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Study to quantify and analyse the VAT gap in the EU-25 Member States

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CONTENTS

SECTION 1: INTRODUCTION AND SUMMARY	5
SECTION 2: TOP-DOWN ESTIMATES OF THE VAT GAP	
Results	
Sensitivity analysis Full set of results	
run sei or results	
SECTION 3: ECONOMETRIC ANALYSIS OF THE VAT GAP	47
Previous econometric studies of the determinants of the VAT gap	47
Empirical modelling of top–down VAT gap estimates	
Conclusions from the econometric analysis of the VAT gap	58
SECTION 4: AN OUTLINE OF THE TOP-DOWN APPROACH	59
SECTION 5: DATA SOURCES	63
Final and intermediate expenditure	63
Gross fixed capital formation	
VAT rates	
VAT receipts	
SECTION 6: ASSUMPTIONS	74
Completeness of national accounts	74
Proportion of intermediate consumption on which VAT is not recoverable	74
Interpreting the data on final consumption	77
Gross capital formation	
SECTION 7: ADJUSTMENTS	84
Business entertainment expenditure	
Company cars	
"Tank tourism"	
Exemption granted to small businesses	
Supplies in domestic territories with different VAT regimes	
Adjustments that have not been carried out	88
SECTION 8: DEFINITIONS OF THE VAT GAP	90
Possible definitions of the VAT gap	90
Worked examples of the differences between the definitions for the VAT gap	91
Choice of definition for the study	
SECTION 9: REVIEW OF PUBLISHED ESTIMATES OF VAT FRAUD AND THE V	AT GAP96
Published top-down estimates of the VAT gap	96
Bottom-up quantification of the components of VAT fraud	99
Published estimates of MTIC fraud	
APPENDIX	107

TABLES

Table 1	Aggregate estimates of the VAT gap, 2000-2006 (EUR billion)	8
Table 2	Aggregate estimates of the VAT gap as a share of theoretical liability, 2000-2006	9
Table 3	Estimates of the VAT gap, 2006 (EUR million)	9
Table 4	Sensitivity to assumption on <i>propex</i> of the financial services sector	18
Table 5	Sensitivity to assumption on <i>propex</i> of the education sector	19
Table 6	Sensitivity to assumption on the split of GFCF on dwellings	
Table 7	Sensitivity to assumption on the VAT treatment of company cars	
Table 8	Austria: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 9	Belgium: VAT receipts, theoretical liability and gap, 2000-2006 (EUR million)	
Table 10	Czech Republic: VAT receipts, theoretical liability and gap, 2000-2006 (CZK million)	
Table 11	Germany: VAT receipts, theoretical liability and gap, 2000-2006 (EUR million)	
Table 12	Denmark: VAT receipts, theoretical liability and gap, 2000-2006 (DKK million)	
Table 13	Estonia: VAT receipts, theoretical liability and gap, 2000–2006 (EEK million)	
Table 14	Spain: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 15	Finland: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 16	France: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 17	Greece: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 18	Hungary: VAT receipts, theoretical liability and gap, 2000–2006 (HUF million)	
Table 19	Ireland: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 20	Italy: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 21	Lithuania: VAT receipts, theoretical liability and gap, 2000–2006 (LTL million)	
Table 22	Luxembourg: VAT receipts, theoretical liability and gap, 2000-2006 (EUR million)	
Table 23	Latvia: VAT receipts, theoretical liability and gap, 2000–2006 (LVL million)	
Table 24	Malta: VAT receipts, theoretical liability and gap, 2000–2006 (MTL million)	
Table 25	Netherlands: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 26	Poland: VAT receipts, theoretical liability and gap, 2000–2006 (PLN million)	
Table 27	Portugal: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 28	Sweden: VAT receipts, theoretical liability and gap, 2000–2006 (SEK million)	
Table 29	Slovenia: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)	
Table 30	Slovakia: VAT receipts, theoretical liability and gap, 2000–2006 (SKK million)	
Table 31	United Kingdom: VAT receipts, theoretical liability and gap, 2000-2006 (GBP million)	
Table 32	Candidate explanatory variables.	
Table 33	Random effects model results	
Table 34	Panel corrected standard error modelling results	
Table 35	Robust regression modelling results	
Table 36	Instrumental variable robust regression modelling results	
Table 37	Robust regression without VAT burden, with gross capital formation variable	57
Table 38	Eurostat use table availability as of 30 June 2008	65
Table 39	Breakdown of "CPA 15 – Manufacture of food and beverages"	71
Table 40	Thresholds for application of special scheme for small businesses, May 2008	
Table 41	Estimated VAT revenue foregone due to small business exemption	
Table 42	Calculation of different definitions of the VAT gap in worked examples	
Table 43	Other published estimates of the VAT gap	
Table 44	HMCE bottom-up and top-down estimates of VAT losses	
Table 45	Swedish VAT tax gap reported in Skatteverket (2008)	102
Table 46	HMRC estimates of attempted MTIC fraud, 2000/2001-2005/2006	104
Table 47	EU-25 Member States	
Table 48	List of 2-digit CPA products	108

SECTION 1: INTRODUCTION AND SUMMARY

1. This report is concerned with quantifying and analysing the VAT gap in each EU Member State over the period 2000–2006. It has been prepared by Reckon LLP in the context of a study carried out for the European Commission.

We provide estimates of the VAT gap

- 2. We provide estimates of the VAT gap based on a comparison of accrued VAT receipts with a theoretical net VAT liability for the economy as a whole. We estimate the theoretical net liability by identifying the categories of expenditure that give rise to irrecoverable VAT and combining these with appropriate VAT rates.
- 3. The VAT gap is not a measure of VAT fraud. For example:
 - (a) The VAT gap might include VAT not paid as a result of legitimate tax avoidance measures.
 - (b) The VAT gap is estimated primarily on the basis of national accounts data, and therefore depends on the accuracy and the completeness of such data. Moreover, it does not take account of taxable activities that are outside the scope of national accounts.
 - (c) Due to lack of data, we do not adjust our estimates of the VAT gap to remove the VAT that is not collected due to insolvencies arising as a result of regular business activity, yet this portion of VAT that is not remitted is not due to VAT fraud.
- 4. The estimates presented in this report are of the VAT gap, as defined above, and not of VAT fraud.

We focus on a top-down approach to estimating the VAT gap

- 5. The main focus of our research is to derive top-down estimates of the VAT gap, obtained by comparing total accrued tax receipts with a theoretical tax liability calculated from general economic data. They can be contrasted with bottom-up estimates, which are derived by extrapolating data relating to individual companies or discovered frauds.
- 6. Our top-down approach relies on published national accounts. We are only able to develop these estimates for those Member States where relevant national accounts data are publicly available.
- 7. We are unable to produce similar estimates on the basis of a bottom-up approach that compiles information from surveys or other studies on estimates of particular types of VAT fraud, as:



- (a) Published data on the size of different types of VAT fraud are insufficient indeed they are scant to allow us to piece together an estimate of VAT fraud in the economy as a whole.
- (b) There may be a selection bias. Presenting the value of the different types of VAT fraud detected by tax agencies, as reported by some in annual reports, would risk giving a distorted account of the relative importance of different types of VAT fraud as well as of overall level of VAT fraud.
- (c) The raw data underlying the estimates of particular types of VAT fraud that we aware of are based, almost invariably, on operational data held by the tax agencies. Generally, these are confidential, as are the methods used to derive them.
- 8. The top-down approach allows us to estimate the VAT gap in the economy as a whole but it does not allow us to characterise it in terms of identifying what sectors, or trade in what goods, or what types of business are more susceptible to VAT fraud.
- 9. Our top-down approach is comparable to those that we have found published by national tax agencies. It is also related to the approach followed in the compilation of VAT own resources accounts submitted annually by each Member State to the European Commission.

We draw on national accounts to compute net VAT liability

- 10. A top-down estimate of the VAT gap is based on comparing accrued VAT receipts with a theoretical net VAT liability for the economy as a whole. We estimate the theoretical net liability by identifying and measuring the categories of expenditure that give rise to irrecoverable VAT.
- 11. The main categories of relevant expenditure that give rise to irrecoverable VAT are final consumption expenditure by households, non-profit institutions serving households (NPISH) and government, intermediate consumption expenditure on goods and services used in making exempt supplies of goods and services; and gross fixed capital formation on assets and changes in the stock of valuables which can be allocated to exempt supplies of goods and services.
- 12. National accounts data provide the primary information for our estimates of the value of these transactions that give rise to irrecoverable VAT. Within this, we draw in particular on published use tables which report the use of goods and services by product category and by type of use. Because of this structure, use tables lend themselves to the task of identifying transactions that give rise to irrecoverable VAT.
- 13. Our analysis is broadly based on Member States' use tables downloaded from Eurostat on 30 June 2008. Use tables were available for all Member States for some of the years in the period 2000–2006, with the exception of Greece and Latvia for which use tables were only found for some years prior to 2000 and of Cyprus, for which we were told by the National Accounts Division of the Cypriot Ministry of Finance that no use tables were publicly available. Because these tables are at the heart of our top-down approach we do not include Cyprus in our analysis.

14. To estimate the VAT liability associated with transactions on which VAT is not recovered, it is necessary to apply the appropriate VAT rate. Information on the applicable VAT rates is drawn from national VAT legislation and secondary sources.

We adjust our estimate to account for items affecting net VAT liability

- 15. We make a series of adjustments to the estimates we obtain through the approach outlined above to take account of a number of features common to the VAT systems in most Member States. In particular, we adjust our estimates to reflect the fact that in most Member States an exemption from registration is granted to businesses with a turnover below a certain threshold. We also make adjustments to reflect the limitations relating to the recoverability by corporations of expenditure on entertainment and on the purchase of company cars.
- 16. In the case of Luxembourg, our estimation makes a further adjustment to capture the contribution to the VAT liability associated with "tank tourism", the practice of haulage and transport companies from other Member States filling up their trucks with diesel and petrol in Luxembourg, whether for logistical reasons or to benefit from differences in fuel prices.

Limitations of estimating theoretical VAT liability from national accounts

- 17. There are three main types of limitations in using national accounts data for the purpose of estimating VAT gap. The first relates to the fineness of the data available, the second relates to the coverage of national accounts insofar as they measure taxable activity, and the third to the question of whether the national accounts data accurately measure what they are supposed to. We consider the implication of each in turn.
- 18. The minutiae of the VAT system in most Member States is such that it would require unfeasibly detailed information about the pattern of transactions in an economy to ensure that the correct VAT treatment is applied to a given volume of trade. As an example, it would be necessary to know how expenditure by Danish consumers on football matches is divided between games where both teams fielded professionals and games where that is not the case; the former attract a standard VAT rate, the latter are exempt. We are certain that pursuing data that would allow us make this split, and that would allow us to accommodate all of the details of the VAT legislation more generally, is not a feasible exercise.
- 19. The top-down approach requires instead an exercise of judgement to identify those trades that are thought to have a material impact on the measure of net VAT liability at the economy-wide level. For example, in many Member States, the rates applied to food products are lower than those applied to beverages. Further, expenditure on food products and beverages account for a significant share of household consumption. Based on this, we take a view that it is appropriate to consider the contribution to net VAT liability of the expenditure in these two classes of products separately. Indeed, we take the view that it is appropriate to examine expenditure in these classes of products at an even greater level of detail, for example distinguishing between alcoholic and non-alcoholic drinks. There are data which allow us to explore this. On some other points, which would also have a material impact on our estimates, the national accounts data available to us do not allow for detailed analysis.

- 20. Our top-down approach relies on the extent of the overlap between taxable activities and those that contribute to national accounts. Some activities fall outside this overlap, as is the case of own house building, or of the exemptions to small businesses. To address this, it is necessary to draw on data outside of national accounts, where such data are available.
- 21. Our top-down estimation of the VAT gap relies on the premise that the national accounts data, and the use tables in particular, have been compiled in line with the European System of Accounts 95 (ESA 95). An important corollary of this is that national accounts data are deemed to include the contribution of the shadow economy, as ESA 95 requires. An inadequate or inconsistent estimation by statistics offices of this contribution will have a direct impact on our estimates of the theoretical VAT liability.

We have contrasted our approach with that of other institutions

- 22. Our work has benefitted from contact with national tax authorities, national statistics offices and other relevant government departments in Member States.
- 23. We shared details of our approach and interim results with relevant institutions from Member States and have used the information and feedback received from them to improve our estimates.
- 24. At a late stage of the study, for almost all Member States, we were granted access to the VAT own resources accounts that are submitted annually to the European Commission. There is considerable overlap in the methods used in our top-down approach to estimating VAT gap and the approach adopted by Member States in those submissions for the purpose of estimating the weighted average VAT rate. We have not sought to reconcile our estimates with those reported in the own resources accounts, nor have we used data contained within them. Rather, we have used the workings submitted within the own resources accounts to help us identify errors and unjustified assumptions that we might have made in our analysis. Where these were found, we sought to correct them by drawing on alternative, published information or on information obtained directly from national institutions.

Our top-down estimates of VAT gap

25. We have estimated The VAT gap for each of the Member States, other than Cyprus, for each of the years in the period 2000-2006. Table 1 presents our estimates of the VAT gap for the EU-25, the EU-10 and for the EU-15 in value terms. Table 2 reports the gap as a share of the net theoretical liability.

Table 1Aggregate estimates of the VAT gap, 2000-2006 (EUR billion)

	2000	2001	2002	2003	2004	2005	2006
EU-10	6.5	8.3	8.3	7.6	8.6	8.1	7.9
EU-15	84.4	96.2	98.9	101.1	103.6	105.2	98.8
EU-25	90.9	104.5	107.1	108.7	112.3	113.3	106.7

Note: EU-10 and EU-25 exclude Cyprus. Non-Euro currencies converted to EUR using the average exchange rate in each year.

	2000	2001	2002	2003	2004	2005	2006
EU-10	20%	22%	20%	19%	19%	16%	14%
EU-15	12%	13%	13%	14%	13%	13%	12%
EU-25	13%	14%	14%	14%	14%	13%	12%

Table 2	Aggregate estimates of the VAT gap	as a share of theoretical liability, 2000-2006
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Note: EU-10 and EU-25 exclude Cyprus.

26. We estimate the overall VAT gap in the EU-25 has, in value terms, shown an increase over the period from 2000 to 2005, but a drop from 2005 to 2006. As a share of theoretical liability, we estimate that the VAT gap for the EU-25 remained fairly stable from 2000 to 2004 and that it then fell by two percentage points between 2004 and 2006.

Table 3Estimates of the VAT gap, 2006 (EUR million)

Member State	Theoretical VAT liability	VAT receipts	VAT gap	VAT gap as a share of theoretical liability
AT	22,844	19,735	3,108	14%
BE	25,360	22,569	2,791	11%
CZ	9,216	7,541	1,675	18%
DE	164,115	147,150	16,965	10%
DK	23,611	22,560	1,051	4%
EE	1,325	1,215	111	8%
ES	63,013	61,595	1,418	2%
FI	15,176	14,418	758	5%
FR	140,817	131,017	9,800	7%
GR	21,746	15,183	6,563	30%
HU	8,882	6,813	2,070	23%
IE	14,043	13,802	241	2%
IT	119,197	92,860	26,337	22%
LT	2,335	1,826	510	22%
LU	1,961	1,941	20	1%
LV	1,751	1,374	378	22%
MT	463	410	53	11%
NL	41,269	39,888	1,381	3%
PL	23,784	22,127	1,657	7%
PT	14,371	13,757	614	4%
SE	29,294	28,487	807	3%
SI	2,764	2,647	116	4%
SK	4,632	3,320	1,312	28%
UK	155,697	128,721	26,976	17%
EU-25	907,667	800,955	106,712	12%

Note: EU-25 excludes Cyprus. Non-Euro currencies converted to EUR using the average exchange rate in 2006.

We examine the sensitivity of our results to the set of most material assumptions

- 27. We identified four assumptions in our top-down approach which we expect to have a material impact on the estimated VAT gap and for which we have a limited empirical basis. These concern the assumptions on the proportion of consumption by the education and by the financial sectors on which VAT is not recoverable, on how gross fixed capital formation on dwellings is split between investments in new dwellings and expenditure on major improvements to existing dwellings and on the size of the adjustment to be done to account for the VAT treatment of company cars.
- 28. We examined the sensitivity of our results to these assumptions and find that they do have some impact on our results. The impact is greatest with regards to the assumption on the proportion of consumption by the financial sector on which VAT is not recoverable.

