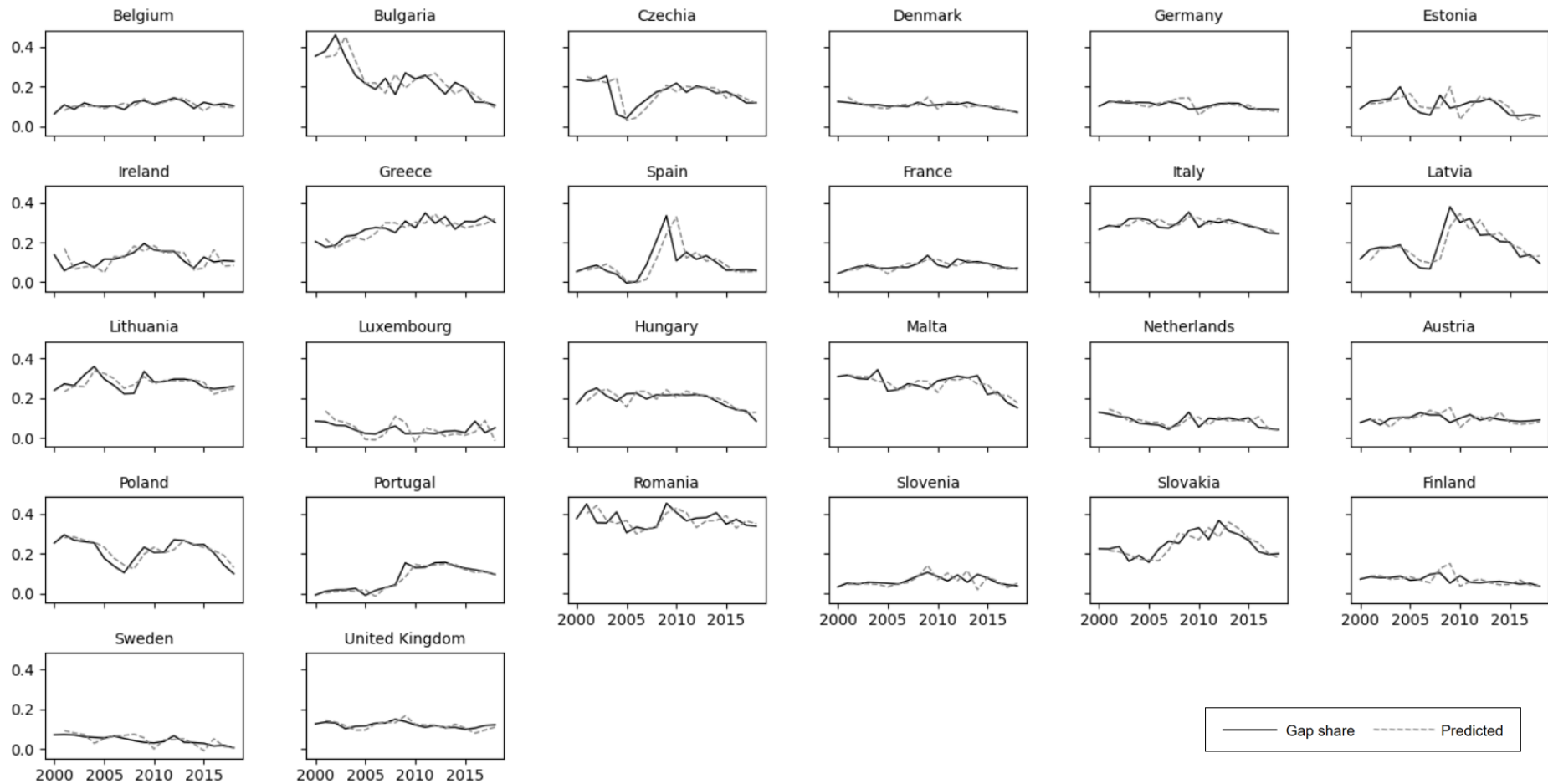
Source: own elaboration. Cyprus and Croatia were not included as the estimates were unavailable for the entire analysed period.

Figure 5.2. Contributions to VAT Gap Change
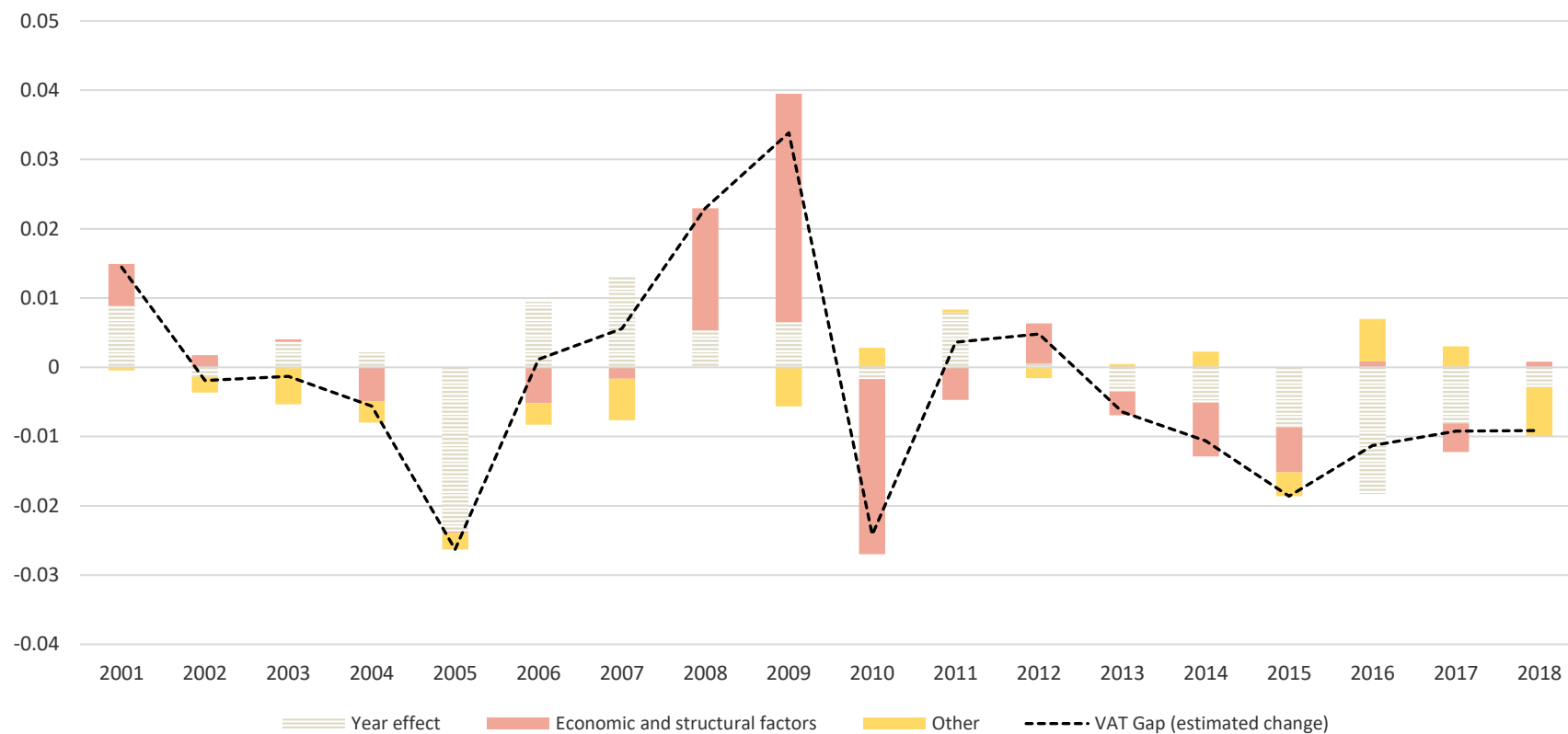
Source: own elaboration.