Comparison with other published estimates of VAT gaps

- 29. We have found published top-down estimates of the VAT gap relating to the period from 2000 to 2006 for only a handful of Member States, namely for Denmark, Germany, Italy, Sweden and the UK. Other than for Germany, these estimates are computed by the relevant national tax agency or statistics office. The estimates are typically accompanied by only a brief description of the precise data sources and assumptions that underpin the estimation. This limits our ability to interpret the differences between our estimates and those that we have found published. But we are aware of two general points that are likely to explain much of the differences. First, we expect national tax agencies and statistics offices to have access to more detailed or recent national accounts data than that which are published, and therefore available to us in the course of the study. We note too that national accounts data are often revised over time and differences between our set of estimates of the VAT and those published by national tax agencies will also differ where we have drawn on different revisions of the data. Second, we have extracted figures on accrued VAT receipts from Eurostat, and, with the exception of Denmark, these do not match the figures used in the estimates of the Member States mentioned earlier.
- 30. Not withstanding these differences, we, we find that our estimates of the VAT gap for Germany, Italy and the UK follow a similar trend to the published estimates for these countries that we have come across.
- 31. We have found even fewer two published bottom-up estimates of VAT gaps; one by the UK's HM Customs and Excise in 2002 and the second by the Swedish Skatteverket in 2008. These studies draw on a range of data sources, including surveys and operational data, to identify the relative importance of different types of VAT losses. Both agencies qualify their findings by noting the significant degree of uncertainty around their estimates. We do not think it reasonable to draw on the findings of these two isolated studies to make inferences about the characterisation of the VAT gap across the EU.



Econometric analysis of the VAT gap

- 32. We conducted econometric analysis to assist in the understanding of the nature and causes of the VAT gap, and to identify country-specific characteristics that appear related to different levels of the VAT gap.
- 33. The variable found to have the strongest relationship with the size of the VAT gap was that connected with the perceived level of corruption in the country. The relationship implies that lower perceived corruption is associated with a lower VAT gap.
- 34. The main difference between our analysis and the results obtained by other studies surrounds the relationship between the VAT gap and the VAT burden. If the VAT burden, characterised by the ratio between the theoretical VAT liability and GDP, is treated as a candidate explanatory variable, then we find that it has a significant positive relationship with the VAT gap. This is in line with the limited literature on this topic, and with the theory that a higher tax burden should lead to higher levels of evasion. We have identified a risk that this estimated relationship may be biased by measurement errors in the estimation of the theoretical liability. Once this risk has been taken into account by using an instrumental variable regression, we find no statistically significant relationship between the VAT gap and the VAT burden.



SECTION 2: TOP-DOWN ESTIMATES OF THE VAT GAP

- 35. This section sets out, in more detail, the results of our top-down estimation of the VAT gap across Member States in the period 2000-2006. Our analysis draws on an array of assumptions and we present in this section the relative impact of some of these assumptions on the estimated VAT gap. This sensitivity analysis focuses on those assumptions that are of greater materiality and for which we have less evidence underpinning them. Charts and tables reporting the full set of results for each Member State are presented at the end of this section.
- 36. In this section we refer at times to the EU-25 to mean the set of Member States in our analysis. We do so for convenience, as strictly speaking this is not correct: Cyprus is not included in our analysis because no use tables are available for it, and we have therefore only estimated the VAT gap for 24 Member States. Similarly, we use the term EU-10 to refer to those Member States that joined the EU in 2004 although again Cyprus is not included.

Results

37. The estimates of the VAT gap for each Member State over the period 2000–2006 are set out in a chart and in an accompanying table in the pages at the end of this section. Ahead of presenting those charts, we set out a brief overview and discussion of our estimates.

There is no common trend in VAT gap across Member States

- 38. There is no common trend in the estimated VAT gap over the period 2000–2006 across the 24 Member States.
- 39. For most, the estimated VAT gap exhibits a slight downward trend, the decreases tending to be sharper over the period 2003 to 2006. Over the entire period of observations the decreases have been most pronounced in Luxembourg (from 12 per cent in 2000 to 1 percent in 2006), in Poland (from 22 per cent in 2000 to 7 per cent in 2006) and in Slovenia (from 16 per cent in 2000 to 4 per cent in 2006).
- 40. The estimated gap for Belgium, Denmark, Spain, Ireland, the Netherlands, Poland, Sweden and Slovenia have shown a steady year-on-year fall for most years, particularly in the latter half of the period analysed.
- 41. For Austria, Germany, France, Finland and the UK, the VAT gap has been estimated to be relatively stable, fluctuating within a relatively narrow band.
- 42. For Greece, Hungary and Lithuania, we estimate that the VAT gap has increased from 2000 or 2001 to the later years of our sample period. We have estimated the Greek gap to have increased from 20 per cent in 2001 to 30 per cent in 2006. For Hungary, we estimated the gap to have increased in the earlier years and to have remained relatively stable since; the gap increased from 15 per cent in 2000 to 25 per cent in 2002 and has remained at that level, or slightly below, until 2006. The gap for Lithuania is estimated to have risen from 15 per cent in 2000 to 28 per cent in 2004, from which it subsequently fell; for 2006 it was estimated to be 22 per cent.

Section 2: Top-down estimates of the VAT gap

- 43. The observation that for many of the Member States the estimated VAT gap have fallen over the period, particularly in the second half of the sample period, applies more widely than to the Member States joining the EU in 2004 though it is most noticeable amongst the newer members. In this regard, we note that the VAT gap for Estonia dropped from 21 per cent in 2004 to 8 per cent in 2006 and for Latvia they fell from 31 to 22 per cent over that same period. We have already noted above that for Lithuania we estimated the VAT gap falling between 2004 (28 per cent) and 2006 (22 per cent). The reforms to the VAT legislation and/or the greater effort in gaining fiscal efficiency that may be associated with joining the EU are potential explanations of the remarkable fall in the VAT gap of these Member States. However, the estimates for the Czech Republic and Slovakia are contrary to this interpretation. In those Member States, the estimated gaps have risen between 2004 and 2006: from 24 to 28 per cent in the case of Slovakia and from 13 to 18 per cent in the case of the Czech Republic (although until 2003 the estimated gap for the Czech Republic fluctuates around 16 per cent).
- 44. Figure 1 provides a summary of the discussion set out above. The figure plots the estimated VAT gap expressed as a share of theoretical net liability in 2006 against the estimate we obtained for 2000. The dashed diagonal line in the figure is a 45 degree line. For those Member States lying above this diagonal line, the VAT gap is estimated to have increased between 2000 and 2006. For those below the line, the VAT gap is estimated to have fallen. As can be read from Figure 1, most Member States are in the latter group.

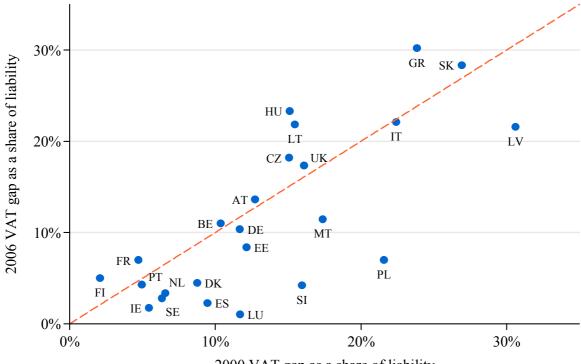


Figure 1 Comparison of estimated VAT gap in 2000 and 2006

2000 VAT gap as a share of liability

A closer look at the trend of the VAT gap for some Member States

- 45. We turn now to an analysis of the evolution of the VAT gap for specific Member States. For many Member States, we find little to comment on with regard to the evolution of the VAT gap between 2000 and 2006 that is not already apparent from the relevant figures and tables presented at the end of this section. In many cases, we have no particular insights to offer on the movement of accrued receipts relative to the estimated VAT liability. Clearly, it could be of interest to understand why receipts may have grown faster or slower than estimated liability did the tax authority put more resources in the fight against VAT fraud or did it change its mode of operations but this is beyond the scope of the study.
- 46. In the light of this, the discussion below focuses on a set of Member States for which we observe movements in the estimated VAT gap which might merit a supplementary comment.

The Czech Republic

47. As a share of the theoretical net VAT liability, the estimated VAT gap for the Czech Republic remained at around the 16 per cent level from 2000 to 2003 but in 2004 fall to 13 per cent, dropped marginally to 12 per cent in 2005 but then increased to 18 per cent in 2006. Behind this increase between 2005 and 2006 lies the fact that the estimated net VAT liability rose considerably, from CZK 245 to CZK 261 million, whilst accrued receipts fell slightly, from CZK 215 billion to CZK 214 billion in 2006. In turn, the increased liability was driven almost entirely by a significant growth in household final consumption. There were no changes in the standard rates over this period. We note, lastly, that our estimates for the Czech Republic for both 2005 and 2006 are based on extrapolated use tables, as described in Section 5. However, we take comfort from the fact that the Czech total household consumption did register such high levels of growth in this period and so we do not believe that the estimated jump in the VAT gap are driven by the method we have used to extrapolate use tables.

Estonia

48. Our estimates of the Estonian VAT gap show a sharp fall between 2004 and 2005, from 21 per cent to 9 per cent. There was no change to the standard rate in these years nor does it appear to us that that the VAT legislation with regards to the applicability of rates was changed in any other way that would impact significantly on the trend of the net VAT liability. Rather, it has been the trend in accrued receipts which has changed since 2004; whilst this had grown at an average rate of around 9 per cent a year between 2000 and 2004, between 2004 and 2006 receipts grew by around 28 per cent a year.

Hungary

49. The trend of the VAT gap estimated for Hungary is an interesting one: it increases steadily from 15 per cent in 2000 to 25 per cent in 2002 and, following a slight fall in 2003, it remains relatively stable at around 24 per cent. We have no insight to account for the increase in the VAT gap in the earlier years. We do note, however,

that the VAT rate system was simplified in 2004 and the standard rate was reduced from 25 to 20 per cent in January 2006. Neither appears to have had an appreciable impact on VAT gap, which remained relatively flat.

Luxembourg

- 50. Our estimates for Luxembourg show a considerable drop in the VAT gap from 12 per cent in 2000 to 2 per cent in 2004 before increasing to 5 per cent in 2005 and then falling back to 1 per cent in 2006. There is a great margin of uncertainty surrounding our estimate of Luxembourg VAT gap.
- 51. One source of this uncertainty relates to the sensitivity of the results to the assumption on the value of *propex* of the financial sector. We reported in Table 6 that changing the value of that parameter from 50 per cent to 25 per cent would cause our estimate of the VAT gap in 2006 to be 10.3 percentage points lower, and if, instead, the parameter had been set at 100 per cent, the gap would have been 8.8 percentage points higher.
- 52. A second cause of uncertainty relates to the estimation of the net VAT liability associated with "tank tourism", the practice of foreign haulage and transport businesses filling up their trucks in Luxembourg to take advantage of the price differences. This is a significant activity as may be inferred from the observation in a recent Commission document that "whereas the consumption of diesel per capita is less than 750 litres in other Member States, it amounts to more than 4,200 litres in Luxembourg". ¹ The significance of this activity is also explicitly recognized in the submissions by Luxembourg to the United Nations Framework Convention on Climate Change on its national inventory of greenhouse gases; its 2008 submission reports that, in 2006, 18 per cent of diesel sold in Luxembourg was consumed in the country whereas the remaining 82 per cent was "exported".²
- 53. We understand that trade relating to "tank tourism" should be recorded in the Luxembourg use tables as exports of diesel or petrol. Our top-down approach assumes that, in general, no VAT liability arises from exports. In this instance, however, we understand that foreign trucks will pay the VAT due on the diesel or fuel and that those entitled to a VAT refund will not necessarily always apply for a refund from the Luxembourg tax agency. It is necessary, therefore to estimate the contribution to the Luxembourg net theoretical VAT liability that is associated with these "exports".

¹ European Commission (2007) "Accompanying document to the Proposal for a Council Directive amending Directive 2003/96/EC as regards the adjustment of special tax arrangements for gas oil used as motor fuel for commercial purposes and the coordination of taxation of unleaded petrol and gas oil used as motor fuel", Staff Working Paper {COM(2007) 52 final}, p. 8. HTML version available from http://eur-

lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52007SC0170:EN:HTML, accessed on 3 August 2009.

 ² Ministère de l'Environnement, Luxembourg (2008) "Luxembourg's National Inventory Report 1990-2006 – Submission under the United Nations Convention on Climate Change and voluntary submission under the Kyoto Protocol", Table 3.44. Available from

http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/4303.php , accessed on 3 August 2009.

Section 2: Top-down estimates of the VAT gap

54. We have not come across published data on the amount of "tank tourism" on which the VAT is not recovered. For the purpose of our estimation we have assumed, as noted in Section 6 that all of the exports relating to the product category "Coke, refined petroleum products and nuclear fuels" refer to sales of diesel or petrol to "tank tourists" and have further assumed that none of the VAT associated with this is recovered.

Portugal

55. We estimate that there was a fall in the VAT gap as a share of liabilities in Portugal over the sample period as a whole and a sharp drop in particular between 2004 (8 per cent) and 2005 (3 per cent). Use tables are available for the period 2000–2005 implying that the estimated drop is not linked to our forecasting technique. Annual reports from the Portuguese Ministry of Finance and Public Administration on the fight against fiscal fraud and evasion for the more recent years give emphasis to the greater operational effort in targeting VAT fraud, notably MTIC but we are unable to identify specific initiatives as the cause of the observed fall in the VAT gap from 2004 to 2005. We note, however, that the standard rate of VAT did increase in this period, from 19 to 21 per cent on the 1 May 2005.

UK

- 56. Our estimates for the UK show a relatively stable trend in the VAT liability over the period 2000–2006. The VAT gap as a share of liability has also remained fairly stable at around 17 per cent from 2000 to 2002, then falling to 15 per cent in 2003 and 2004 before increasing to 18 per cent in 2005. We note that the increase between 2004 and 2005 is led by a slowdown in the growth of receipts rather than due an extraordinary increase in estimated liability.
- 57. This observed trend in the VAT gap share is in keeping with the trends in HMRC's own estimates of VAT gap.³ HMRC's estimates of VAT gap also show a decline until 2004 before increasing in 2005. Significantly, HMRC also estimates that there was a sharp rise in MTIC fraud in 2005, which possibly contributed to the rise in the estimated gap.

Sensitivity analysis

- 58. Of the assumption underpinning our top-down estimation of the VAT gap we identify four which we expect to have a material impact on our estimate of the VAT gap and for which we have limited empirical backing. Because of this, we think it is of interest to examine the impact on our estimates of considering variations to these assumptions. We carry out such a sensitivity analysis on the following:
 - (a) Across all Member States, we assume that 60 per cent of the value of intermediate consumption of the financial sector attracts irrecoverable VAT.

³ HMRC (2007) Measuring indirect tax losses, 2007. Available from http://www.hmrc.gov.uk/pbr2007/mitl.pdf, accessed on 3 August 2009.

- (b) Across all Member States, we assume that 80 per cent of the value of intermediate consumption of the education sector attracts irrecoverable VAT.
- (c) For four Member States (Belgium, Italy, Portugal and the UK) we assume that half of the gross fixed capital formation on dwellings is accounted for by investments in new dwellings and half by expenditure on major improvements to existing dwellings. This assumption is necessary as national VAT legislation accords different VAT treatment to the two categories of expenditure and we have not found data that allow us to make this split for these countries.
- (d) Across all Member States, we assume that half of the gross fixed capital formation on products within the CPA category "Motor vehicles, trailers and semi-trailers" attract VAT that is not recoverable.
- 59. The sensitivity analysis is done by considering other values for the parameter associated with each of the assumptions and, for each, calculating the associated VAT gap. The first two assumptions refer to the share of intermediate consumptions by a given sector on which VAT is not recoverable; we have denoted this parameter as *propex*. As an example, and with regard to the first assumption, we examine the sensitivity of our results by computing the change in the estimated VAT gap had we assumed that the *propex* associated with the financial sector was 100 per cent, and at the other extreme, had we assumed it to be 25 per cent.
- 60. For each Member State we carry out the sensitivity analysis relating to the first two assumptions and to the fourth listed above using the most recent year for which use tables have been published by Eurostat. This is to ensure that the sensitivity analysis is not vitiated by any possible effects that might arise due to the extrapolation of the use tables we carried out. The exceptions to this are Greece and Latvia as the most recent published use tables refer to years prior to 2000 and we have carried out the sensitivity on the basis of the data for 2000. The sensitivity of our results to the third assumption listed on the split of GFCF on dwellings is done on the basis of 2006 estimates as the parameter relating to that assumption is applied to data on GFCF obtained from Eurostat and hence has no interaction with the extrapolation of the use tables.