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Annex A. Methodological Considerations

This section of the Annex is based to a large extent on the methodological considerations already presented in earlier VAT Gap Reports. More detailed considerations regarding the approaches to estimate the VAT Gap are presented in the seminal VAT Gap Report (Barbone et al., 2013).

a. Source of Revisions of VAT Gap Estimates

Every year, the estimates of the VAT Gap are updated and revised backwards. There are three different sources of such revisions:

1) Updates in the underlying national accounts data published by Eurostat: updates in VAT revenues, new supply and use tables, and revised industry-specific growth rates, among others.

2) Updates in the estimated GFCF liability, based on the new information from the own resource submissions (ORS) on taxable shares of GFCF by five sectors: households, government, NPISH, and exempt financial and non-financial enterprises.

3) Revision of the parameters of the VTTL model: effective rates, pro-rata coefficients, and net adjustments, either due to new information from ORS or due to correcting errors in the previous computation.

b. Decomposition of VAT Revenue

As VAT Revenue (VR) is the difference between the VTTL and the VAT Gap ($VR = VTTL - VAT\ Gap$), and the VTTL is a product of the effective rate and the base ($VTTL = effective\ rate \times base$), VAT revenue could be decomposed using the following formula:

$$VR = VTTL \times VAT\ compliance = effective\ rate \times base \times \left(1 - \frac{VAT\ Gap}{VTTL}\right)$$

Thus, the year-over-year relative change in revenue is denoted as:

$$\frac{\Delta VR}{VR} = \frac{\Delta(effective\ rate)}{effective\ rate} \times \frac{\Delta base}{base} \times \left. \Delta\left(1 - \frac{VAT\ Gap}{VTTL}\right) \middle/ \left(1 - \frac{VAT\ Gap}{VTTL}\right) \right.$$

where $\frac{\Delta(effective\ rate)}{effective\ rate}$ denotes change in effective rate, $\frac{\Delta base}{base}$ denotes change in base, and $\left. \Delta\left(1 - \frac{VAT\ Gap}{VTTL}\right) \middle/ \left(1 - \frac{VAT\ Gap}{VTTL}\right) \right.$ denotes change in VAT compliance.

c. Data Sources and Estimation Method

The method used to estimate the VAT Gap in this report uses a "top-down" approach. Top-down approaches rely on national accounts, which cover the full tax base and are an exhaustive description of all productive activities. On the contrary, "bottom-up" approaches use data gathered by tax administrations including audits, surveys, and enquiry programmes. This enables us to estimate non-compliance in VAT for specific taxpayer groups as well as types of non-compliance.

Within top-down approaches, VAT liability can be calculated using a "consumption-side" approach focused on the last link in the VAT chain (including intermediate consumption for exempt services) or a "production-side" approach that considers VAT due by each sector of economic activity.[26] If the choice of underlying observations is random or if it is possible to estimate selection bias, a "bottom-up" approach might be used to derive the economy-wide tax gap figure.

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[26] For more details see Hutton (2017).

Aside from the different methodologies used, estimates of tax gaps could also be differentiated by the treatment of the tax collected by audit activities and assessed but finally not collected. The estimates presented herein show a "net" gap, meaning that they account for all revenue, including late payments and VAT collected in audit procedures. Estimates of a "gross gap" containing only the liabilities paid on time would be larger.

In the "top-down consumption-side" method that is utilised in this Report, the VTTL is estimated as the sum of the liability from six main components: household, government, and NPISH final consumption; intermediate consumption; GFCF; and other, largely country-specific, adjustments.

In the "top-down consumption-side" approach, the VTTL is estimated using the following formula:

$$VTTL = \sum_{i=1}^{N} (rate_i \times Value_i)$$
$$+ \sum_{i=1}^{N} \sum_{j=1}^{M} (rate_{i,j} \times propex_{i,j} \times IC\ Value_{i,j})$$
$$+ \sum_{i=1}^{N} \sum_{j=1}^{M} (rate_{i,j} \times propex_{i,j} \times GFCF\ Value_{i,j}) + net\ adjustments$$

Where:

Rate is the effective rate,

Value is the final consumption value,

IC Value is the value of intermediate consumption,

Propex is the percentage of output in a given sector that is exempt from VAT,

GFCF Value is the value of gross fixed capital formation, and

index *i* denotes categories of goods and services, whereas *j* denotes sectors of the economy.

To summarise, the VTTL is a product of the VAT rates and the propexes multiplied by the theoretical values of consumption and investment (plus country-specific net adjustments).

For the purpose of VAT Gap estimation, roughly 10,000 parameters are estimated for each year, including the effective rates for each 2-digit CPA (i.e. $rate_i$ in the VTTL formula presented above) group of products and services and the percentage of output in a given sector that is exempt from VAT for each type of consumption (i.e. *propex$_i$* in the VTTL formula presented above). For instance, for *Education services* (CPA no. 85) in Croatia, like for any other country and group of products and services, we estimated effective rates in household, government, and NPISH final consumption, as well as the percentage of output that is exempt from VAT. The main source of information is national accounts data and ORS, i.e. VAT statements provided by Member States to the European Commission. In a number of specific cases where ORS information was insufficient, additional data provided by Member States were used. As

these data are not official Eurostat publications, we decline responsibility for inaccuracies related to their quality.

A complete description of data and sources is shown in Table A1.

Table A1. Data Sources

	DESCRIPTION	PURPOSE	SOURCE	COMMENT
1	Household expenditure by CPA/COICOP category.	Estimation of effective rates for household final consumption for each 2-digit CPA category.	ORS / HBS[27]	…
2	The intermediate consumption of industries for which VAT on inputs cannot be deducted, pro-rata coefficients, alternatively share of exempt output.	Estimation of propexes.	ORS / assumptions common for all EU MS	…
3	Investment (gross fixed capital formation) of exempt sectors.	Estimation of VAT liability from investment.	ORS / Eurostat	Values forecasted two years ahead of available time series.
4	Government expenditure by CPA/COICOP category.	Estimation of effective rates for government final consumption for each 2-digit CPA category of products and services.	ORS	Only individual government consumption and social transfers in kind specifically are a part of the tax base. However, the effective rate is estimated using a broad definition of the base that includes entire government consumption.
5	NPISH expenditure by CPA/COICOP category.	Estimation of effective rates for NPISH final consumption for each 2-digit CPA category of products and services.	ORS	…
6	VTTL adjustment due to small business exemption, business expenditure on cars and fuel, and other country-specific adjustments.	Estimation of net adjustments.	ORS	In general, adjustments forecasted two years ahead of available time series.
7	Final household consumption, government final consumption, NPISH final consumption, and intermediate consumption.	Estimation of VTTL.	Eurostat	As national accounts figures do not always correspond to the tax base, two corrections to the base are applied: (1) adjustments for the self-supply of food and agricultural products and (2) adjustments for the intermediate consumption of construction work due to the treatment of construction activities abroad. If use tables are not available for a particular year or available use tables include confidential values, use tables are imputed using the RAS method.[28]
8	VAT revenue.	VAT revenue.	Eurostat	…

Source: own.

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[27] Household Budget Survey, Eurostat.

[28] The RAS method is an iterative proportional fitting procedure used in a situation when only row and column sums of a desired input-output table are known.

d. Fast VAT Gap Estimates

The methodology used to estimate the VTTL for 2020 differs markedly from the one employed to estimate the VTTL for 2015-2019. The main simplifications and assumptions include:

1) Structure of household final consumption does not change with respect to 2018. In fact, due to the unavailability of up-to-date figures, it relies in most cases on a three-year lagged series.

2) Non-deductible GFCF liability changes in line with the year-over-year change in government GFCF published by AMECO.[29]

3) In the vast majority of cases where there are no significant changes in the statuary rates, net adjustments and intermediate consumption liability are rescaled from 2018 using growth rates for the entire tax base.

Due to the simplified methodology, uncertainty around the "fast estimates" is substantially larger than for the full estimates. For 10 Member States, because of the tax measures introduced (e.g. deferrals and temporary reduction of rates), the estimation error was exceptionally large, hence, we decided not to publish these estimates. The "fast estimates" for 2012 can be found in Annex B.

e. Derivation of the Policy Gap and C-efficiency

This section of the Annex defines the concepts used in Chapter 5 for estimating foregone revenue due to policies introduced and discusses some of the methodological considerations.

We begin with the **Notional Ideal Revenue** that, by definition, should indicate an upper limit of VAT revenue (i.e. the revenue levied at a uniform rate in the environment of perfect tax compliance). As shown in Figure A1, ideal revenue is larger than the VTTL and subsequently larger than VAT collection. However, due to the existence of exemptions, it does not capture the entire VTTL and tax collection. If no exemptions were applied, neither intermediate consumption nor the GFCF of the business sector would be the base for computing the VTTL.

The problem arises when deciding whether investment by the non-business sector should be part of the VAT base. According to the OECD (2014), Notional Ideal Revenue is defined as the standard rate of VAT times the aggregate net final consumption. Multiplying the standard rate and final consumption would yield, however, lower liability than in the case where a country applied no exemptions, no reduced rates, and was able to enforce all tax payments. In real life, the VTTL is comprised partially from VAT liability from investment made by households, government, and NPISH. In the case of the non-inclusion of this investment to the base, the VTTL would be partially extended beyond the ideal revenue despite "no exemptions" present in the system (see Figure A1 (c)).

Policymakers can see the upper limit of VAT revenue by considering all final use categories of the household, non-profit, and government sectors. Thus, in this Report, Notional Ideal

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Revenue is defined as the standard rate of VAT times the aggregate net final and net GFCF of the household, non-profit, and government sectors, as recorded in the national accounts (interdependence among the various concepts presented is shown in Figure A1).[30]

The **Policy Gap** is defined as one minus the ratio of the "legal" tax liability (i.e. the chunk of the Notional Ideal Revenue that, in the counterfactual case of perfect tax compliance, is not collected due to the presence of exemptions and reduced rates). The Policy Gap is denoted by the following formula:

Policy Gap = (Notional Ideal Revenue – VTTL)/Notional Ideal Revenue

The Policy Gap could be further decomposed to account for the loss of revenue. Such components are the **Rate Gap** and the **Exemption Gap**, which capture the loss in VAT liability due to the application of reduced rates and the loss in liability due to the implementation of exemptions.

The Rate Gap is defined as the difference between the VTTL and what would be obtained in a counterfactual situation, in which the standard rate, instead of the reduced, parking, and zero rates, is applied to final consumption. Thus, the Rate Gap captures the loss in revenue that a particular country incurs by adopting multiple VAT rates instead of a single standard rate (Barbone et al., 2015).

The Exemption Gap is defined as the difference between the VTTL and what would be obtained in a counterfactual situation, in which the standard rate is applied to exempt products and services, and no restriction of the right to deduct applies.[31] Thus, the Exemption Gap captures the amount of revenue that might be lost because of exempted goods and services. Note that the Exemption Gap is composed of the loss in the VAT on the value added of exempt sectors, minus the VAT on their inputs, minus the VAT on GFCF inputs for these sectors. Thus, in principle, the Exemption Gap might be positive or negative (if the particular sector had negative value added, or if it had large GFCF expenditures relative to final consumption) (Barbone et al., 2015).

In algebraic terms, we have the following:

Definitions:

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[30] National accounts for most countries report final consumption on a gross (i.e. VAT-inclusive) basis. Net consumption is estimated on the basis of the gross consumption recorded in the use tables, from which VAT revenues are subtracted.

[31] The additive decomposition of the Policy Gap into the Exemption and Rate Gap presented in this Report differs from that in Keen (2013). Keen (2013) defines the Rate Gap as the loss from applying reduced and zero rates to the final consumption liability, measured as a percentage of the Notional Ideal Revenue. The Exemption Gap measures unrecovered VAT accumulated in the production process as a percentage, on the contrary, of final consumption liability. Due to these definitions, the Policy Gap can be split multiplicatively into gaps attributable to reduced rates and exemptions. Since the numerator of the "[1 - Rate Gap]" and denominator of the "[1 - Exemption Gap]" are equal, multiplication of these two components yields – VAT revenue as a percentage of Notional Ideal Revenue, which equals "[1 - Policy Gap]" (Barbone et al., 2015).

$T_i^{*,E} = \frac{VTTL_i^{*,E}}{C_i}$ – effective rate for group *i* of products in the case where the standard rate instead of the zero rate, parking rate, or reduced rate is applied (for final consumption and the GFCF of non-business activities).

$VTTL_i^{*,E}$ – liability from final consumption and GFCF of the non-business activities of group *i* of products, in the case where the standard rate instead of the zero rate, parking rate, or reduced rate is applied. Actual liability from intermediate consumption and the GFCF of business activities is assumed.

$T_i^{*,R} = \frac{VTTL_i^{*,R}}{C_i}$ – effective rate for group *i* of products in the event where exempt products within the group are taxed at the standard rate.

$VTTL_i^{*,R}$ – liability from the **final consumption** of group *i* when exempt products within the group are taxed at the standard rate. Actual liability from final consumption GFCF of non-business activities is assumed.

τ_s – statutory rate.

$i \in (1; 65)$ – sectors of the economy.

Policy Gap:

$$1 - P = \left(\frac{\sum_{i=1}^{N} T_i C_i}{\tau_s \sum_{i=1}^{N} C_i}\right)\left(\frac{\sum_{i=1}^{N} T_i^* C_i}{\sum_{i=1}^{N} T_i C_i}\right) = \left(\frac{\sum_{i=1}^{N} T_i^* C_i}{\tau_s \sum_{i=1}^{N} C_i}\right)$$

Exemption Gap:

$$1 - P_E = \left(\frac{\sum_{i=1}^{N} T_i C_i}{\tau_s \sum_{i=1}^{N} C_i}\right)\left(\frac{\sum_{i=1}^{N} T_i^{*,E} C_i}{\sum_{i=1}^{N} T_i C_i}\right) = \left(\frac{\sum_{i=1}^{N} T_i^{*,E} C_i}{\tau_s \sum_{i=1}^{N} C_i}\right)$$

Rate Gap:

$$1 - P_R = \left(\frac{\sum_{i=1}^{N} T_i C_i}{\tau_s \sum_{i=1}^{N} C_i}\right)\left(\frac{\sum_{i=1}^{N} T_i^{*,R} C_i}{\sum_{i=1}^{N} T_i C_i}\right) = \left(\frac{\sum_{i=1}^{N} T_i^{*,R} C_i}{\tau_s \sum_{i=1}^{N} C_i}\right)$$

By definition we have:

$$\tau_s \sum_{i=1}^{N} C_i = \sum_{i=1}^{N} T_i^* C_i + \left(\tau_s \sum_{i=1}^{N} C_i - \sum_{i=1}^{N} T_i^* C_i \right)$$

$$= \sum_{i=1}^{N} T_i^* C_i + \left(\tau_s \sum_{i=1}^{N} C_i - \sum_{i=1}^{N} T_i^{*,R} C_i \right) + \left(\tau_s \sum_{i=1}^{N} C_i - \sum_{i=1}^{N} T_i^{*,E} C_i \right)$$

Thus:

$$P = 1 - \left(\frac{\sum_{i=1}^{N} T_i^* C_i}{\tau_s \sum_{i=1}^{N} C_i} \right) = \left(\frac{\tau_s \sum_{i=1}^{N} C_i - \sum_{i=1}^{N} T_i^* C_i}{\tau_s \sum_{i=1}^{N} C_i} \right) = \left(\frac{2\tau_s \sum_{i=1}^{N} C_i - \sum_{i=1}^{N} T_i^{*,E} C_i - \sum_{i=1}^{N} T_i^{*,R} C_i}{\tau_s \sum_{i=1}^{N} C_i} \right)$$

$$= P_R + P_E$$

Using the above convention, one can decompose the Rate Gap and the Exemption Gap into components indicating the loss of the Notional Ideal Revenue due to the implementation of reduced rates and exemptions on specific goods and services. Such additive decomposition is carried out for the computation of, as defined by Barbone et al. (2015), the Actionable Exemption Gap, which excludes the services and notional values that are unlikely to be taxed even in an ideal world.