Sensitivity to the assumption on the propex of the financial sector

- 61. Our estimates assume that, across all Member States, 60 per cent of the value of the intermediate consumption of the financial sector attracts irrecoverable VAT. That is to say, we assume that the value of *propex* for the financial sector, as defined by NACE category "J. Financial intermediaries", is 60 per cent. The grounds for this assumption are set out in Section 6.
- 62. Table 4 presents the impact on the estimation of the VAT gap for each Member State of changing this assumption. In particular, it reports how the VAT gap would change if rather than assuming a *propex* of 60 per cent we assumed it to be (a) 25 per cent, and (b) 100 per cent.

Member State	Year	VAT gap as a share of theoretical	Percentage points change to VAT gap is assume finance <i>propex</i> of		
		liability (%)	25 per cent	100 per cent	
AT	2004	12.5%	-1.0	1.0	
BE	2004	12.4%	-1.4	1.4	
CZ	2004	12.5%	-1.0	1.0	
DE	2004	13.8%	-1.2	1.2	
DK	2004	7.1%	-0.7	0.7	
EE	2004	21.3%	-0.3	0.3	
ES	2004	7.9%	-0.7	0.7	
FI	2005	3.8%	-0.9	0.9	
FR	FR 2004	6.7%	-1.5	1.4	
GR	2000	23.8%	-0.5	0.5	
HU	2004	23.7%	-0.7	0.7	
IE	2002	2.6%	-2.0	1.9	
IT	2004	27.5%	-0.7	0.6	
LT	2004	27.6%	-0.3	0.3	
LU	2006	1.0%	-10.3	8.8	
LV	2000	30.6%	-0.6	0.6	
MT	2001	15.5%	-0.5	0.5	
NL	2004	5.6%	-1.4	1.4	
PL	2003	19.9%	-0.9	0.9	
РТ	2005	3.0%	-1.4	1.3	
SE	2005	1.9%	-0.8	0.7	
SI	2004	7.8%	-0.7	0.7	
SK	2004	23.7%	-0.5	0.5	
UK	2003	14.3%	-2.7	2.6	

Table 4Sensitivity to assumption on propex of the financial services sector

63. As would be expected, changing the assumption on the *propex* of the financial sector has greatest impact for those Member State where this sector is particularly important: hence the considerable impact on the estimated VAT gap for Luxembourg and, to a much less but still significant extent, for the UK and Ireland. For most other Member States, the rise or fall in the estimated VAT gap of assuming one of the alternate values for the parameter would be within 1.5 percentage points of our estimate.

Sensitivity to the assumption on the propex of the educational sector

64. Our estimates assume that the *propex* attributable to the education sector, NACE code "N Education" is 80 per cent; a discussion of this assumption is set out in Section 6. We examine the impact on our estimates of the VAT gap if this parameter takes the value of 50 per cent, and, alternatively, if we assume it to be 100 per cent. The results are presented in Table 5.

Member State			Percentage points change to VA assume finance <i>propex</i> of		
		liability (%)	50 per cent	100 per cent	
AT	2004	12.5%	-0.3	0.2	
BE	2004	12.4%	-0.2	0.1	
CZ	2004	12.5%	-0.5	0.3	
DE	2004	13.8%	-0.3	0.2	
DK	2004	7.1%	-0.6	0.4	
EE	2004	21.3%	-0.5	0.3	
ES	2004	7.9%	-0.3	0.2	
FI	2005	3.8%	-0.5	0.3	
FR	2004	6.7%	-0.4	0.2	
GR	2000	23.8%	-0.1	0.0	
HU	2004	23.7%	-0.4	0.2	
IE	2002	2.6%	-0.3	0.2	
IT	2004	27.5%	-0.2	0.1	
LT	2004	27.6%	-0.2	0.1	
LU	2006	1.0%	-0.2	0.1	
LV	2000	30.6%	-0.5	0.3	
MT	2001	15.5%	-0.2	0.1	
NL	2004	5.6%	-0.3	0.2	
PL	2003	19.9%	-0.3	0.2	
РТ	2005	3.0%	-0.3	0.2	
SE	2005	1.9%	-0.6	0.3	
SI	2004	7.8%	-0.5	0.3	
SK	2004	23.7%	-0.2	0.1	
UK	2003	14.3%	-0.6	0.4	

Table 5Sensitivity to assumption on propex of the education sector

65. The results in Table 5 report that had we assumed the *propex* of the education sector to have been 50 or 100 per cent rather than 80 per cent, our estimate of the share of the VAT gap would have changed by at most 0.6 percentage points, and for most Member States it would have changed considerably less.

Sensitivity to the assumption on the split of GFCF on dwellings

66. GFCF associated with dwellings is made up of investment in new dwellings and of expenditure in major improvements to existing dwellings. In some Member States, different VAT rates apply to the supply of goods or services relating to these two activities and, for these Member States, it is necessary to identify the contribution of each of the activities. Whilst we have found disaggregated data that allow us to split GFCF between the two types of capital formation for some of the relevant Member States, for four of the Member States we have made an assumption about that split. This assumption is relevant to Belgium, Italy, Portugal and the UK. In particular, and

as discussed in Section 6 we assume that each of the two forms of capital formation relating to dwellings account for half of the GFCF on dwellings.

67. For these Member States, Table 6 reports the impact on the estimated VAT gap under two scenarios: first, that the GFCF associated with new dwellings account for 25 per cent of total GFCF on dwellings and, second, that the percentage is 75 percent.

Member State	Member State Year		Percentage points change to VAT gap if assume ratio of GFCF on new dwellings to improvements to existing dwellings		
		liability (%)	25:75	75:25	
BE	2006	11.0%	-2.2	2.2	
IT	2006	22.1%	0.7	-0.8	
РТ	2006	4.3%	0.5	-0.5	
UK	2006	17.3%	1.7	-1.7	

Table 6 Sensitivity to assumption on the split of GFCF on dwellings

68. The impact on the estimated VAT gap of changing the assumption about the split of GFCF on dwellings is greatest for Belgium and the UK. For Belgium, our estimate of the VAT gap would be around 2.2 percentage points higher or lower depending on which of the alternative values is assumed. In contrast, the impact of considering the more extreme values of the parameter is relatively small for Italy and Portugal.

Sensitivity to the assumption on the VAT treatment of company cars

69. We examine the sensitivity of our estimates of the VAT gap to the assumption on the share of gross fixed capital formation in the economy on products of the sector "DM34 Motor vehicles, trailers and semi-trailers" on which VAT is recoverable. The estimates reported earlier in Table 3 assume that that share is 50 per cent. Table 7 below reports the changes to those estimates if that share were assumed to be 25 or 75 per cent.



Member State			assume share of	hange to VAT gap if GFCF to be not rable of	
		liability (%)	25 per cent	75 per cent	
AT	2004	12.5%	-0.7	0.7	
BE	2004	12.4%	-0.9	0.9	
CZ	2004	12.5%	-1.4	1.4	
DE	2004	13.8%	-0.7	0.6	
DK	2004	7.1%	-0.6	0.6	
EE	2004	21.3%	-1.3	1.2	
ES	2004	7.9%	-0.9	0.9	
FI	2005	3.8%	-0.4	0.4	
FR	2004	6.7%	-0.6	0.6	
GR	2000	23.8%	-0.6	0.6	
HU	2004	23.7%	-0.7	0.7	
IE	2002	2.6%	-1.3	1.3	
IT	2004	27.5%	-0.6	0.6	
LT	2004	27.6%	-0.5	0.5	
LU	2006	1.0%	-0.8	0.7	
LV	2000	30.6%	-1.2	1.2	
MT	2001	15.5%	-0.2	0.2	
NL	2004	5.6%	-0.8	0.7	
PL	2003	19.9%	-1.1	1.1	
РТ	2005	3.0%	-0.6	0.6	
SE	2005	1.9%	-0.8	0.8	
SI	2004	7.8%	-1.0	1.0	
SK	2004	23.7%	-0.6	0.6	
UK	2003	14.3%	-0.3	0.3	

Table 7 Sensitivity to assumption on the VAT treatment of company cars

70. As reported in Table 7, our estimates of the VAT gap for the Czech Republic, Estonia, Ireland, Latvia, Poland and Slovenia are relatively sensitive to this assumption: in each of these Member States the estimated VAT gap would change by at most 1.4 percentage points, and in most cases less than 1 percentage point, if the more extreme parameter values were chosen.

Conclusions on the sensitivity analyses

71. We have carried out sensitivity analyses for those assumptions which we expect to have a more material impact on our estimates and for which we have relatively limited empirical support. Not surprisingly, the results of the analyses do show that each of these assumptions have a material impact on the estimated VAT gap. However, the impact is relatively limited with respect to the assumption on company

cars and to the assumption on the *propex* associated with the education sector; typically the estimates are affected by less than 1.5 percentage points.

- 72. We also find that the sensitivity of our results to the assumption on the *propex* of the financial sector is limited for most of the Member States. The two significant exceptions in this regard are the UK and Luxembourg.
- 73. As a final comment on the sensitivity analysis, we note that whilst altering the values of the parameters relating to the above assumptions will affect the level of the estimated VAT gap as discussed above, we would not expect the *trend* in the gap to be similarly affected. Rather, the parameter values assumed for a given assumption will only affect the trend to the extent that the structure of consumption changes over time.

Full set of results

- 74. Taking each Member State in turn, we set out over the following pages a chart and accompanying table showing the estimates of the estimated VAT liability, receipts and VAT gap over the period 2000–2006.
- 75. The tables break down the total estimated VAT liability into the liability associated with:
 - (a) household final consumption;
 - (b) gross fixed capital formation;
 - (c) other consumption, which covers government intermediate and final consumption and intermediate consumption of other sectors; and
 - (d) the set of adjustments relating to small business exemptions, company cars and business entertainment and, for Luxembourg, "tank tourism", and changes in valuables.
- 76. The data sources we have used to compile our estimate do not adopt a common approach to classifying government expenditure. For example, gross fixed capital formation on private dwellings could be classified as being carried out by households in some cases and government or non-financial corporations on others. Consequently, we choose not to separately identify the liability arising from government expenditure.



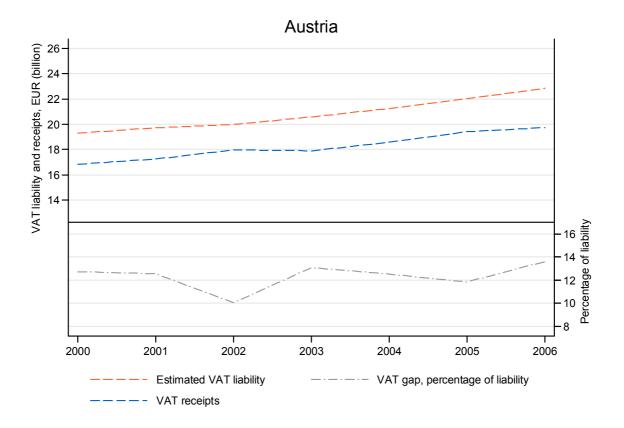


 Table 8
 Austria: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

AT	2000	2001	2002	2003	2004	2005^{\dagger}	2006 [†]
Total theoretical VAT liability	19,295	19,726	19,978	20,585	21,250	22,020	22,844
Of which							
Household consumption	13,038	13,437	13,676	14,067	14,539	15,056	15,654
Gross fixed capital formation	2,570	2,556	2,464	2,545	2,562	2,630	2,772
Other consumption	3,288	3,317	3,456	3,536	3,702	3,855	3,966
Net adjustments	398	415	381	436	445	479	451
Actual VAT receipts	16,840	17,251	17,972	17,893	18,590	19,414	19,735
VAT gap	2,455	2,475	2,006	2,692	2,660	2,606	3,108
VAT gap as a share of theoretical liability	13%	13%	10%	13%	13%	12%	14%



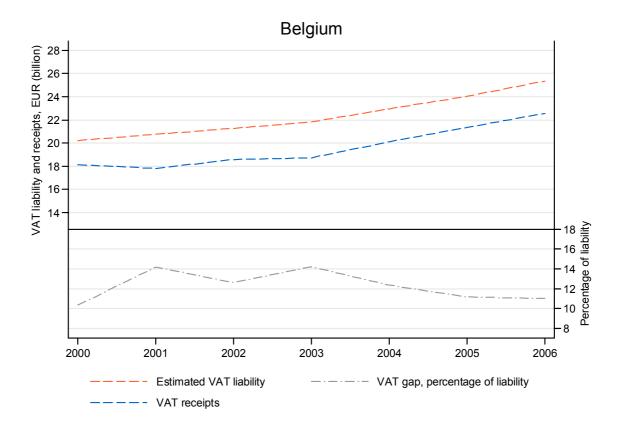


Table 9Belgium: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

BE	2000	2001	2002	2003	2004	2005^{\dagger}	2006 [†]
Total theoretical VAT liability	20,224	20,764	21,275	21,829	22,959	24,047	25,360
Of which							
Household consumption	12,414	13,017	13,245	13,669	14,074	14,769	15,531
Gross fixed capital formation	2,554	2,568	2,629	2,465	2,828	2,980	3,202
Other consumption	4,341	4,301	4,529	4,823	5,080	5,274	5,530
Net adjustments	915	878	872	872	976	1,025	1,096
Actual VAT receipts	18,130	17,817	18,591	18,730	20,122	21,362	22,569
VAT gap	2,094	2,946	2,684	3,098	2,837	2,685	2,791
VAT gap as a share of theoretical liability	10%	14%	13%	14%	12%	11%	11%



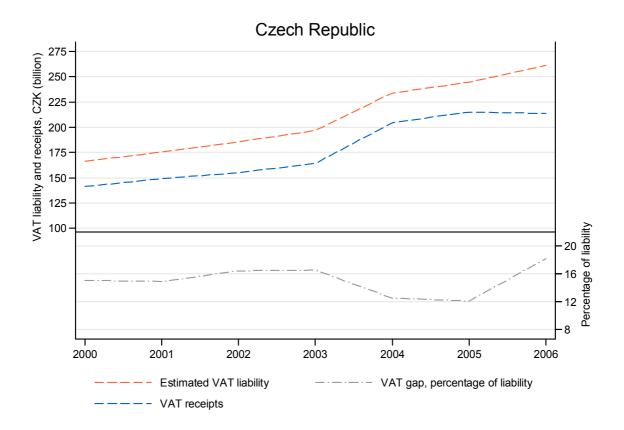


Table 10	Czech Rep	ublic: VAT r	eceipts.	theoretical liability	v and gap.	2000-2006	(CZK million)

CZ	2000	2001	2002	2003	2004	2005^{\dagger}	2006 [†]
Total theoretical VAT liability	166,392	175,418	185,630	196,790	233,855	244,671	261,196
Of which							
Household consumption	112,156	118,010	121,072	127,426	141,673	140,266	151,190
Gross fixed capital formation	19,530	20,507	24,030	23,273	32,480	37,219	39,817
Other consumption	28,683	29,709	31,603	36,291	49,057	55,354	56,400
Net adjustments	6,023	7,191	8,925	9,799	10,646	11,832	13,789
Actual VAT receipts	141,341	149,271	155,136	164,250	204,618	215,118	213,728
VAT gap	25,051	26,147	30,494	32,540	29,237	29,553	47,468
VAT gap as a share of theoretical liability	15%	15%	16%	17%	13%	12%	18%