As discussed in Chapter 4, C-efficiency is used as an indicator of the departure of the VAT from a perfectly enforced tax levied at a uniform rate on all consumption. It is expressed as:

$$E^C = \frac{VR}{tC}$$

where, *VR* stands for VAT revenue, *t* for statutory standard rate, and *C* for final consumption (net of VAT). The values of the measure could range from zero to one. However, values larger than 65 percent are rarely observed.[32] Even in a utopian situation of full compliance and a flat rate system, C-efficiency should be considerably lower than one as domestic final consumption in the denominator of C-efficiency is broader than the actionable VAT base.[33]

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[32] See: Keen (2013).

[33] Total domestic final consumption includes government and NPISH consumption, which to large extent cannot be taxed.

Figure A1. Components of Ideal Revenue, VTTL, and VAT Collection

(a)   (b)   (c)
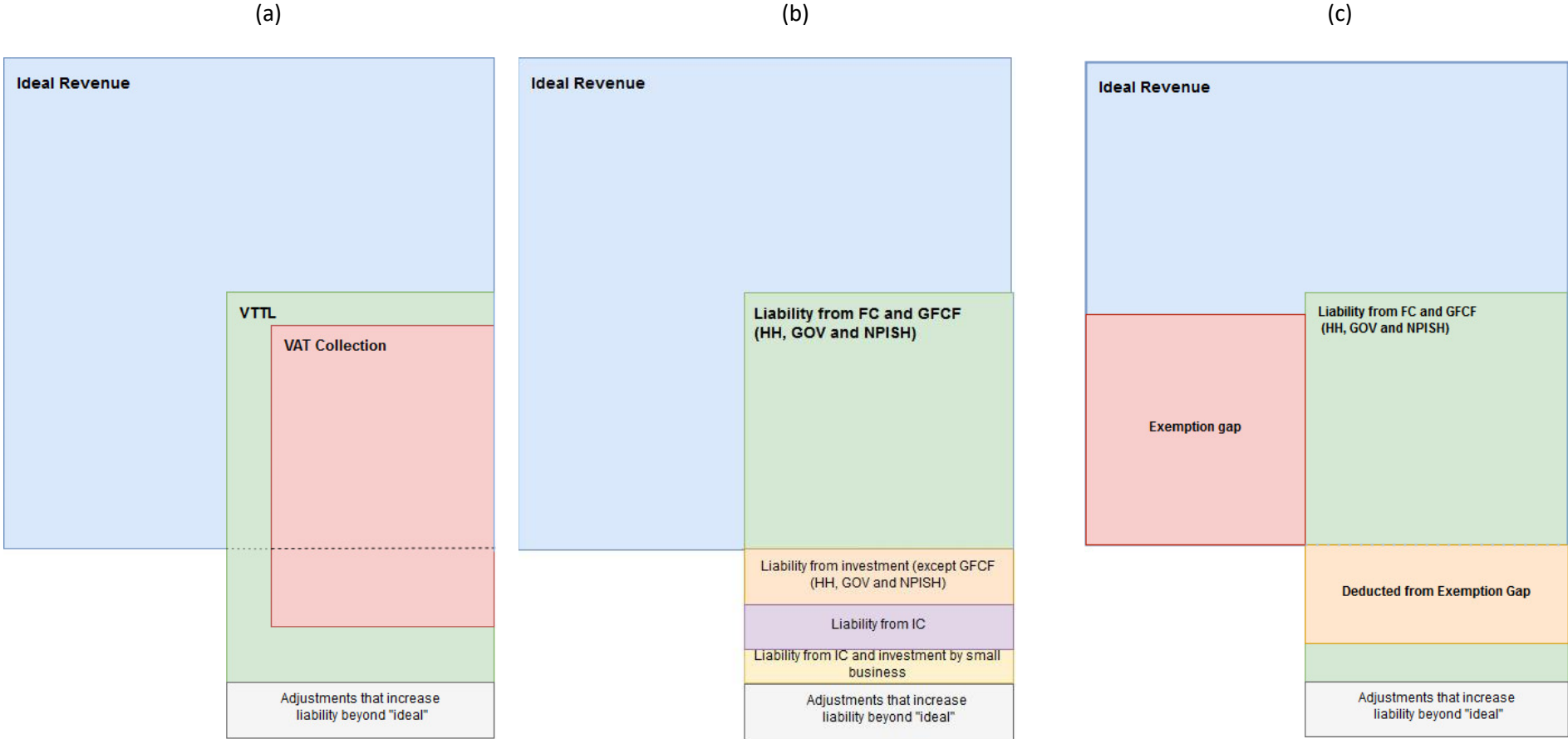
Source: own.

f. Tests of the Econometric Model

Within the procedure for selecting exogenous variables aiming at minimising the problems of endogeneity, multicollinearity, and the omitted variables, we created a correlation matrix of pre-selected exogenous variables. As this test proved, there was no case of pairwise correlation of above 0.65 in the specifications presented in Table 5.6. To test whether the data matrix could result in unstable coefficient estimates, we used the singular value decomposition method. In all of the data matrices underlying the baseline and alternative equations, condition numbers were lower than 30, which is associated with well-behaved data matrices.

Several other statistical tests were performed. The appropriateness of including time and country fixed effects was verified through the Hausmann tests. As the tests indicated that in the random effects specification, errors are correlated with the regressors, the fixed effects specification was chosen.

Since the model contains time series, we verified that the model does not suffer from the issue of spurious regression. For this purpose, we performed unit root tests – Levin-Lin-Chu (2002), Harris-Tzavalis (1999), and Im-Pesaran-Shin (2003). All tests indicated that the VAT Gap and explanatory variables included in the specifications are stationary. The tests showed that unemployment is non-stationary and cannot be included in levels in the equation regressing the VAT Gap denoted as a percent of the VTTL. In addition to unit root tests, all model specifications were tested for cointegration using the Pedroni panel-data test (Pedroni, 1999) and the Wald test for groupwise heteroskedasticity. The residuals of all model specifications appeared to be homoscedastic, stationary, and I(0).

We also verified whether there is no reverse causality between the evolution of the VAT Gap and tax administration variables. In other words, we tested if relative to other Member States pace of improvements in VAT compliance does not affect the willingness of Member States to increase efforts and introduce various measures. For this purpose, we employed a procedure proposed by Dumitrescu and Hurlin (2012) for testing Granger causality in panel datasets. The tests were performed on year-over-year relative changes in the VAT Gap and tax administration variables. To account for some potential forward-looking impact of introducing reporting obligations, the first lag was excluded from the analysis.