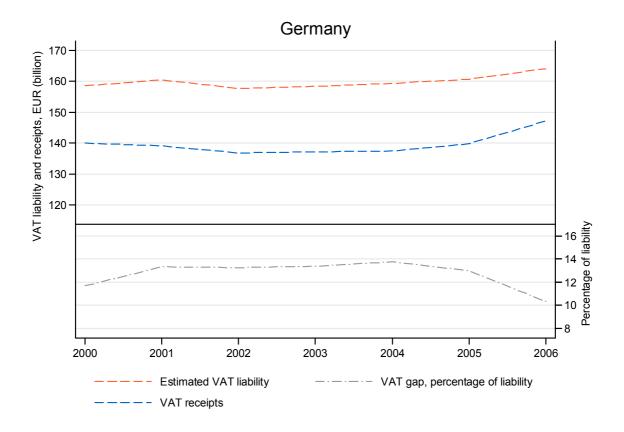


 Table 11
 Germany: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

DE	2000	2001	2002	2003	2004	2005^{\dagger}	2006 [†]
Total theoretical VAT liability	158,538	160,460	157,694	158,376	159,352	160,664	164,115
Of which							
Household consumption	97,402	101,232	100,174	100,350	102,069	102,464	103,947
Gross fixed capital formation	30,540	28,309	26,863	26,437	26,060	25,819	27,301
Other consumption	27,670	28,261	28,314	29,108	28,506	29,750	30,042
Net adjustments	2,926	2,657	2,343	2,481	2,717	2,630	2,825
Actual VAT receipts	140,020	139,090	136,810	137,190	137,430	139,810	147,150
VAT gap	18,518	21,370	20,884	21,186	21,922	20,854	16,965
VAT gap as a share of theoretical liability	12%	13%	13%	13%	14%	13%	10%



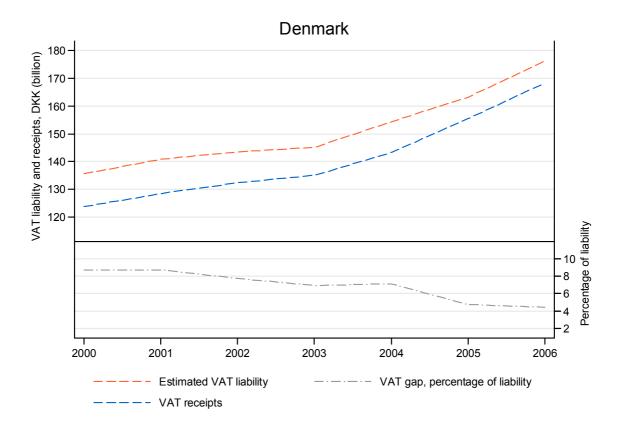


 Table 12
 Denmark: VAT receipts, theoretical liability and gap, 2000–2006 (DKK million)

DK	2000	2001	2002	2003	2004	2005	2006 [†]
Total theoretical VAT liability	135,645	140,878	143,523	145,160	154,301	163,228	176,119
Of which							
Household consumption	81,768	83,562	86,080	86,885	92,828	96,522	102,746
Gross fixed capital formation	19,398	20,309	19,089	19,094	19,943	22,139	25,311
Other consumption	29,929	32,368	33,867	34,829	37,047	39,637	42,930
Net adjustments	4,551	4,639	4,487	4,352	4,483	4,930	5,132
Actual VAT receipts	123,777	128,550	132,394	135,088	143,277	155,463	168,276
VAT gap	11,868	12,328	11,129	10,072	11,024	7,765	7,843
VAT gap as a share of theoretical liability	9%	9%	8%	7%	7%	5%	4%

[†] Estimates compiled using forecasted use table data. Revised estimates for Denmark calculated with use tables downloaded from Eurostat in July 2009.

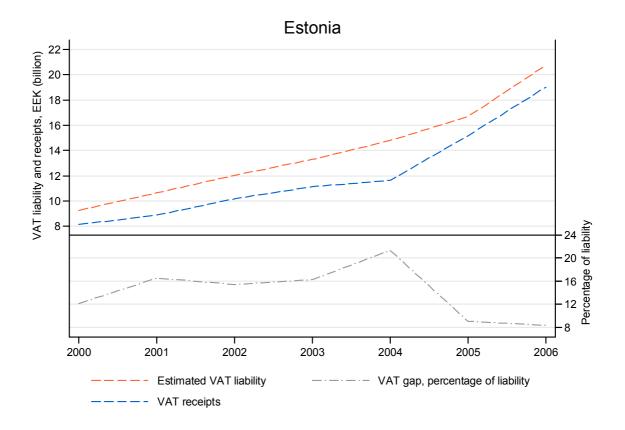


 Table 13
 Estonia: VAT receipts, theoretical liability and gap, 2000–2006 (EEK million)

EE	2000	2001	2002	2003	2004	2005^{\dagger}	2006^{\dagger}
Total theoretical VAT liability	9,267	10,652	12,033	13,301	14,790	16,692	20,739
Of which							
Household consumption	6,571	7,436	8,272	9,155	10,239	11,364	13,589
Gross fixed capital formation	1,071	1,347	1,714	1,888	2,216	2,850	4,004
Other consumption	1,482	1,663	1,797	2,001	2,050	2,341	2,748
Net adjustments	143	206	251	257	285	137	399
Actual VAT receipts	8,142	8,892	10,178	11,141	11,638	15,176	19,009
VAT gap	1,125	1,760	1,855	2,160	3,152	1,516	1,731
VAT gap as a share of theoretical liability	12%	17%	15%	16%	21%	9%	8%



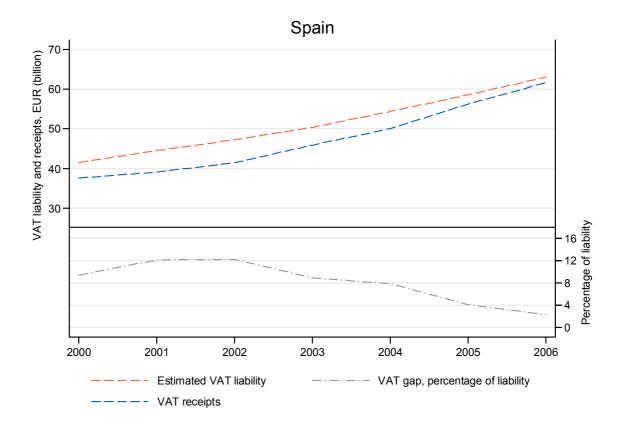


 Table 14
 Spain: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

ES	2000	2001	2002^\dagger	2003 [†]	2004	2005^{\dagger}	2006^{\dagger}
Total theoretical VAT liability	41,565	44,525	47,265	50,397	54,363	58,599	63,013
Of which							
Household consumption	28,804	30,614	32,028	33,698	36,067	38,553	41,028
Gross fixed capital formation	6,178	6,878	7,431	8,254	8,989	9,885	10,766
Other consumption	5,608	6,042	6,746	7,316	8,094	8,857	9,816
Net adjustments	975	991	1,060	1,130	1,211	1,305	1,403
Actual VAT receipts	37,640	39,117	41,475	45,915	50,084	56,197	61,595
VAT gap	3,925	5,408	5,790	4,482	4,278	2,402	1,418
VAT gap as a share of theoretical liability	9%	12%	12%	9%	8%	4%	2%



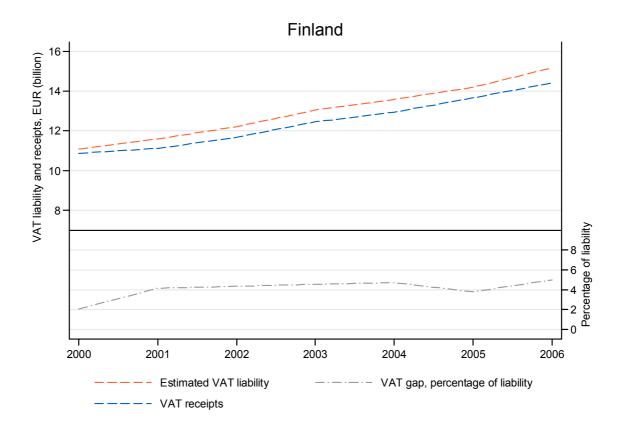


 Table 15
 Finland: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

FI	2000	2001	2002	2003	2004	2005	2006 [†]
Total theoretical VAT liability	11,099	11,599	12,210	13,048	13,589	14,195	15,176
Of which							
Household consumption	6,518	6,833	7,128	7,587	7,853	8,149	8,661
Gross fixed capital formation	1,653	1,663	1,731	1,874	1,990	2,112	2,248
Other consumption	2,816	2,966	3,193	3,387	3,538	3,683	3,967
Net adjustments	111	137	158	199	209	252	300
Actual VAT receipts	10,869	11,118	11,680	12,455	12,949	13,658	14,418
VAT gap	230	481	530	593	640	537	758
VAT gap as a share of theoretical liability	2%	4%	4%	5%	5%	4%	5%



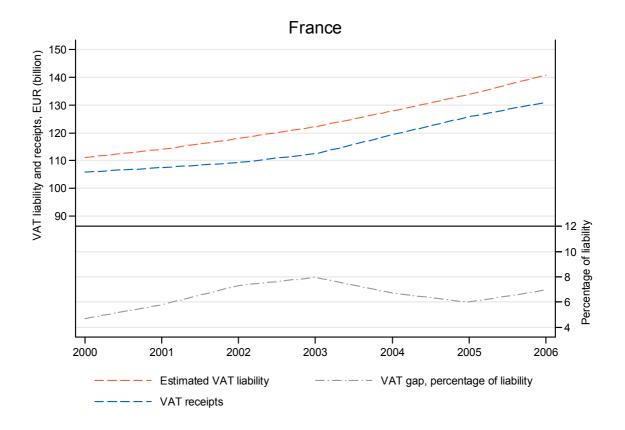


 Table 16
 France: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

FR	2000	2001	2002	2003	2004	2005^{\dagger}	2006 [†]
Total theoretical VAT liability	111,119	114,078	117,990	122,180	127,879	133,793	140,817
Of which							
Household consumption	71,008	73,075	75,250	77,614	80,661	83,530	86,440
Gross fixed capital formation	17,780	17,942	18,284	19,416	20,694	22,184	23,896
Other consumption	19,751	20,451	21,854	22,542	23,727	25,149	27,326
Net adjustments	2,579	2,610	2,603	2,608	2,797	2,930	3,154
Actual VAT receipts	105,887	107,465	109,353	112,460	119,294	125,768	131,017
VAT gap	5,231	6,613	8,637	9,720	8,585	8,025	9,800
VAT gap as a share of theoretical liability	5%	6%	7%	8%	7%	6%	7%



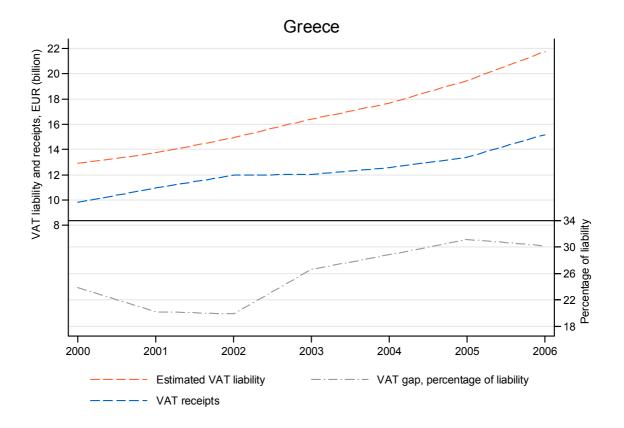


 Table 17
 Greece: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

GR	2000^{\dagger}	2001^{\dagger}	2002^{\dagger}	2003^{\dagger}	2004^{\dagger}	2005^{\dagger}	2006^{\dagger}
Total theoretical VAT liability	12,900	13,737	14,942	16,410	17,666	19,456	21,746
Of which							
Household consumption	8,199	8,792	9,381	10,100	10,828	12,229	13,385
Gross fixed capital formation	2,973	3,169	3,536	4,169	4,569	4,795	5,707
Other consumption	1,501	1,530	1,744	1,809	1,900	2,025	2,165
Net adjustments	226	246	281	332	369	407	490
Actual VAT receipts	9,824	10,960	11,969	12,043	12,573	13,398	15,183
VAT gap	3,076	2,777	2,973	4,367	5,093	6,058	6,563
VAT gap as a share of theoretical liability	24%	20%	20%	27%	29%	31%	30%



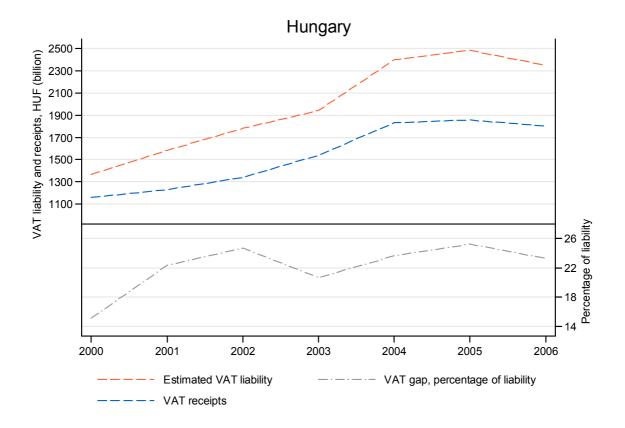


 Table 18
 Hungary: VAT receipts, theoretical liability and gap, 2000–2006 (HUF million)

HU	2000	2001	2002	2003	2004	2005 [†]	2006 [†]
Total theoretical VAT liability	1,366,496	1,584,177	1,780,756	1,941,165	2,399,106	2,483,996	2,347,243
Of which							
Household consumption	916,738	1,036,046	1,118,808	1,258,368	1,559,005	1,584,940	1,467,214
Gross fixed capital formation	232,003	293,011	363,193	351,705	411,850	414,325	382,406
Other consumption	185,652	219,086	256,641	287,871	385,306	441,378	452,785
Net adjustments	32,103	36,035	42,115	43,222	42,945	43,353	44,837
Actual VAT receipts	1,159,959	1,230,216	1,340,914	1,539,868	1,831,647	1,856,547	1,800,345
VAT gap	206,537	353,961	439,842	401,297	567,459	627,449	546,898
VAT gap as a share of theoretical liability	15%	22%	25%	21%	24%	25%	23%

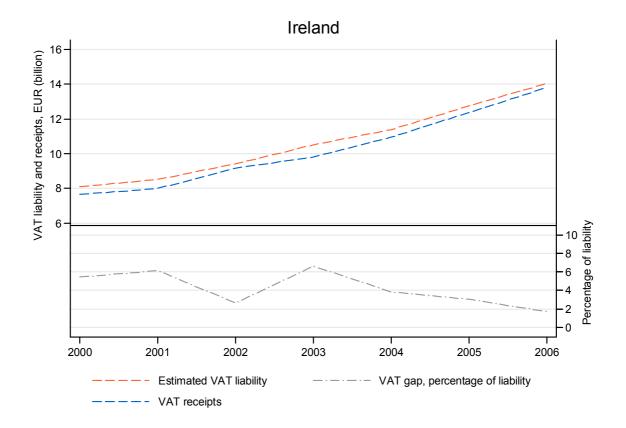


 Table 19
 Ireland: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

IE	2000	2001	2002	2003^{\dagger}	2004^{\dagger}	2005^{\dagger}	2006 [†]
Total theoretical VAT liability	8,096	8,521	9,415	10,509	11,385	12,750	14,043
Of which							
Household consumption	4,526	4,668	5,121	5,716	6,033	6,574	7,091
Gross fixed capital formation	2,060	2,094	2,324	2,656	3,074	3,637	4,192
Other consumption	1,139	1,413	1,569	1,673	1,783	1,939	2,098
Net adjustments	372	348	400	464	494	600	662
Actual VAT receipts	7,657	7,999	9,168	9,814	10,947	12,364	13,802
VAT gap	440	523	247	694	437	386	241
VAT gap as a share of theoretical liability	5%	6%	3%	7%	4%	3%	2%