Annex B. Statistical Appendix

Table B1. VTTL (EUR million)

	2015	2016	2017	2018	2019
Belgium	31,578	32,263	33,888	35,060	36,146
Bulgaria	5,045	5,038	5,312	5,714	6,136
Czechia	15,177	15,601	16,926	18,642	19,766
Denmark	28,610	29,308	30,577	31,653	32,410
Germany	232,436	240,870	249,909	259,421	267,554
Estonia	1,986	2,090	2,265	2,428	2,599
Ireland	13,543	14,028	14,970	15,716	17,002
Greece	17,965	19,707	21,372	21,525	20,740
Spain	72,283	74,791	79,381	82,788	85,148
France	167,521	169,342	177,340	182,148	187,811
Croatia	6,400	6,545	6,946	7,501	7,497
Italy	137,201	138,938	140,187	141,748	141,639
Cyprus	1,647	1,701	1,804	1,988	1,998
Latvia	2,361	2,341	2,566	2,726	2,869
Lithuania	3,954	4,097	4,426	4,660	4,898
Luxembourg	3,510	3,736	3,564	3,896	4,030
Hungary	12,779	12,344	13,621	14,210	15,398
Malta	893	956	1,035	1,123	1,221
Netherlands	49,756	50,500	53,023	55,751	60,791
Austria	28,736	29,768	30,909	32,356	33,301
Poland	39,925	38,734	43,149	45,711	47,762
Portugal	17,598	17,890	18,656	19,627	20,395
Romania	19,797	17,421	18,447	19,148	21,206
Slovenia	3,491	3,504	3,623	3,928	4,186
Slovakia	7,230	6,783	7,125	7,734	8,143
Finland	20,069	20,679	21,724	22,248	22,620
Sweden	42,244	44,017	45,811	44,886	44,009
United Kingdom	203,316	187,929	183,437	188,538	193,493
EU-28, EU-27 (2015)	1,187,051	1,190,921	1,231,993	1,272,872	1,310,613

Source: own calculations.

Table B2. Household VAT Liability (EUR million)

	2015	2016	2017	2018	2019
Belgium	17,855	18,522	19,150	19,831	20,181
Bulgaria	3,615	3,711	3,978	4,236	4,543
Czechia	9,447	9,900	10,661	11,457	11,933
Denmark	16,604	17,289	18,052	18,669	19,052
Germany	140,938	145,822	149,860	154,352	158,305
Estonia	1,374	1,436	1,525	1,652	1,746
Ireland	7,732	7,816	8,786	8,655	9,708
Greece	13,459	15,268	16,396	16,830	16,391
Spain	52,864	55,178	58,695	60,507	61,919
France	98,826	100,505	102,950	105,752	108,530
Croatia	4,613	4,793	5,127	5,437	5,460
Italy	98,134	99,321	100,323	101,726	103,285
Cyprus	1,084	1,121	1,196	1,282	1,325
Latvia	1,801	1,847	1,980	2,051	2,166
Lithuania	3,233	3,394	3,664	3,878	4,093
Luxembourg	1,289	1,331	1,361	1,469	1,560
Hungary	8,605	9,033	9,536	9,616	10,319
Malta	521	542	565	618	658
Netherlands	25,953	26,218	27,204	28,397	31,430
Austria	19,259	19,885	20,658	21,334	21,908
Poland	27,605	27,434	30,470	31,767	33,400
Portugal	13,190	13,345	13,791	14,455	14,976
Romania	12,153	10,944	11,682	12,336	13,139
Slovenia	2,448	2,573	2,682	2,843	3,016
Slovakia	5,007	5,054	5,437	5,759	6,099
Finland	11,386	11,575	11,830	12,198	12,281
Sweden	22,041	22,604	23,327	22,877	22,733
United Kingdom	133,938	124,849	123,027	127,019	130,217
EU-28, EU-27 (2015)	754,974	761,309	783,913	807,005	830,320

Source: own calculations.

Table B3. Intermediate Consumption and Government VAT Liability (EUR million)

	2015	2016	2017	2018	2019
Belgium	8,132	8,289	8,732	9,102	9,445
Bulgaria	708	734	794	897	964
Czechia	3,561	3,739	3,993	4,400	4,855
Denmark	7,872	7,619	7,923	8,133	8,372
Germany	51,432	53,797	56,328	58,638	60,553
Estonia	279	326	349	375	404
Ireland	3,991	4,022	4,131	4,577	4,238
Greece	2,603	2,803	3,061	3,075	2,897
Spain	10,884	11,046	11,959	12,714	13,343
France	31,790	32,198	33,515	34,159	34,906
Croatia	1,109	1,165	1,219	1,224	1,229
Italy	23,457	23,977	24,013	24,055	24,566
Cyprus	426	429	433	472	506
Latvia	366	369	414	441	483
Lithuania	452	453	485	494	523
Luxembourg	1,102	1,171	1,204	1,304	1,304
Hungary	2,102	2,054	2,236	2,377	2,619
Malta	276	328	377	400	463
Netherlands	14,313	14,259	14,788	15,793	16,823
Austria	5,131	5,130	5,275	5,841	6,090
Poland	7,683	7,590	8,198	8,685	9,051
Portugal	2,877	3,218	3,463	3,606	3,815
Romania	3,026	2,522	2,570	2,793	3,146
Slovenia	544	554	544	615	664
Slovakia	1,027	975	1,006	1,139	1,178
Finland	4,754	4,900	5,140	5,231	5,333
Sweden	12,113	12,337	12,635	12,452	12,003
United Kingdom	49,666	44,337	41,968	42,235	43,723
EU-28, EU-27 (2015)	251,676	250,341	256,753	265,227	273,499

Source: own calculations.

Table B4. GFCF VAT Liability (EUR million)

	2015	2016	2017	2018	2019
Belgium	4,957	4,808	5,319	5,455	5,804
Bulgaria	679	585	532	568	620
Czechia	2,192	1,971	2,275	2,725	2,923
Denmark	3,402	3,639	3,826	4,070	4,195
Germany	37,843	39,483	41,422	44,163	46,582
Estonia	323	318	381	398	443
Ireland	1,649	1,995	1,839	2,301	2,787
Greece	1,641	1,355	1,605	1,332	1,135
Spain	7,777	7,891	7,981	8,751	9,044
France	31,667	31,450	35,807	36,965	38,560
Croatia	592	567	586	820	785
Italy	13,318	13,883	14,342	14,560	15,085
Cyprus	108	134	153	211	161
Latvia	238	175	217	280	269
Lithuania	461	470	526	571	621
Luxembourg	411	625	580	694	737
Hungary	1,894	1,099	1,658	2,090	2,395
Malta	82	58	71	84	92
Netherlands	8,962	9,481	10,487	11,004	11,882
Austria	2,890	3,284	3,437	3,641	3,866
Poland	4,072	3,139	3,890	4,652	4,692
Portugal	1,170	941	1,031	1,151	1,235
Romania	4,193	3,638	3,950	3,882	4,716
Slovenia	419	303	329	393	423
Slovakia	1,206	763	680	815	865
Finland	3,316	3,513	3,987	4,116	4,212
Sweden	7,521	8,486	9,307	9,010	8,724
United Kingdom	18,555	17,396	16,997	17,542	18,810
EU-28, EU-27 (2015)	161,540	161,452	173,216	182,241	191,665

Source: own calculations.

Table B5. VAT Revenues (EUR million)

	2015	2016	2017	2018	2019
Belgium	27,594	28,750	29,763	31,053	31,702
Bulgaria	4,059	4,417	4,664	5,097	5,628
Czechia	12,382	13,101	14,703	16,075	16,931
Denmark	25,672	26,770	28,049	29,137	29,632
Germany	211,616	218,779	226,697	235,130	244,111
Estonia	1,873	1,975	2,149	2,331	2,483
Ireland	11,831	12,603	13,060	14,175	15,281
Greece	12,885	14,333	14,642	15,288	15,390
Spain	67,913	70,214	73,970	77,536	79,308
France	151,680	154,490	162,011	167,720	173,953
Croatia	5,699	5,992	6,465	6,949	7,419
Italy	100,345	102,086	107,576	109,333	111,533
Cyprus	1,506	1,654	1,634	1,817	1,943
Latvia	1,876	2,032	2,164	2,449	2,632
Lithuania	2,889	3,028	3,310	3,522	3,850
Luxembourg	2,991	3,147	3,338	3,563	3,763
Hungary	10,676	10,595	11,729	12,950	13,916
Malta	673	712	810	920	934
Netherlands	44,746	47,849	49,833	52,712	58,131
Austria	26,247	27,301	28,304	29,323	30,405
Poland	30,089	30,854	36,339	40,423	42,383
Portugal	15,368	15,767	16,810	17,868	18,786
Romania	12,939	10,968	11,650	12,890	13,795
Slovenia	3,220	3,318	3,481	3,765	3,888
Slovakia	5,423	5,424	5,919	6,319	6,830
Finland	18,974	19,694	20,404	21,364	21,974
Sweden	40,532	42,788	44,098	43,403	43,412
United Kingdom	183,164	167,827	162,724	168,703	176,317
EU-28, EU-27 (2015)	1,034,863	1,046,469	1,086,295	1,131,814	1,176,331

Source: Eurostat.

Table B6. VAT Gap (EUR million)

	2015	2016	2017	2018	2019
Belgium	3,984	3,513	4,126	4,007	4,444
Bulgaria	985	621	648	617	508
Czechia	2,794	2,499	2,223	2,567	2,835
Denmark	2,938	2,539	2,528	2,516	2,778
Germany	20,820	22,091	23,212	24,291	23,443
Estonia	113	115	117	98	116
Ireland	1,712	1,426	1,910	1,541	1,721
Greece	5,080	5,374	6,730	6,237	5,350
Spain	4,370	4,577	5,411	5,252	5,840
France	15,841	14,852	15,329	14,428	13,858
Croatia	702	553	482	553	77
Italy	36,856	36,852	32,611	32,415	30,106
Cyprus	141	47	169	171	54
Latvia	484	309	402	277	237
Lithuania	1,065	1,070	1,116	1,137	1,048
Luxembourg	519	589	226	333	267
Hungary	2,103	1,748	1,891	1,261	1,483
Malta	220	244	225	203	287
Netherlands	5,010	2,651	3,190	3,039	2,660
Austria	2,488	2,466	2,605	3,033	2,895
Poland	9,836	7,880	6,810	5,288	5,379
Portugal	2,230	2,123	1,847	1,759	1,609
Romania	6,858	6,453	6,797	6,258	7,411
Slovenia	271	186	142	163	298
Slovakia	1,808	1,360	1,206	1,414	1,313
Finland	1,095	985	1,320	884	646
Sweden	1,712	1,228	1,713	1,483	597
United Kingdom	20,151	20,102	20,714	19,835	17,176
EU-28, EU-27 (2015)	152,188	144,452	145,698	141,059	134,436

Source: own calculations.

Table B7. VAT Gap (percent of VTTL)

	Backcasted series															Full estimates					Fore-cast
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Belgium	6.8%	11.4%	9.1%	12.3%	10.8%	10.5%	10.8%	9.0%	12.8%	13.4%	11.7%	13.1%	14.9%	13.1%	9.6%	12.6%	10.9%	12.2%	11.4%	12.3%	12.0%
Bulgaria	35.4%	38.0%	46.0%	34.9%	25.8%	21.7%	18.7%	24.2%	16.1%	27.0%	24.0%	25.7%	21.4%	16.3%	22.2%	19.5%	12.3%	12.2%	10.8%	8.3%	7.2%
Czechia	24.5%	23.7%	24.1%	26.3%	7.0%	5.0%	10.6%	14.5%	18.3%	19.8%	22.7%	18.2%	21.3%	20.2%	17.7%	18.4%	16.0%	13.1%	13.8%	14.3%	15.6%
Denmark	12.6%	12.1%	11.5%	10.9%	11.0%	10.3%	10.4%	10.0%	12.1%	10.6%	11.0%	11.4%	11.2%	12.2%	10.8%	10.3%	8.7%	8.3%	7.9%	8.6%	6.3%
Germany	10.2%	12.6%	12.1%	11.9%	12.1%	12.0%	10.7%	12.4%	11.5%	8.8%	9.0%	10.3%	11.5%	11.7%	11.6%	9.0%	9.2%	9.3%	9.4%	8.8%	-
Estonia	9.0%	12.5%	13.3%	14.1%	20.0%	10.4%	6.9%	5.7%	15.7%	9.3%	10.5%	12.4%	12.5%	14.1%	10.4%	5.7%	5.5%	5.2%	4.0%	4.5%	4.4%
Ireland	13.8%	5.8%	8.3%	10.3%	7.4%	11.6%	11.6%	13.0%	15.0%	19.4%	16.3%	15.6%	15.6%	10.6%	7.1%	12.6%	10.2%	12.8%	9.8%	10.1%	-
Greece	18.2%	15.4%	16.3%	20.8%	21.4%	24.3%	25.2%	24.9%	22.7%	28.5%	25.1%	32.6%	27.4%	30.8%	24.4%	28.3%	27.3%	31.5%	29.0%	25.8%	-
Spain	5.4%	7.2%	8.5%	5.7%	4.0%	-0.4%	0.2%	8.8%	20.9%	33.4%	10.7%	15.1%	11.5%	13.3%	10.0%	6.0%	6.1%	6.8%	6.3%	6.9%	8.0%
France	4.4%	6.3%	7.8%	8.3%	7.1%	7.0%	7.5%	7.5%	9.3%	13.5%	8.7%	7.4%	11.7%	10.0%	10.3%	9.5%	8.8%	8.6%	7.9%	7.4%	9.5%
Croatia																11.0%	8.4%	6.9%	7.4%	1.0%	-
Italy	25.2%	27.2%	26.5%	30.5%	30.9%	29.9%	26.3%	25.9%	28.8%	33.9%	26.3%	29.4%	28.7%	30.0%	28.6%	26.9%	26.5%	23.3%	22.9%	21.3%	22.4%
Cyprus																8.5%	2.7%	9.4%	8.6%	2.7%	3.6%
Latvia	12.1%	16.9%	18.0%	17.9%	19.2%	11.3%	7.6%	7.1%	22.0%	38.3%	30.5%	32.4%	24.1%	24.4%	20.9%	20.5%	13.2%	15.7%	10.2%	8.3%	-
Lithuania	25.4%	28.6%	27.7%	33.1%	37.3%	31.1%	27.8%	23.6%	23.9%	34.9%	29.6%	29.8%	31.0%	31.0%	30.2%	26.9%	26.1%	25.2%	24.4%	21.4%	20.0%
Luxembourg	20.7%	20.4%	18.6%	18.4%	16.1%	14.5%	14.1%	16.4%	18.2%	14.3%	14.4%	14.8%	14.3%	15.5%	15.8%	14.8%	15.8%	6.3%	8.5%	6.6%	2.0%
Hungary	17.6%	23.5%	25.5%	21.6%	19.1%	22.7%	23.0%	20.1%	22.2%	22.0%	22.3%	22.0%	22.2%	21.6%	19.1%	16.5%	14.2%	13.9%	8.9%	9.6%	6.1%
Malta	33.7%	34.3%	32.6%	32.3%	37.0%	26.2%	27.0%	30.0%	29.1%	27.4%	31.5%	32.5%	33.9%	33.0%	34.1%	24.6%	25.6%	21.7%	18.1%	23.5%	29.3%
Netherlands	12.8%	11.9%	10.7%	10.1%	7.4%	6.9%	6.4%	4.2%	7.7%	12.8%	5.4%	9.9%	9.3%	10.0%	9.0%	10.1%	5.3%	6.0%	5.5%	4.4%	-
Austria	7.7%	9.4%	6.5%	9.8%	10.2%	10.3%	12.6%	11.5%	11.5%	7.8%	9.9%	11.7%	8.9%	10.3%	9.2%	8.7%	8.3%	8.4%	9.4%	8.7%	5.6%
Poland	25.3%	29.4%	26.8%	26.0%	25.4%	17.7%	13.7%	10.4%	17.1%	23.2%	20.5%	20.8%	27.0%	26.6%	24.4%	24.6%	20.3%	15.8%	11.6%	11.3%	10.0%
Portugal	-0.7%	1.1%	1.8%	1.9%	2.6%	-0.9%	1.5%	3.0%	4.4%	15.3%	12.9%	13.2%	15.4%	15.7%	13.7%	12.7%	11.9%	9.9%	9.0%	7.9%	-
Romania	37.5%	44.9%	35.3%	35.2%	40.7%	30.4%	33.2%	32.0%	33.2%	45.2%	40.5%	36.4%	37.7%	38.0%	40.4%	34.6%	37.0%	36.8%	32.7%	34.9%	33.9%
Slovenia	3.4%	5.3%	4.8%	5.7%	5.5%	5.1%	4.7%	6.5%	8.8%	10.6%	8.5%	6.3%	9.3%	5.7%	9.6%	7.8%	5.3%	3.9%	4.1%	7.1%	7.9%
Slovakia	20.8%	20.7%	22.0%	14.5%	17.4%	14.0%	20.7%	24.6%	23.5%	29.9%	31.3%	25.5%	35.0%	29.7%	27.9%	25.0%	20.0%	16.9%	18.3%	16.1%	17.1%
Finland	7.2%	8.4%	7.9%	8.0%	8.7%	6.6%	7.0%	9.6%	10.3%	5.2%	8.9%	5.6%	5.4%	5.9%	6.1%	5.5%	4.8%	6.1%	4.0%	2.9%	-
Sweden	8.3%	8.5%	8.2%	7.4%	7.1%	6.7%	7.7%	6.5%	5.4%	4.6%	4.3%	5.0%	7.9%	4.6%	4.4%	4.1%	2.8%	3.7%	3.3%	1.4%	-
United Kingdom	12.7%	13.6%	13.1%	10.2%	11.4%	11.7%	13.0%	13.1%	15.0%	13.9%	12.2%	11.0%	11.9%	10.8%	10.9%	9.9%	10.7%	11.3%	10.5%	8.9%	-