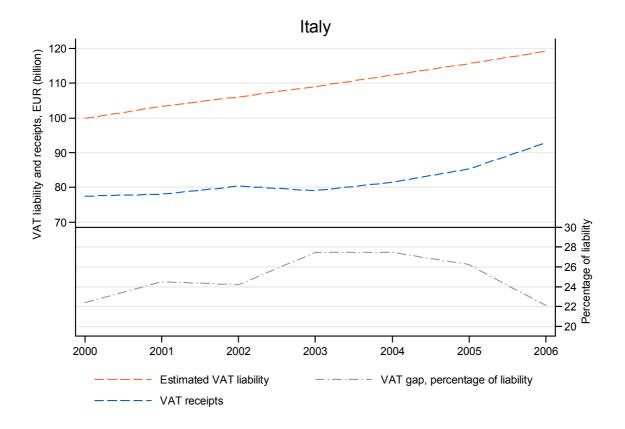


 Table 20
 Italy: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

IT	2000	2001	2002	2003	2004	2005^{\dagger}	2006 [†]
Total theoretical VAT liability	99,869	103,362	106,055	109,046	112,358	115,646	119,197
Of which							
Household consumption	73,284	75,101	76,650	78,534	80,889	82,549	85,070
Gross fixed capital formation	9,552	10,103	10,460	11,058	11,384	11,925	12,309
Other consumption	13,121	14,283	15,086	15,783	16,184	17,327	17,809
Net adjustments	3,913	3,876	3,859	3,671	3,902	3,845	4,009
Actual VAT receipts	77,473	78,056	80,382	79,099	81,515	85,317	92,860
VAT gap	22,396	25,306	25,673	29,947	30,843	30,329	26,337
VAT gap as a share of theoretical liability	22%	24%	24%	27%	27%	26%	22%



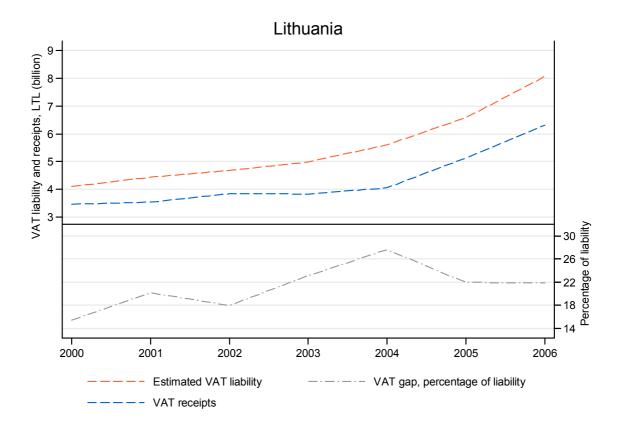


 Table 21
 Lithuania: VAT receipts, theoretical liability and gap, 2000–2006 (LTL million)

LT	2000	2001	2002	2003	2004	2005^{\dagger}	2006^{\dagger}
Total theoretical VAT liability	4,105	4,440	4,684	4,989	5,608	6,583	8,063
Of which							
Household consumption	3,091	3,365	3,494	3,789	4,267	5,057	6,006
Gross fixed capital formation	441	468	541	617	763	828	1,215
Other consumption	541	551	602	541	513	623	745
Net adjustments	32	56	47	42	64	74	98
Actual VAT receipts	3,471	3,544	3,843	3,836	4,059	5,138	6,303
VAT gap	635	895	841	1,154	1,549	1,445	1,760
VAT gap as a share of theoretical liability	15%	20%	18%	23%	28%	22%	22%



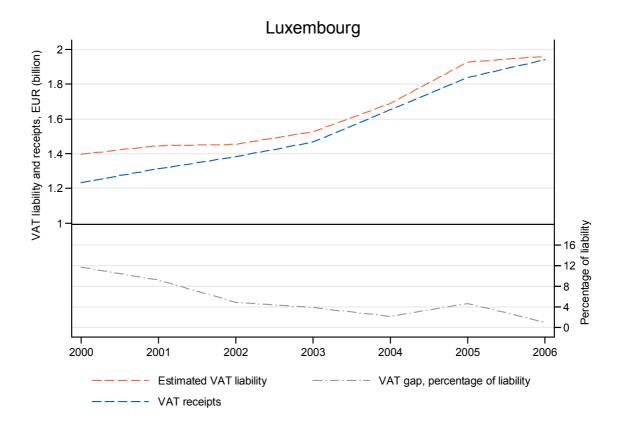


Table 22	Luxembourg:	VAT receipts.	, theoretical liabilit	y and gap	, 2000–2006 ((EUR million)

LU	2000	2001	2002	2003	2004	2005	2006
Total theoretical VAT liability	1,397	1,446	1,454	1,526	1,690	1,927	1,961
Of which							
Household consumption	730	747	806	811	881	951	962
Gross fixed capital formation	214	224	219	216	215	215	221
Other consumption	324	356	356	370	446	497	566
Net adjustments*	129	118	73	129	147	264	211
Actual VAT receipts	1,234	1,314	1,383	1,467	1,654	1,838	1,941
VAT gap	163	133	71	59	36	90	20
VAT gap as a share of theoretical liability	12%	9%	5%	4%	2%	5%	1%

*Includes estimated VAT liability from "tank tourism" by business vehicles



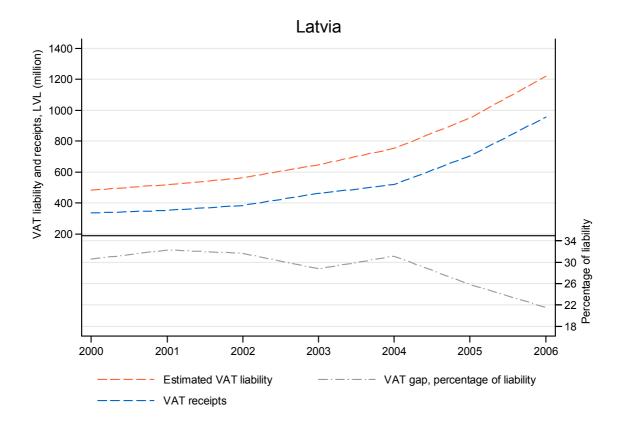


 Table 23
 Latvia: VAT receipts, theoretical liability and gap, 2000–2006 (LVL million)

LV	2000 [†]	2001 [†]	2002 [†]	2003 [†]	2004 [†]	2005 [†]	2006 [†]
Total theoretical VAT liability	482	518	562	647	753	949	1,219
Of which							
Household consumption	324	358	395	475	548	667	869
Gross fixed capital formation	48	43	50	51	65	122	150
Other consumption	94	96	91	89	94	91	102
Net adjustments	17	22	26	32	46	69	98
Actual VAT receipts	335	351	384	461	519	704	956
VAT gap	148	167	178	186	235	245	263
VAT gap as a share of theoretical liability	31%	32%	32%	29%	31%	26%	22%



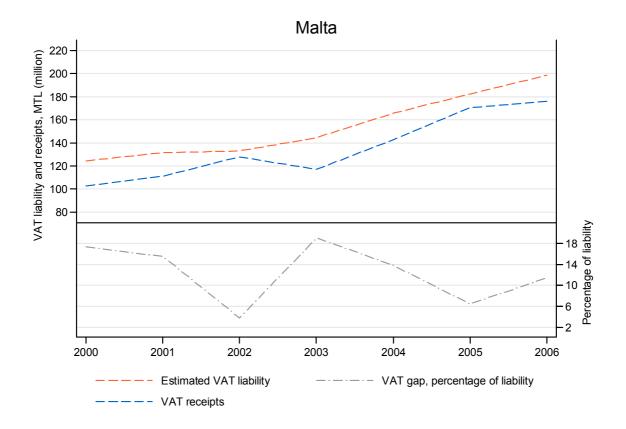


 Table 24
 Malta: VAT receipts, theoretical liability and gap, 2000–2006 (MTL million)

MT	2000	2001	2002 [†]	2003 [†]	2004 [†]	2005 [†]	2006 [†]
Total theoretical VAT liability	124	132	133	145	166	182	199
Of which							
Household consumption	81	87	86	90	109	114	117
Gross fixed capital formation	18	21	22	27	26	33	37
Other consumption	22	20	23	25	28	33	41
Net adjustments	3	3	2	2	3	3	4
Actual VAT receipts*	103	111	128	117	143	171	176
VAT gap	22	20	5	28	23	12	23
VAT gap as a share of theoretical liability	17%	16%	4%	19%	14%	6%	11%

[†] Estimates compiled using forecasted use table data *Eurostat data in EUR converted to MTL using a fixed exchange rate of 1 EUR = 0.4293 MTL.



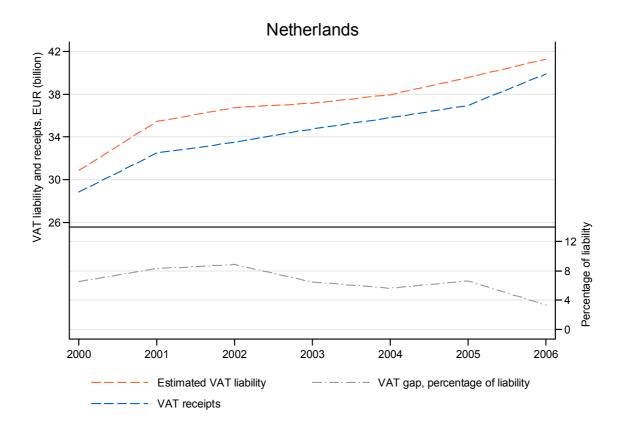


 Table 25
 Netherlands: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

NL	2000	2001	2002	2003	2004	2005^{\dagger}	2006^{\dagger}
Total theoretical VAT liability	30,873	35,457	36,752	37,163	37,951	39,571	41,269
Of which							
Household consumption	16,419	18,928	19,679	19,514	19,945	20,537	20,780
Gross fixed capital formation	7,565	7,722	7,856	8,272	8,179	8,674	9,380
Other consumption	6,194	7,964	8,451	8,640	9,013	9,534	10,222
Net adjustments	695	843	766	738	815	826	887
Actual VAT receipts	28,849	32,509	33,493	34,754	35,811	36,950	39,888
VAT gap	2,024	2,948	3,259	2,409	2,140	2,621	1,381
VAT gap as a share of theoretical liability	7%	8%	9%	6%	6%	7%	3%



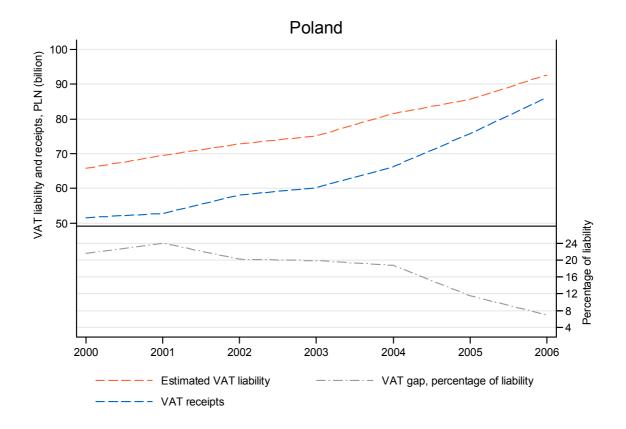


 Table 26
 Poland: VAT receipts, theoretical liability and gap, 2000–2006 (PLN million)

PL	2000	2001^{\dagger}	2002	2003	2004^{\dagger}	2005^{\dagger}	2006 [†]
Total theoretical VAT liability	65,811	69,506	72,820	75,136	81,530	85,643	92,660
Of which							
Household consumption	45,498	47,614	50,844	51,281	55,894	58,221	61,789
Gross fixed capital formation	6,850	6,794	6,492	6,610	7,877	8,393	9,400
Other consumption	11,254	12,983	13,697	14,923	15,526	16,642	18,687
Net adjustments	2,209	2,116	1,787	2,323	2,233	2,387	2,783
Actual VAT receipts	51,615	52,810	58,115	60,212	66,242	75,783	86,203
VAT gap	14,196	16,696	14,705	14,924	15,288	9,860	6,457
VAT gap as a share of theoretical liability	22%	24%	20%	20%	19%	12%	7%



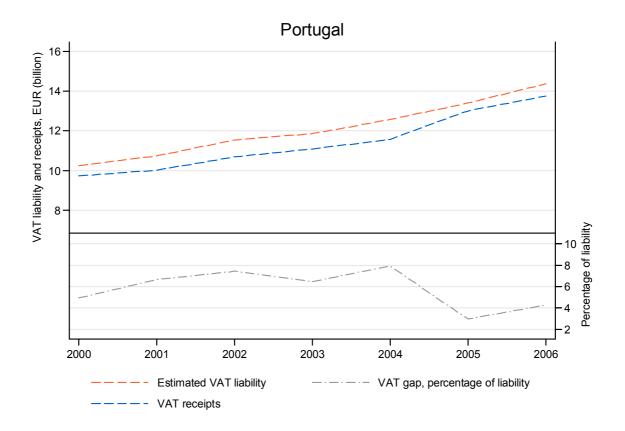


 Table 27
 Portugal: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

РТ	2000	2001	2002	2003	2004	2005	2006^{\dagger}
Total theoretical VAT liability	10,241	10,737	11,549	11,861	12,571	13,403	14,371
Of which							
Household consumption	6,759	7,085	7,663	7,927	8,318	8,931	9,540
Gross fixed capital formation	1,249	1,313	1,401	1,330	1,461	1,382	1,571
Other consumption	1,880	2,005	2,163	2,298	2,464	2,740	2,923
Net adjustments	354	334	323	305	328	350	338
Actual VAT receipts	9,734	10,021	10,690	11,092	11,574	13,006	13,757
VAT gap	508	716	859	769	997	397	614
VAT gap as a share of theoretical liability	5%	7%	7%	6%	8%	3%	4%



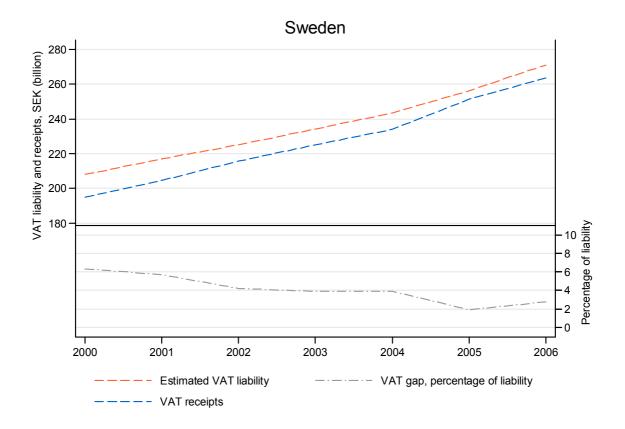


 Table 28
 Sweden: VAT receipts, theoretical liability and gap, 2000–2006 (SEK million)

SE	2000	2001	2002	2003	2004	2005	2006 [†]
Total theoretical VAT liability	208,030	216,982	225,179	234,229	243,455	256,213	271,100
Of which							
Household consumption	121,518	126,116	130,748	136,713	141,294	147,213	153,978
Gross fixed capital formation	19,575	20,365	22,098	22,880	24,772	28,507	31,458
Other consumption	59,985	63,342	65,356	67,220	69,520	72,357	76,852
Net adjustments	6,952	7,159	6,977	7,415	7,869	8,136	8,812
Actual VAT receipts	194,860	204,629	215,697	225,145	233,966	251,309	263,632
VAT gap	13,170	12,353	9,482	9,084	9,489	4,904	7,468
VAT gap as a share of theoretical liability	6%	6%	4%	4%	4%	2%	3%



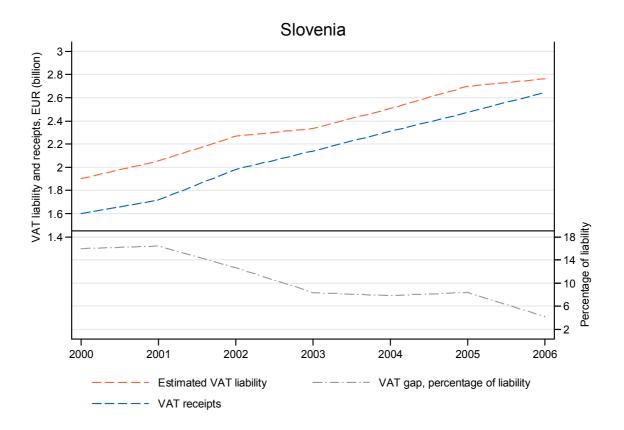


 Table 29
 Slovenia: VAT receipts, theoretical liability and gap, 2000–2006 (EUR million)

SI	2000	2001	2002	2003	2004	2005	2006 [†]
Total theoretical VAT liability	1,902	2,055	2,268	2,336	2,508	2,699	2,764
Of which							
Household consumption	1,242	1,316	1,435	1,513	1,636	1,747	1,763
Gross fixed capital formation	296	358	405	387	430	478	523
Other consumption	298	309	353	357	361	390	390
Net adjustments	66	72	75	79	81	84	87
Actual VAT receipts	1,599	1,718	1,982	2,140	2,311	2,472	2,647
VAT gap	303	337	287	195	197	227	116
VAT gap as a share of theoretical liability	16%	16%	13%	8%	8%	8%	4%



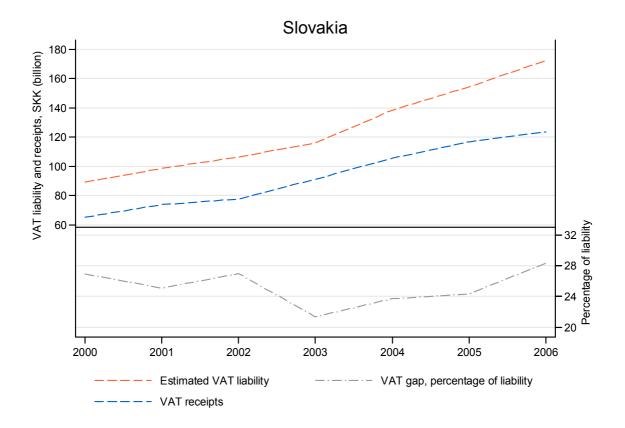


 Table 30
 Slovakia: VAT receipts, theoretical liability and gap, 2000–2006 (SKK million)

SK	2000	2001	2002	2003	2004	2005^{\dagger}	2006^{\dagger}
Total theoretical VAT liability	89,365	98,705	106,506	116,139	138,493	154,476	172,477
Of which							
Household consumption	59,698	66,723	71,816	79,127	97,219	103,957	113,591
Gross fixed capital formation	11,354	11,600	12,934	12,694	14,421	17,721	21,445
Other consumption	15,872	17,297	18,654	22,062	24,396	30,194	34,739
Net adjustments	2,441	3,086	3,102	2,256	2,457	2,604	2,702
Actual VAT receipts*	65,301	73,938	77,779	91,324	105,649	116,880	123,628
VAT gap	24,064	24,767	28,727	24,815	32,844	37,596	48,848
VAT gap as a share of theoretical liability	27%	25%	27%	21%	24%	24%	28%

^{\dagger} Estimates compiled using forecasted use table data *Eurostat data in EUR converted to SKK using a fixed exchange rate of 1 EUR = 30.1260 SKK.