Source: own calculations.

Annex C. External Reviews

This Annex contains reports of the external reviewers that provided comments and suggestion to the draft version of the Final Report. The reviews of Michael Smart (of Chapter 1-4) and Hana Zídková (of Chapter 5) are followed by Authors' response to the major comments and description of the changes that were introduced in response to the comments.

a. Report 1

Michael Smart

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September 8, 2021

Overall Assessment

This paper updates calculations of VAT compliance and policy gaps for EU member states up to 2020. The paper provides informative data on revenue loss from VAT gaps across all Member States, and a very discussion of the sources of policy gaps in particular. The results presented are sensible, and broadly consistent with results of prior years' VAT gap reports. In what follows, I offer certain suggestions about how the exposition of the paper could be improved, and I ask certain questions about assumptions and methods that could be explored in more detail in subsequent updates.

Key comments

1. The paper talks about "the" compliance gap and offers this identity:

   Actual Revenue = Net Base × Effective Rate × Compliance Ratio,

   I think this masks important heterogeneity and interaction effects that should be discussed in the paper. For example, some portion of non-compliant supplies result from illegally unregistered traders, or from traders that underreport sales and may tend to underreport ITCs as well. That means that some portion of VAT revenue actually collected comes from unrecovered ITCs on non-compliant traders in taxable sectors. So the top-down method underestimates the portion of economy-wide value added that comprises non-compliant sales: the unrecovered input VAT in effect masks some of the non-compliance problem under the top-down method.
   Despite this observation, I am not suggesting that the gap calculations should be done in a different way. Instead, I think that the paper should be clearer about the algebra behind its statements and offer a franker discussion of the limits of the top-down method.

2. "Net adjustments" to the VTTL appear quantitatively important. I could find no discussion in the text of what the basis for these adjustments is. For several countries, adjustments are 25-30% of the estimated VAT gap and for some they exceed it. For example, in Luxembourg the gap is 267 and adjustments are 429. I believe this means that, if the adjustments were excluded, Luxembourg's compliance gap would be -4% instead of +6.6%. I suspect that in Luxembourg's case at least this has something to do with VAT collected on exports not captured in the national accounts. Given that

some of the calculations may be quite sensitive to the net adjustments, they should be carefully discussed in the text.

3. The paper offers gap estimates for 2020 based on a "fast gap" method. If I understand this method correctly, it involves comparing actual revenues in 2020 to a calculation of the VTTL based in 2018 and scaled to notional 2020 values using certain assumed scale factors that are largely common across member states. If I have that right, then the change in compliance gap between 2018 and 2020 is closely related to the percentage change in actual VAT revenues (or C-efficiency). This could easily reflect sectoral swings rather than actual changes in compliance. I see the value in providing up-to-date estimates, despite data lags. I am not sure the fast gap method is sufficiently reliable to be used on a going-forward basis.

4. I believe the expression for VTTL in the Annex should be clarified to avoid misinterpretation:

$$VTTL = \sum_{i=1}^{N}(rate_i \times Value_i)$$
$$+ \sum_{i=1}^{N}(rate_i \times propex_i \times IC\ Value_i)$$
$$+ \sum_{i=1}^{N}(rate_i \times propex_i \times GFCF\ Value_i) + net\ adjustments$$

It is not clear if i indexes commodities or sectors. Let us assume it is the latter. Then $rate_i$ in the second term refers to taxes on intermediate use by exempt firms. This $rate_i$ cannot be the same as the $rate_i$ in the first term, which refers to taxes on paid on outputs of a sector. It is tempting to think this expression is correct, if the summation is over sectors rather than commodities. But in that case, $propex_i$ cannot refer to the exempt proportion of firms in sector i but rather to the exempt proportion of downstream intermediate users of commodity i.

I am sure that the calculations have done correctly, but this short statement of the method is potentially misleading. It would be better to write out the algebra with double summation of inputs and outputs, and then define aggregates and averages appropriately.

5. I could not follow the algebraic derivations of the decomposition of C-efficiency into policy, exemption, and rate gaps, as explained in Annex e. The problem was that several terms are not defined formally, including T_i^*, $VTTL_i^{*,E}$, and $VTTL_i^{*,R}$. As well, when the relationship to C-efficiency is explained, entirely new notation is used:

$$CE = \frac{VR}{tC}$$

This section of the paper is important, and a little formality would probably help readers to follow the important points being made in this section. The alternative is simply to adopt the definitions and notation in Keen (2013), and compute the gaps in that way instead.

6. In Chap. 4, the paper states:
"…that exclude liability from the final consumption of "imputed rents" (the notional value of home occupancy by homeowners), the provision of public goods and services, and

financial services. For these specific groups of services, charging VAT is impractical or currently goes beyond the control of national authorities."

This is a strong view and one might take issue with it. The fundamental principle behind exemption in "hard to tax" sectors is that the unrecovered input tax is a proxy tax for the VAT not collected on consumption. It is definitely interesting to ask how far off we are if we tax inputs instead of outputs in housing or in quasi-public sectors. But it would be wrong to suggest that the revenue loss from not taxing these sectors is out of policymakers' control or should be excluded entirely from the policy gap.

7. The paper states:
   "In three cases, i.e. the financial services Gaps in Cyprus, Ireland and Malta and the Actionable Exemption Gap in Malta, negative gaps were observed. Although theoretically possible, this likely results from a measurement error."

8. Isn't this likely related to the exemption for financial services, and other examples of exports with not refunded VAT on inputs? Elsewhere the paper does mention this explanation for the Luxembourg results.

9. It would be useful to compare your results to other estimates of compliance gaps for member states. One possible source of comparisons is: Morrow, Smart, and Swistak, 2021, "VAT Compliance, Trade, and Institutions", University of Toronto, mimeo.

Expositional and other comments

1. The paper states: "Table 1.3 and Figure 1.1 present the decomposition of the total changes in nominal VAT revenues into these three components: change in net taxable base, change in the effective rate applied to the base, and change in the compliance ratio."

   This is useful. But, it is not clear what units revenue is being measured in here. Is it the change in revenues in local currency units? Some of the changes are large, but it does not seem like changes in the compliance gap are driving the data in this figure and table.

2. The paper states:
   "For the EU overall, the average Policy Gap level was 44.69 percent. This means that the VAT that could currently be levied in the case of full compliance generates 44.69 percent of what could have been generated if all the exemptions and reduced rates were abolished." Shouldn't this be 55.31 percent?