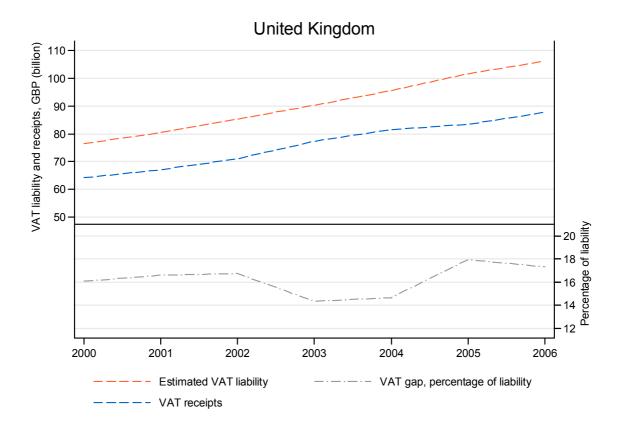


Table 31	United Kingdom:	VAT receipts	s, theoretical liabilit	v and gap.	2000-2006	(GBP million)

UK	2000	2001	2002	2003	2004^{\dagger}	2005^{\dagger}	2006^{\dagger}
Total theoretical VAT liability	76,500	80,449	85,348	90,287	95,559	101,646	106,143
Of which							
Household consumption	51,836	54,200	57,201	59,909	62,915	65,374	68,018
Gross fixed capital formation	4,748	5,150	5,800	6,485	7,277	8,098	9,421
Other consumption	18,370	19,722	21,100	22,583	23,891	27,301	27,780
Net adjustments	1,546	1,378	1,246	1,310	1,476	872	924
Actual VAT receipts	64,202	67,100	71,066	77,343	81,550	83,415	87,753
VAT gap	12,298	13,349	14,282	12,944	14,009	18,231	18,390
VAT gap as a share of theoretical liability	16%	17%	17%	14%	15%	18%	17%



SECTION 3: ECONOMETRIC ANALYSIS OF THE VAT GAP

- 77. This section presents an econometric analysis of the VAT gap.
- 78. The aim of the analysis is to contribute to the understanding of the nature and causes of the VAT gap, and to identify country characteristics that appear related to different levels of the VAT gap.
- 79. This section is structured as follows:
 - (a) First, we review published econometric studies of the causes of the VAT gap.
 - (b) Second, we provide an empirical analysis of the VAT gap figures obtained by the top-down method reported elsewhere in this report.

Previous econometric studies of the determinants of the VAT gap

- 80. Before presenting our own empirical analysis, we review the findings from other studies on the topic. This review informs the choice of candidate explanatory variables used in our own models.
- 81. There have been few investigations of the determinants of VAT losses.
- 82. Christie and Holzner (2006) did not include a review of other similar papers "there is typically no econometric modelling involved at all" within the studies that measure the size of tax evasion.⁴ Keen and Smith (2007) suggest that "the difficulty of measuring VAT noncompliance [...] has impeded serious empirical work" on the determinants of the VAT gap.⁵
- 83. Keen and Smith (2007) comment on only one study that provided an econometric analysis of the determinants of VAT compliance. This paper is Agha and Houghton (1996) which constructs and analyses a cross–section of VAT compliance rates for 17 OECD member countries in 1987.⁶
- 84. Agha and Houghton (1996) found that:
 - (a) a higher VAT rate is associated with lower VAT compliance;
 - (b) the number of VAT rates negatively affect the level of VAT compliance;
 - (c) VAT compliance increases the longer VAT has been in operation; and
 - (d) smaller countries (in terms of population) tend to have higher levels of compliance.

⁴ Christie, E and M. Holzner (2006) "What explains tax evasion? An empirical assessment based on European data", WIIW Working Paper 40. Available from http://www.wiiw.ac.at/pdf/wp40.pdf, accessed on 3 August 2009.

⁵ Keen, M and S. Smith (2007) "VAT fraud and evasion: What do we know, and what can be done?", IMF Working Paper. Available from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=964339, accessed on 3 August 2009.

 ⁶ Agha, A and J. Haughton (1996) "Designing VAT systems: Some efficiency considerations", The Review of Economics and Statistics 78, No.2, pp. 303-308

- 85. Other factors, including the VAT base as a proportion of GDP, the severity of penalties for late payment, and the proportion of the population registered to pay VAT, had no statistically significant impact on compliance.
- 86. We have found two other studies which provide econometric analysis of the VAT gap.
- 87. Otranto, Pisano and Polidoro (2003) examines the determinants of VAT fraud in Italy in the period 1982–2001.⁷ The authors find that VAT evasion is positively affected by GDP, by the share of the fiscal burden and by the ratio of gross profits and value added over the economy, and that it is negatively affected by one period lagged values of the number of taxpayers checked by the authorities. The authors also find that initiatives by government to grant amnesty to tax evaders in a given period have a negative and only transitory effect on the level of the VAT gap.
- 88. Christie and Holzner (2006) analyses data for 29 European countries from 2000 to 2003.⁸ The effects on VAT compliance identified by this paper are as follows:
 - (a) a higher weighted average VAT rate reduces VAT compliance;
 - (b) greater judicial and legal effectiveness increases VAT compliance;
 - (c) countries where citizens want more power for local authorities (which is, according to the authors, a proxy for tax morale) tend to have lower levels of VAT compliance; and
 - (d) countries with a large proportion of GDP from travel revenues tend to have higher levels of VAT compliance.
- 89. Christie and Holzner (2006) found that other factors, such as the confidence in the health care system, measures of income inequality, a measure of poverty, complexity of the VAT system, a corruption index, and GDP per capita, did not have a statistically significant relationship to the estimated rate of VAT compliance.

Empirical modelling of top-down VAT gap estimates

90. We draw on some of the ideas found in the literature to develop our own econometric analysis of the determinants of the estimated VAT gap.

Data used in the modelling

91. The dependent variable for our econometric analysis is the VAT gap share, defined as the VAT gap divided by the theoretical VAT liability. Data for this variable come from our top-down analysis reported in Section 2.

⁷ Otranto, E., S. Pisani and F. Polidoro (2003) "Un modello statistico per comprendere le determinanti dell'evasione" in R. Convenevole and S. Pisani "Le basi imponibili IVA Un'analisi del periodo 1982-2001", Working paper 2003/1 of Agenzia Entrate, Ministerio dell'Economia e della Finanze, Italy. Available from http://www1.agenziaentrate.it/ufficiostudi/pdf/2003/basi%20imponibili%20IVA%2082-01.pdf, accessed on 3 August

nttp://www1.agenziaentrate.it/ufficiostual/pdf/2005/basi%20imponibili%20iVA%2082-01.pdf, accessed on 3 August 2009.
 ⁸ Christia E and M. Halman (2000) "Wild tambing tam analyzing 2 An ampirical accessed an European data" Wild tambing tam analyzing 2 An ampirical accessed on 5 August 2009.

⁸ Christie, E and M. Holzner (2006) "What explains tax evasion? An empirical assessment based on European data", WIIW Working Paper 40. Available from http://www.wiiw.ac.at/pdf/wp40.pdf, accessed on 3 August 2009.

92. This variable measures the proportion of theoretical liability that is not remitted.

Table 32 Candidate explanatory variables

Variable	Underlying factor(s) captured by the variable	Source
Judicial/legal effectiveness index	Proxy for the punishment rate and the audit rate and may be an indicator of the shadow economy	Kaufman (2004), "Corruption, Governance and Security: Challenges for the Rich Countries and the World", Chapter in the World Bank's Global Competitiveness Report 2004/2005
Proportion of population who think that it is unjustifiable to cheat on taxes if you have a chance	Moral standards	1999 wave of the World Values Survey ⁹ . (Proportion of answers 1–5 for the question F116)
Transparency International Corruption Perceptions Index	Level of corruption	Transparency International's annual Corruption Perceptions Index report
Theoretical VAT liability divided by GDP	VAT burden	Reckon's top-down analysis and Eurostat
Standard VAT rate	VAT burden	National VAT legislation
GINI coefficient (measure of income inequality)	Income inequality	Eurostat (income and living conditions indicators) UK data taken from its national statistics office
At risk of poverty rate (cut–off point: 60% of median equivalised income after social transfers)	Poverty	Eurostat (income and living conditions indicators) UK data taken from the Institute of Fiscal Studies
GDP per capita (EUR in 1995 prices)	Wealth/level of development	Eurostat (national accounts)
Unemployment rate	Income inequality / poverty	Eurostat (EU Labour Force Survey)
Government final consumption expenditure divided by GDP	Overall tax burden / level of government controls (including tax inspections)	Eurostat (national accounts)
GDP (Euros in 1995 prices)	Size of the economy	Eurostat (national accounts)
Population	Country size	Eurostat
EU membership (dummy variable)	EU membership might make certain types of fraud easier (e.g. MTIC). Conversely, EU membership might coincide with a crack down on VAT fraud.	Takes the value 1 if the country is the EU, and zero otherwise. 10 countries joined on 1 May 2004; variable pro–rated for the year 2004

⁹ European Values Study Group and World Values Survey Association. European and World Values Surveys Four Wave Integrated Data File, 1981-2004, v.20060423, 2006. Aggregate File Producers: Análisis Sociológicos Económicos y Políticos (ASEP) and JD Systems (JDS), Madrid, Spain/Tilburg University, Tilburg, The Netherlands. Data Files Suppliers: Analisis Sociologicos Economicos y Politicos (ASEP) and JD Systems (JDS), Madrid, Spain/Tilburg University, Tilburg, The Netherlands/ Zentralarchiv fur Empirische Sozialforschung (ZA), Cologne, Germany:) Aggregate File Distributors: Análisis Sociológicos Económicos y Políticos (ASEP) and JD Systems (JDS), Madrid, Spain/Tilburg University, Tilburg, The Netherlands/Zentralarchiv fur Empirische Sozialforschung (ZA) Cologne, Germany.

Variable	Underlying factor(s) captured by the variable	Source
EU accession (dummy variable)	Countries might have stepped up enforcement on joining the EU.	Takes the value 1 after accession, pro-rated for time as necessary, for the 10 countries that joined the EU in 2004; and 0 in all other cases
Effect of EU–10 accession on the EU–15 (dummy variable)	Impact of an enlarged EU	Takes the value 1 after accession by the EU–10, pro–rated for time as necessary, for the 15 countries that joined the EU before 2004; and 0 in all other cases
Gross fixed capital formation of construction products divided by GDP	Relative size of the construction sector	Eurostat (national accounts)
Household final consumption of hotel and restaurant services divided by GDP	Proxy for the effect of tourism	Eurostat (national accounts)

- 93. VAT gap estimates were available for all countries from 2000 to 2006 for 24 of the 25 countries covered by this study. There are no VAT gap estimates for Cyprus.
- 94. Table 32 lists the candidate explanatory variables that we have considered, a short description of the reason for their inclusion and the source from which they were obtained. Several of these variables have been used in the Agha and Houghton (1996) and Christie and Holzner (2006) studies mentioned earlier.
- 95. Two of the variables in Table 32 are not available on a time series basis. The judicial/legal effectiveness index and the variable about how justifiable it is to cheat on taxes are both available for a single year only. In our modelling we have assumed that these variables are constant over time for each country.
- 96. Some of the other variables had missing values for some years and countries:
 - (a) The Gini coefficient and the poverty rate both had missing entries for some countries and years. These gaps were filled in using the fitted values of a country-specific regression of the variable in question on time.
 - (b) Malta has no data for the corruption perceptions index and judicial/legal effectiveness index.
 - (c) Eurostat reported no Gini coefficient and poverty rate variables for Slovakia.
- 97. Where there were missing values for a variable, the observations affected were not included in the estimation of models using that variable.

Econometric analysis — general considerations

98. The general form of the models that we considered is as follows:

 $VAT \ gap \ share(i,t) = a + b_1 X_1(i,t) + ... + b_k X_k(i,t) + e(i,t)$



- 99. In this equation, *i* denotes the country, *t* the year, *a* is a constant, the *b* coefficients are the slopes on the explanatory variables *X*, and *e* is the model's disturbance term.
- 100. The starting point for our analysis was to estimate a random effects model. A model of this type decomposes the disturbance into a country-specific component (the random effect) that is fixed over time and an unrelated noise component that is not correlated over time or between countries.
- 101. We do not report results from fixed effects models, in which a specific intercept term would be included for each country. The inclusion of such intercept terms would mask the effect of any explanatory variables that are constant over time or very close to being constant over time even though there may be large differences between countries. Given that we are interested in the estimated effects of such variables, a fixed effects model does not contribute to our analysis.
- 102. The estimated effect of the explanatory variables in a random effects model are only unbiased if the random effects are not correlated with the explanatory variables. A method that can be used to test whether this is the case is the Hausman test. This test compares the estimated results of a fixed effects model and a random effects model. The more different the coefficients obtained by both methods are, the more likely it is that the assumption of no correlation between random effects and explanatory variable has been violated.
- 103. A further important assumption is that the random effect estimates are based on the hypothesis that the noise component of the disturbance term in the model is homoskedastic (i.e. has a constant variance) and is not autocorrelated. When hetereskedasticity or autocorrelation are present the estimated standard errors can lead to misleading inferences about statistical significance.
- 104. We have used a general-to-specific approach to identifying those variables that exhibit a not-insignificant relationship with the VAT gap share. This approach involves starting with the most general model, including all the candidate explanatory variables. We then drop variables from the model, one at a time, starting with the one that has the highest p value. We stop when each remaining variable is significant at a level of 95 per cent.

Random effects estimates

- 105. Table 33 shows the results of estimating a random effects model over the period 2000-2006 using a general-to-specific approach. It also includes the results of diagnostic tests.
- 106. Data for only 23 countries are used, as:
 - (a) There were no VAT gap data for Cyprus.
 - (b) There was no judicial/legal effectiveness index for Malta.



107. We have tried fitting models without the explanatory variables for which data are missing; we did not find any case in which the results were qualitatively different from those in Table 33.