3. In chapter 4, the paper states:
   "In other words, the Policy Gap is an indicator of the additional VAT revenue that could theoretically (i.e. under the assumption of perfect tax compliance) be generated if a uniform VAT rate is applied to the final domestic use of all goods and services. Due to the idealistic assumption of perfect tax compliance and a very broad base that captures entire final consumption and households' GFCF, the practical interpretation of the Policy Gap draws criticism. Nonetheless, the assumption of perfect VAT collectability is indispensable, as interdependencies between tax compliance and rate structure are not straightforward."

   I found the argument in this paragraph difficult to follow. It is true that it would be difficult to tax value added in some sectors of the economy. But, what does that have to do with "perfect VAT collectability," which seems to suggest a compliance issue?

4. Is "o/w" a common abbreviation for "of which" in European English? it is new to me – I use it for "otherwise"

5. In the Annex, the paper uses the term "collection efficiency". For clarity and consistency with others, I believe this should be "C-efficiency".
6. In Annex e, reference is made to Chap. 5 where Chap. 4 is intended.

b. Report 2

17th August 2021

Final review of the Econometric Analysis of VAT gap Determinants in 2021 Study and Reports on the VAT Gap in the EU-28 Member States

Please find below my review of Econometric Analysis of VAT Gap Determinants (Part 5 plus section f of Appendix A) contained in the Study and Reports on the VAT gap in the EU-28 Member States, Final Report 2021 (further referred as "2021 VAT gap Study" or just "Study"). I received the final version of the 2021 VAT gap Study on 23rd July 2021.

The 2021 VAT gap study contains econometric procedures partly identical to the methods contained in last year's study. I commented on these methods in my review of August 24, 2020. Therefore, in the following text I will cover only the newly used procedures in the econometric part of the Study.

1.1. Principal Components Analysis

I appreciate the use of Principal Components Analysis (further referred to as "CPA") to reduce the number of explanatory variables and deal with the multicollinearity in the data set. I think that it is very good idea for this type of macroeconomic data. In my opinion, the method is used correctly. However, I would recommend linking it more to the subsequent panel regression analysis. It would be useful for the readers of the report to explain which variables were chosen based on the CPA for each of the regression models in Table 5.6. For example, the variable general government surplus was used in the base model, and it also has the highest loading with Component 2. But, it is not clear whether it was included into the base model due to this result of the CPA.

I would also welcome the interpretation of models where the identified principal components are used directly as explanatory variables. The theoretical part explains that interpretation of principal components variables is difficult. But, it would be helpful if some conclusion is drawn about the direction of the influence of a given group of variables. I admit that it is very difficult in the resulting models in Table 5.6. There are always two principal components statistically significant in the respective models (No. 10 and No. 11) containing them as explanatory variables. The problem is that each component has a different sign and therefore different influence on the VAT gap. However, if there is no way to interpret them, the question is whether to include them in the models at all.

1.2. New variable: Reporting obligations

I very much appreciate the inclusion of a variable expressing tax administration measures consisting of more detailed reporting obligations of VAT payers, such as VAT listings, control reports, e-invoicing or SAF-T. However, I would like to draw attention to the causality problem related to this variable. The measures against tax evasion can have the effect on reducing the VAT gap but can also be taken in countries with high tax evasion, therefore as a result of a high VAT gap. Econometric methods that address this problem, such as Granger causality tests could be used in the next VAT gap Study.
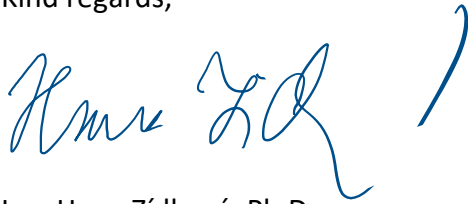
1.3. Minor comments

Furthermore, I would recommend making a reference to the performed panel regression tests contained in Appendix A part of somewhere in the text below Table 5.6. with the results of regression models. This information would be helpful to readers with more extensive knowledge of econometrics to let them know that these tests have been performed and the models are not spurious regressions.

Before concluding my opinion, just a small observation about the name of the study, where before the words "Final Report" the year 2020 is mistakenly mentioned instead of the year 2021. Then on page 72 in the last paragraph, there is a reference to Figure 5.6., which is not included in the Report, and it should probably be a reference to Figure 5.2.

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Overall, I evaluate the performed econometric analysis as excellent; the authors have done a huge amount of work on the way to a better understanding of the factors that affect the VAT gap. The analysis uses sophisticated econometric methods that are suitable for a given set of macroeconomic data.

Kind regards,

Ing. Hana Zídková, Ph.D.

Assistant professor at Department of Public Finance

University of Economics, Prague

c. Authors' Response

The authors acknowledge and thank reviewers for valuable comments and observations that helped improving the quality of the presentation of findings.

Comment	Authors' response
Response to Report 1	
Comment 1	We acknowledge the existence of interactions between the factors of the equation that decomposes sources of revenue growth. To highlight this, we added a new footnote informing of such relations and quoting an example of an interaction between tax base and compliance ratio.
Comment 2	As noted by the reviewer, in few Member States the adjustments have a significant contribution to the VTTL. This is the case of Luxembourg, among others. The values of specific adjustments come directly from Member States and the ORS. Their values cannot be shared for confidentiality reasons. To highlight that the calculations of the VAT Gap in Luxembourg hinge on the values of net adjustments, we added additional highlight in the country page for Luxembourg.
Comment 3	We acknowledge limited accuracy of fast as it only partially accounts for changes in the structure of the economy and changes to tax rules (see Annex A section d). For this reason, the estimates are presented only in Annex for selected Member States.
Comment 4	We agree with reviewer's comment. Changes to the formula were introduced for simplicity and in order to avoid double summation and additional indexes. However, as this could be confusing, we amended the formula accordingly.
Comment 5	To address the comment we applied consistent notation for C-efficiency (as in Keen (2013)). However, we decided to maintain definition of the Policy Gap and Exemption Gap that slightly differs from Keen. The change in definitions was implemented on purpose in the third update of the Study to achieve that components of the Policy Gap are additive (see footnote 31 in the report for the explanation)
Comment 6	Revenue loss from goods/services hard to tax is included in the Policy Gap but not included in the Actionable Policy Gap. The inclusion of specific components (financial services, public goods and imputed rents) was consulted with the Commission. We believe that charging VAT to these good is impractical (public goods and imputed rents) or beyond full MS control (as the treatment of financial services is included in the VAT Directive).
Comment 7	Unfortunately, the Authors have insufficient evidence to judge on the source of the negative values of the Policy Gaps.
Comment 8	Each year, the estimates presented in the Report are thoroughly cross-checked with own estimates available of Member States' Authorities. We suggest that the potential updates to this study include extended review of estimates presented by other sources.

Comment	Authors' response
Response to Report 2	
Principal Components Analysis	In order to improve the presentation of the results, we included an additional paragraph discussing the econometric specifications with principal components used as regressors (Equation 11 and 12 in Table 5.6).
New variable: Reporting obligations	To verify if the model does not suffer for reversed causality problem we performed Granger tests for all tax administration variables. In fact, due to using fixed effects specification (both for time and Member States), we controlled for the specific problem mentioned by the reviewer – possibility that countries with large Gaps are more eager to introduce reporting obligations. Still, it was possible that the relative pace of improving compliance has an impact on the measures that are being introduced. As an additional test, we employed a procedure proposed by Dumitrescu and Hurlin (2012) for testing Granger causality in panel datasets. The tests were performed on year-over-year relative changes in the VAT Gap and tax administration variables. To account for some potential forward-looking impact of introducing reporting obligations, the first lag was excluded from the analysis. The test for the second and third lag showed that there is no reverse (Granger) causality neither for IT expenditure, nor for reporting obligations. To acknowledge performing the tests, we expanded Section f in Annex A.

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