Dependent variable:	VAT gap divided by the theoretical VAT liability (proportion)			
Explanatory variables:	Coefficient	Standard error		
Constant	0.152	0.071		
Judicial/legal effectiveness index divided by 100 (0–1)	-0.212	0.042		
EU accession (dummy variable)	-0.044	0.009		
Impact of EU enlargement in 2004	-0.012	0.006		
VAT liability as a proportion of GDP	3.313	0.654		
Standard VAT rate	0.008	0.003		
Statistical indicators:	Number of observations: 161	Number of countries: 23		
	Overall R-squared: 0.6308			
Diagnostic tests	Hausman test statistic: 2.0 (p = 0.7359)	Likelihood ratio test for heteroskedasticity: 115.95 (p = 0.000)		
	Wooldridge test for autocorrelation: 34.815 (p = 0.000)			

 Table 33
 Random effects model results

- 108. For this model, the Hausman test was passed. This suggests that there is low risk of a bias in the estimated coefficients as a result of correlations between the random effects and the explanatory variables.
- 109. One explanatory variable that might have been expected to display such correlation is the VAT liability as a proportion of GDP (i.e. the VAT burden). This is because errors in estimating a country's theoretical VAT liability, and therefore its VAT gap, affect the measure of the VAT burden for that country. This is what is termed in econometrics an endogeneity problem.
- 110. The Hausman test however does not rule out the possibility of correlations between the VAT burden and the noise component of the disturbance. This issue is discussed later in this section.
- 111. We tested for heteroskedasticity and autocorrelation:
 - (a) We carried out a likelihood ratio test in which the null hypothesis is that the noise term has a constant variance across countries was rejected. This suggests the presence of heteroskedasticity.
 - (b) We carried out the Wooldridge test, where the null hypothesis is of no first-order autocorrelation was rejected. This suggests the presence of autocorrelation in the noise term.

- 112. These two tests indicate that assumptions behind the random effects model are not satisfied in this case and that the estimated standard errors cannot be relied upon for statistical testing. Christie and Holzner (2006) reached similar findings when they carried out these tests on their estimated random effects model.
- 113. To take account of the detected heteroskedasticity and autocorrelation an alternative modelling approach is required, one that is robust to these features. We have used two different estimation techniques to accomplish this:
 - (a) Panel corrected standard errors in conjunction with assuming a disturbance term with first-order autocorrelation.¹⁰ This was the approach adopted by Christie and Holzner (2006).
 - (b) Estimating the model by ordinary least squares and then adjusting the standard errors so that they are "robust" to heteroskedasticity and autocorrelation.¹¹ This approach does not specify the form of the autocorrelation and instead uses the correlation detected in the data itself to estimate the standard errors.
- 114. When applying these techniques we again took a general-to-specific modelling approach.

Panel corrected standard error estimates

115. Table 34 presents the results of our modelling using the panel corrected standard errors approach.

Table 34	Panel corrected standard error modelling results
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Dependent variable:	VAT gap divided by the theoretical VAT liability (proportion)				
Explanatory variables:	Coefficient	Panel corrected standard error			
Constant	0.217	0.068			
Corruption Perceptions Index (0– 10, a lower score represents a higher perception of corruption)	024	0.002			
Gross fixed capital formation of construction products divided by GDP	-0.399	0.672			
Theoretical VAT liability divided by GDP (proportion)	2.725	0.697			
Standard VAT rate	-0.006	0.002			
Population (millions)	0.522	0.186			
Statistical indicators:	Number of observations: 161	Number of countries: 23			
	R-squared: 0.5671				

¹⁰ This method is implemented in the Stata statistical software package by using the xtpcse function.

¹¹ This method is implemented in the Stata statistical software package by using the regress function with the robust and cluster options.

- 116. These results suggest the following:
 - (a) There are conflicting signs about the relationship between the VAT burden and the VAT gap. A one percentage point rise in the theoretical VAT liability divided by GDP coincides with an increase in the VAT gap share of 2.725 percentage points. On the other hand, a one percentage point increase in the standard rate of VAT seems to coincide with a reduction in the VAT gap share of 0.6 percentage points.
 - (b) A lower perception of corruption appears to reduce the VAT gap share. An increase of 1 point in the Corruption Perception Index coincides with a reduction in the VAT gap share by approximately 2.4 percentage points.
 - (c) Countries with a larger population have a larger VAT gap share.
 - (d) Countries where construction services account for a greater share of GDP have a lower VAT gap share.
- 117. Our finding about the influence of the VAT burden seems inconsistent with Christie and Holzner (2006), which found that VAT compliance is greater in countries with lower weighted average VAT rates.
- 118. Our finding about the effect of lower perceived corruption is consistent with Christie and Holzner (2006), which found that VAT compliance is higher in countries with better judicial/legal effectiveness. Both perceived corruption and judicial/legal effectiveness are measures of the effectiveness of the legal system and perceptions of corruption, and our model above could be formulated using either variable without much change in explanatory power. A feature in favour of the use of the Corruption Perceptions Index is that it is available on a time-series basis whereas the judicial/legal effectiveness index is only available for 2004. Thus, the Corruption Perceptions Index might capture changes such as the affect of joining the EU for the accession countries whereas the judicial/legal effectiveness index cannot.
- 119. We see a similar effect of country size between the results above, which found that larger and richer economies have a greater VAT gap, and Agha and Houghton (1996), which found that countries with larger populations have less VAT compliance.

Robust regression estimates

120. Very similar results to the panel corrected standard error model were obtained when the "robust" regression procedure was implemented. The results of the "robust" regression are shown in Table 35.



Dependent variable:	VAT gap divided by the theoretical VAT liability (proportion)			
Explanatory variables:	Coefficient	"Robust" standard error		
Constant	0.446	.067		
Corruption Perceptions Index (0–10, a lower score represents a higher perception of corruption)	-0.029	0.003		
GDP per capita (EUR 000 in 1995 prices)	0.00009	0.00002		
Theoretical VAT liability divided by GDP (proportion)	2.419	0.705		
EU accession (dummy variable)	-0.05	0.02		
Standard VAT rate	-0.012	0.002		
Gross fixed capital formation of construction products divided by GDP	-0.821	0.22		
Statistical indicators:	Number of observations: 161	Number of countries: 23		
	R-squared: 0.7318	Root mean square error: 0.0437		

Table 35Robust regression modelling results

121. The results in Table 35 above are similar to those in Table 34 reported earlier.

Instrumental variable regression estimates

- 122. We noted above that even though the Hausman test was passed there may still be a possible problem of "endogeneity" which could be attributed to the use of the VAT burden as an explanatory variable.
- 123. The relationship between VAT gap share and VAT liability as a proportion of GDP reported in Tables 34 and 35 is intuitively and theoretically satisfying: it seems that attempts at capturing a greater share of national wealth through VAT lead to more VAT evasion and avoidance.
- 124. But the endogeneity issues mean that there is a risk that the magnitude of this effect has been overstated. As well as the underlying relationship between the VAT burden and the VAT gap share, the coefficients shown in Tables 34 and 35 might be capturing the effect of any errors in the estimation of the theoretical liability.
- 125. This is because any measurement errors in the estimation of the theoretical liability would tend to affect both the estimated tax gap and the burden measured by reference to the same estimate of VAT theoretical liability, and to affect them systematically in the same direction.
- 126. We therefore tested for endogeneity using the Durbin-Wu-Hausman test to decide whether it is necessary to use an instrumental variable.
- 127. Based on the model presented in Table 35, the VAT burden variable was tested for endogeneity using the standard VAT rate and government final consumption divided by GDP as instruments for the VAT burden. The requirement for the instruments is

that they should be correlated with the VAT burden, but they must not be correlated with the disturbance term. The test was failed: estimates from ordinary least squares may be biased. A standard econometric approach to remove the bias arising from this endogeneity is to use instrumental variables.

- 128. Under this approach, in order to obtain an unbiased estimate of the effect of the VAT burden (the variable to be instrumented), a set of instruments needs to be used as part of the estimation. We used the standard VAT rate and government final consumption divided by GDP as instruments for the VAT burden.
- 129. Table 36 shows the results when the model was estimated under this approach. The estimated standard errors are "robust" to autocorrelation and heteroskedasticity, as in Table 35.

Dependent variable:	VAT gap divided by theoretical VAT liability (proportion)		
Explanatory variables:	Coefficient	"Robust" standard error	
Constant	0.583	0.151	
Theoretical VAT liability divided by GDP (proportion) [instrumented by the standard VAT rate and government final consumption divided by GDP]	-1.309	1.388	
Corruption Perceptions Index (0–10, a lower score represents a higher perception of corruption)	-0.035	0.005	
Gross fixed capital formation of construction products divided by GDP	-0.987	0.335	
Statistical indicators:	Number of observations: 161	Number of countries: 23	
	R-squared: 0.5432	Root mean square error: 0.056	

Table 36 Instrumental variable robust regression modelling results

- 130. Table 36 shows that once the VAT burden has been instrumented, its estimated coefficient becomes negative: this would now suggest that countries with a higher VAT burden have a lower VAT gap share. In other words, this model indicates that the positive correlation found in Tables 34 and 35 may be attributable to the bias arising from correlations between the error in estimating the VAT gap and the VAT burden estimate.
- 131. The instrumented VAT burden explanatory variable is also no longer statistically significant. We have checked that other combinations of instruments lead to the same findings.
- 132. Our conclusion is therefore that there is no reliable statistical evidence of any relationship between the VAT burden and the VAT gap.
- 133. Christie and Holzner (2006) found a relationship between the VAT burden measured by a weighted average VAT rate and the VAT gap. This result, like our results in Tables 34 and 35, is vulnerable to a risk of bias due to correlations between VAT gap

and VAT burden arising from possible errors in estimating the theoretical liability or weighted average VAT rate. Christie and Holzner (2006) did not use an instrumental variable approach or any other way to address this risk of bias, and does not therefore, in our view, provide reliable statistical evidence of any relationship between the VAT burden and the VAT gap.

Models without the VAT burden as an explanatory variable

- 134. In the light of the above analysis, we focus on models that do not include a measure of the VAT burden as an explanatory variable. This means that the general model in our general-to-specific modelling approach no longer includes the VAT burden as an explanatory variable. All the other candidate explanatory variables presented earlier in this section are included.
- 135. We used a "robust" regression estimation technique for these models as it makes less restrictive assumptions about the form of the autocorrelation in the data.
- 136. Table 37 below presents the results of a model without the VAT burden as an explanatory variable.

Dependent variable:	VAT gap divided by the theoretical VAT liability (proportion)		
Explanatory variables:	Coefficient	"Robust" standard error	
Constant	0.4347	0.0465	
Corruption Perceptions Index (0–10, a lower score represents a higher perception of corruption)	-0.032	0.004	
Gross fixed capital formation of construction products divided by GDP	-0.8192	0.277	
Statistical indicators:	Number of observations: 161	Number of countries: 23	
	R-squared: 0.6233	Root mean square error: 0.051	

Table 37 Robust regression without VAT burden, with gross capital formation variable

- 137. The regression reported in Table 37 shows that gross fixed capital formation of construction products as a share of GDP was found to be statistically significant without the presence of the VAT burden variable. Countries with 1 percentage point more gross fixed capital formation of construction products as a share of GDP are estimated to have 0.82 percentage points less of a VAT gap.
- 138. There are three possible interpretations for the apparent relationship between gross fixed capital formation of construction products and the VAT gap share:
 - (a) Countries with large construction sectors have smaller VAT gaps suggesting that there may be relatively low levels of VAT losses associated with that sector.
 - (b) National accounts could consistently underestimate the value of economic activity related to the construction sector. This might lead to estimates of gross fixed capital formation that are biased downwards, causing our estimates of the

VAT liability (and gap) to be lower. This bias would be correlated with the size of the construction sector relative to the economy as a whole.

- (c) There could be an error in the assumptions we have used to calculate the VAT gap related to the construction sector.
- 139. It is not possible to test between these alternative theories. To address the risk that b) and c) above is the case, we have re-run our modelling process excluding the gross fixed capital formation variable
- 140. The results of this process show that no variables other than the Corruption Perception Index become statistically significant once the gross fixed capital formation variable is excluded from the regression. The coefficients of the other variables are very similar to those in Table 36.

Conclusions from the econometric analysis of the VAT gap

- 141. This section uses an econometric analysis of the VAT gap share, measured by our topdown analysis, in an attempt at identifying possible causes of differences in the gap between countries and over time.
- 142. If the VAT liability as a proportion of GDP is included as a candidate explanatory variable, then we find that it has a significant positive relationship with the VAT gap. This is in line with the literature on this topic, and with the theory that a higher tax burden should lead to higher levels of evasion.
- 143. However, we have identified a risk that this estimated relationship may be biased by measurement errors in the estimation of the theoretical liability. If this risk is taken into account by using an instrumental variable regression, then there is no statistically significant relationship between the VAT gap share and the VAT liability or the standard VAT rate.
- 144. We do not find reliable statistical evidence of a relationship between the VAT burden and the VAT gap share.
- 145. The variable found to have the strongest relationship with the VAT gap was the Corruption Perceptions Index. The relationship implies that lower perceived corruption is associated with a lower VAT gap share.
- 146. Our analysis has shown that countries where gross capital formation in construction as a proportion of GDP is higher, tend to have a lower VAT gap share. This apparent relationship could be due to errors, either in our method or in the coverage of national accounts.
- 147. Our general-to-specific approach revealed no statistical signs of a relationship between the VAT gap share and many of our other candidate explanatory variables that captured the effects of factors that included the standard VAT rate, income inequality and poverty, size of the country and tourism.



SECTION 4: AN OUTLINE OF THE TOP-DOWN APPROACH

- 148. Our top-down estimate of the VAT gap is based on a comparison of accrued VAT receipts with an estimate of the theoretical VAT net liability that would have arisen had all VAT due been remitted.
- 149. This section outlines the top-down approach we follow to compute the VAT gap and gives an overview of the main data sources used and the main assumptions made. We keep the description set out here brief, and present in other sections a more detailed discussion of the data sources used, of the assumptions and adjustments made and of possible definitions of the VAT gap.

An outline of the top-down approach

- 150. We estimate the VAT gap of a Member State in a given year as the difference between the net theoretical VAT liability associated with the economic activity in that year and the accrued VAT receipts of that Member State in that year.
- 151. The second of these components, accrued VAT revenues, refers to information that is readily available from published sources, namely from Eurostat. Data on VAT receipts obtained from Eurostat are prepared according to ESA 95 rules. These rules require Member States to report revenues on an accrual basis, i.e. the VAT on taxable transactions occurring during the year should be reported as part of that year's revenues, irrespective of when the VAT was actually paid.
- 152. As such, virtually all of the effort in computing a top-down estimate of the VAT gap lies in estimating the net theoretical VAT liability. Most of this section is concerned with this.

Identifying expenditure contributing to net theoretical VAT liability

- 153. In broad terms, the method we have used to calculate the theoretical net VAT liability identifies and measures the categories of expenditure that make a net contribution to the total VAT base, for each Member State and year. The main categories of expenditure that make such a contribution are:
 - (a) final consumption expenditure by households, non-profit institutions serving households (NPISH) and by government on goods and services;
 - (b) intermediate consumption expenditure that attracts irrecoverable VAT, such as expenditure on inputs used in the supply of exempt goods and services; and
 - (c) gross fixed capital formation (GFCF) that attracts irrecoverable VAT, including those that can be allocated to the supply of exempt goods and services, and purchases of valuables on which VAT cannot be reclaimed.
- 154. We do not include expenditure on intermediate consumption on which VAT can be recovered as this expenditure makes no net contribution to the VAT liability.

- 155. Our main source of data on final and intermediate consumption is the set of use tables prepared by each Member State as part of its national accounts and published by Eurostat. These tables report the value of expenditure on final consumption by households, government and NPISH, intermediate consumption by 59 industry groups, total gross capital formation and exports. Each of these consumption categories are further split into 59 product groups that are defined according to the Classification of Products by Activity (CPA).
- 156. Use tables are usually published with a time lag of two or more years, and so we do not have published data for many Member States for more recent years. Where use tables are not available, we estimate them by combining past trends in the pattern of consumption with aggregate consumption data for the recent years. Section 5 describes the approach followed in detail.
- 157. The data we use on GFCF is derived primarily from the national accounts domain of Eurostat. This dataset allows us to distinguish between capital formation by each institutional sector, and in many cases, by broad industry classifications. We supplement these data with information obtained directly from Member States.

We estimate the weighted average VAT rates for the defined product categories

- 158. Goods and services differ with respect to the VAT rate that they attract. This needs to be recognised when estimating the theoretical net VAT liability.
- 159. The use tables report expenditure on 59 product groups defined by the CPA and accordingly, we need to estimate a single VAT rate for each of these 59 groups of products. In many cases, a group contains products that attract different VAT rates. For these mixed product groups, a weighted average rate for the group is estimated based on the relative shares of consumption associated with the products within each group.
- 160. In computing the weighted average rates, we take into account differences in the VAT rates based on who the consumer is. For example, the relative share of consumption that different products within a given CPA group account for will vary depending on whether we are considering consumption by households or by businesses. To compute these weighted average rates, we rely on consumption data from household budget surveys (HBS) and production data from the Structural Business Statistics (SBS) dataset from Eurostat.

Estimating the share of intermediate consumption on which VAT cannot be reclaimed

- 161. Each of the 59 consuming industries for which data are reported in the use tables can recover VAT paid by them on their intermediate consumption to varying extents. The proportion of VAT that can be recovered depends on the nature of their activities, their output and their size. We denote this proportion by *propex*; the value of *propex* is defined at the industry level.
- 162. Some industries will cover a mixture of exempt and non-exempt activities. In this case, we estimate a weighted average *propex* for the industry as a whole.

- 163. National accounts data do not allow us to estimate *propex* directly. Instead, we estimate *propex* to be the proportion of the output of a sector that is exempt. As with the exercise of estimating weighted average VAT rates for product categories, we estimate the *propex* for an industry using data from the HBS and SBS for each Member State. This relies on the crucial assumption that mixed industries are homogenous in their inputs and outputs, i.e. we assume the share of the value of exempt output in total output value is equal to the share of the value of inputs used in the production of exempt output in total input value consumed.
- 164. Data on the relevant categories of expenditure, on the corresponding weighted average VAT rates and on *propex* provide the basis for our estimate of net VAT liability resulting from the consumption of each sector.

We consider a number of further adjustments to the net VAT liability

- 165. To arrive at a final estimate of net theoretical VAT liability we make a series of adjustments to the theoretical liability arising from the expenditure categories mentioned earlier. These adjustments take account of special types of activities that impact on VAT liability. Specifically, we seek to adjust for:
 - (a) the restriction on the right to deduct VAT on business entertainment;
 - (b) the restriction on the right to deduct VAT on the purchase of company cars;
 - (c) the exemption granted to small businesses, those whose level of activity is below the threshold for VAT registration; and
 - (d) "tank tourism" in Luxembourg, accounting for the consumption of road fuel by foreign business users on which VAT is paid in Luxembourg and not recovered later.
- 166. Discussion of these adjustments is provided in Section 7.

The interpretation of the VAT gap

- 167. We obtain our final estimate of total net theoretical VAT liability by aggregating the estimated net VAT liability across all expenditure categories and across all products, subject to the adjustments described above. We subtract from this the VAT revenue in the relevant year to compute our estimate of the VAT gap.
- 168. In theory, the VAT gap, which is the difference between the theoretical VAT liability, — what *should* have been paid — and accrued VAT receipts — what was *actually* collected — could be caused by VAT fraud. However, considerable care should be taken in interpreting these VAT gap estimates.
- 169. While fraud contributes to the VAT gap, it is not the only determinant of the gap. The gap, as defined by the construction of the top-down approach outlined above is a function of many variables, including each of the following items:
 - (a) fraud;



- (b) legal avoidance not captured by our approach;
- (c) unpaid VAT liability due to insolvencies; and
- (d) the accuracy and completeness of national accounts.
- 170. Legal avoidance of VAT liabilities and unpaid liabilities due to insolvencies both contribute to increase the VAT gap. On the other hand, any failure by national accounts to detect and adequately incorporate elements of the shadow economy will lower the estimate of the VAT gap.
- 171. The interplay of these factors means that a high VAT gap could be due to the prevalence of legal avoidance schemes, while a low gap could indicate a lack of completeness in national accounts measuring activity, legal or illegal, in the economy.
- 172. In addition to these complexities, our estimates of the gap are also affected by the assumptions we make in the light of data or other constraints. While some of these assumptions have a limited impact only, others have a considerable impact on the final results. For example, we assume that across the EU, 60 per cent of the proportion of VAT paid by financial institutions on their inputs is recoverable. Modifying this assumption to 25 per cent can have a significant impact on the gap, particularly in Member States where the financial sectors make a relatively large contribution to output.
- 173. To present the impact on the estimated VAT gap of these assumptions in a systematic way, we have tested the sensitivity of our estimates to a set of significant assumptions.



SECTION 5: DATA SOURCES

Final and intermediate expenditure

Use tables are the main source of data on expenditure

- 174. For each Member State, the primary source of data on expenditure is a set of use tables. Use tables report "the use of goods and services by product and by type of use, i.e. as intermediate consumption (by industry), final consumption, gross capital formation or exports."¹² Use tables are typically prepared by national statistical offices and are a key component in preparing national accounts. In principle, across all Member States they are prepared according to the European System of Accounts 95 (ESA 95).¹³ Use tables are available for download from Eurostat.¹⁴
- 175. The data drawn from use tables are at the heart of our approach and so we outline with some care what information these contain.
- 176. The use tables published by Eurostat distinguish between 59 separate product categories; these are reported by the 2-digit Classification of Products by Activity (CPA) codes. An example of one such product category is "Products of agriculture, hunting and related services", CPA code 01.
- 177. A use table identifies the following types of use that can be made of each of the 59 different categories of products:
 - (a) intermediate consumption, by industry;
 - (b) final consumption by households;
 - (c) final consumption by non-profit institution serving households;
 - (d) final consumption by government;
 - (e) gross capital formation (this is often split between gross fixed capital formation, changes in inventories and changes in valuables); and
 - (f) exports.
- 178. For each of the 59 2-digit CPA product categories, a use table breaks down total intermediate consumption into the intermediate consumption by types of industry. Industries are classified by 2-digit NACE rev1.1 codes. There are also 59 such categories of industry. The fact that the number of industry categories is the same as the number of product categories is no coincidence: the two classifications are purposefully aligned to each other. Table 51 in the appendix lists the set of 59 2-digit

¹² ESA 95 paragraph 9.04, accessed from http://circa.europa.eu/irc/dsis/nfaccount/info/data/ESA 95/en/een00438.htm on 3 August 2009.

 ¹³ See http://circa.europa.eu/irc/dsis/nfaccount/info/data/esa95/en/esa95en.htm.htm. Accessed on 3 August 2009.
 ¹⁴ The table can be downloaded in Excel format from

http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/workbooks , accessed on 3 August 2009.

CPA product categories — and therefore of the 59 2-digit NACE rev 1.1 industries — for which the use tables report intermediate and final consumption.

179. For the purpose of estimating the theoretical VAT liability, we are not concerned with all flows of expenditure recorded in a use table. In particular, we are only concerned with expenditure which gives rise to an irrecoverable VAT liability. This includes final consumption on goods or services subject to VAT as well as intermediate consumption and gross capital formation used in the production of exempt products. It excludes, on the other hand, intermediate consumption and gross capital formation that attract recoverable VAT.

The values reported in use tables include non-deductible VAT

- 180. In line with the principles set out in ESA 95, the values reported in use tables are at purchaser's price. That is to say, the value reflects the "price the purchaser actually pays for the products; including any taxes less subsidies on the products (but excluding deductible taxes like VAT on the products)".¹⁵
- 181. It follows from this that if we observe in the use tables that household final consumption on a product category that attracts a VAT rate of 20 per cent was EUR 1,200 million, then we will estimate the theoretical VAT liability associated with this consumption to be EUR 200 million.

Coverage of the publicly available use tables

182. Use tables are not available from Eurostat for all years in the period 2000-2006 and for all Member States as reported in Table 38.

¹⁵ ESA 95 paragraph 3.06, accessed from http://circa.europa.eu/irc/dsis/nfaccount/info/data/esa95/en/een00122.htm. Accessed on 3 August 2009.

Country	Pre-2000	2000	2001	2002	2003	2004	2005	2006
AT	\checkmark	✓	\checkmark	\checkmark	\checkmark	\checkmark		
BE	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
CY								
CZ	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
DE	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
DK	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
EE		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
ES	\checkmark	\checkmark	\checkmark			\checkmark		
FI	\checkmark							
FR	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
GR	\checkmark							
HU	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
IE	\checkmark	\checkmark	\checkmark	\checkmark				
IT	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
LT	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
LU	\checkmark							
LV	\checkmark							
MT		\checkmark	\checkmark					
NL	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
PL	\checkmark	\checkmark		\checkmark	\checkmark			
РТ	\checkmark							
SE	\checkmark							
SI	\checkmark							
SK	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
UK	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark			

Table 38Eurostat use table availability as of 30 June 2008

- 183. No use tables are available for Cyprus, and because of this, Cyprus has been dropped from our analysis. Greece and Latvia have produced use tables for some years before 2000 (1995 through to 1999 for Greece, 1996 and 1998 for Latvia) and we have drawn on these in our analysis.
- 184. We have sought to fill in the gaps in the coverage. We have, in short, predicted use tables for those Member States for years that are not available from Eurostat. We have done so using the use tables that are available and the published national accounts data for more recent years. There were two steps to this exercise. First, the data from the available use tables were used to define a pattern of consumption how consumption by a given industry was shared across 59 product categories and this pattern of consumption was then extrapolated to years for which use data are not available. Second, the pattern of consumption derived was applied to national accounts of the corresponding year to obtain estimates of the value of the relevant consumption.

- 185. It is worth stressing that our approach to filling in the gaps in the use tables does not involve forecasting the absolute values of consumption of any product. Instead, our approach forecasts the pattern of consumption, and applies this to actual total expenditure reported in published national accounts. For example, in Slovakia for 2006, we do not forecast the value of consumption of food; we forecast the share of expenditure on food in total household expenditure from past trends and apply this share to actual total household expenditure for 2006 obtained from Eurostat.
- 186. We now set out in more detail the steps involved in our approach.

Filling in the gaps in the use tables to cover the period 2000-2006

- 187. For each of the use tables that are available for the years since 2000, we computed the share that each of the 59 product categories contribute to the total intermediate consumption of each industry, and, similarly, to total intermediate consumption of a broader set of industries, to total intermediate and final consumption across the whole economy and finally to GDP. We also computed the share that each product category contributed to the total final consumption of households, of non-profit institutions serving households, of government expenditure and to gross capital formation.
- 188. In short, taking each column in the use table in turn, we computed the shares that a given cell in that column contributed to total consumption at various levels of aggregation.
- 189. Taking each of these shares separately, we carried out a simple econometric analysis to predict the value of these shares in each of the years from 2000 to 2006. The analysis consisted of a standard ordinary least squares regression of the share calculated as described above against a variable reflecting time. The number of data points used to run each regression was given by the number of years since 2000 for which use tables are available.
- 190. We used the results of the econometric analysis, namely the predicted values of the regression, to populate the cells in the use tables for each of the Member States in each of the years from 2000 to 2006 that are not held by Eurostat with a value that indicates an estimate of the share that each product category contributes towards a given class of consumption.
- 191. We combined our estimates of these shares with data from the national accounts domain of Eurostat. The national accounts domain reports aggregate values of intermediate consumption by some industry classification, of final consumption split by households, NPISH and government, and of gross fixed capital formation. The level of aggregation at which each of these types of consumption is reported varies across Member States:
 - (a) For some Member States, intermediate consumption is broken down by NACE rev 1.1 classification sub-sections, e.g. it reports the total value of intermediate consumption of, say, "DA 15 – Manufacture of food products, beverages and tobacco".

- (b) For a few Member States, intermediate consumption is broken down at the level of NACE rev 1.1 classification sections, e.g. it reports the total value of intermediate consumption of, say, "D Manufacturing".
- (c) Final consumption is broken down by final consumption by households, by NPISH and by government, though for some Member States the first two are grouped together.
- (d) Gross capital formation is presented as a single figure, i.e. not broken down at all by households, NPISH or government. We discuss gross capital formation further below.
- 192. Depending on the level of aggregation at which data are available for a Member State, we applied the forecasted share corresponding to that level of aggregation, giving preference to shares computed on the basis of the most disaggregated total.
- 193. To illustrate the mechanics of this procedure we give a worked example below
- 194. Consider the intermediate consumption by the industry defined as "DA15 Manufacture of food products and beverages" (DA15 for short) of the products classified as "01 Products of agriculture, hunting and related services". Austrian use tables are available for 2000, 2001, 2002, 2003 and 2004, and a value for the consumption of those products by DA15 is reported for each of these years. The purpose of the extrapolation exercise is to estimate what this value would be for 2005 and 2006. This exercise involves the steps outlined above, more specifically:
 - (a) Drawing on the Austrian use tables for 2000, 2001, 2002, 2003 and 2004, we compute the share formed by CPA 01 "Products of agriculture, hunting and related services" in each of the years of each of the following:
 - (i) the intermediate consumption of the broader manufacturing sub-section DA (which also includes DA16 Manufacture of tobacco products);
 - (ii) the intermediate consumption by manufacturing section D (covering all manufacturing);
 - (iii) all intermediate consumption in the economy; and
 - (iv) gross domestic product of the economy.
 - (b) Taking each of these time series in turn, we ran an OLS regression to obtain predicted values of the relevant shares for 2005 and 2006.
 - (c) Data from the Eurostat national accounts domain reveal that data on total intermediate consumption by sub-section DA, which combines "DA15 – Manufacture of food products and beverages" and "DA16 – Manufacture of tobacco products", for 2005 and 2006 are available. This is the most disaggregate level at which such data are available.

- (d) Finally, we multiply the appropriate predicted share described in (b) by the total intermediate consumption by DA 15 in 2005 and 2006 to obtain an estimate of the intermediate consumption of "01 Products of agriculture, hunting and related services" by DA15.
- 195. For Greece and Latvia, the predicted value of the shares in the years 2000-2006 were estimated on the basis of use tables for 1995-1999, and 1997 and 1999 respectively, the most recent years for which use tables are available for these Member States. No use tables are available at all for Cyprus and, as such, this Member State was not included in our analysis.
- 196. For Ireland and Poland, we have needed to modify our approach slightly. As shown in Table 41, use tables for Ireland are only available for 2000-2002 and in the case of Poland, for 2000, 2002 and 2003; data for Poland in 2001 are missing. A detailed visual inspection of the forecasted numbers has uncovered oddities in the data for these two countries. For example in Poland, household final consumption of CPA "95 Products of private households" jumps from PLN 5 million in 2000 to PLN 5,182 million in 2002. In Ireland, household consumption of CPA "34 Motor vehicles, trailers and semi-trailers" falls from EUR 2,569 million in 2000 to EUR 2,142 in 2001. Extending these trends to 2006 would result in obtaining either absurdly high or low numbers.
- 197. We have no reason to doubt that the numbers reported in the use tables of these two Member States accurately reflect consumption patterns in these countries. Rather, the need to revise our method for these Member States reflects the weakness of our forecasting method, namely the assumption that the trend observed over the sample period is a good indicator of the trend expected in the remaining years to 2006. Consequently, for Ireland and Poland, rather than predict shares based on a trend over time, we have computed the average share over the years for which we have data and used that share to predict future values of consumption by combining these with actual aggregate consumption data from the national accounts to 2006. For Malta, where use tables are available for only two years, we did not compute a time trend; instead we used an average of the relevant shares.
- 198. By combining our predicted value of the shares and the data from Eurostat national accounts we are able to improve considerably the coverage of our exercise. However, this method of forecasting relies crucially on the relative consumption patterns of industry groups following a predictable path based on past trends. We recognise this inherent weakness in our estimates for more recent years.

Gross fixed capital formation

199. The use tables report the value of gross fixed capital formation (GFCF) associated with each of the 59 2-digit CPA level product categories. The tables do not report, however, how this aggregate GFCF figure is broken down by the industries that are carrying out the capital formation. That is to say, we know what type of capital is being formed but not by whom. For the purposes of estimating the net VAT liability base this matters as it is only the GFCF carried out by exempt persons that contributes

to the theoretical net VAT liability. We have turned to other data sources to address this.

- (a) Eurostat's national accounts domain gives a breakdown of the GFCF by institutional sectors: households, non-financial corporations, financial corporation, NPISH and government. These data report who is carrying out the capital formation but gives no information on the type of assets associated with it These data are annual and coverage is reasonably good for the period 2000-2006, though for some Member States and for some years (e.g. Hungary, Malta, Luxembourg) a breakdown is not given for all institutional sectors.
- (b) Eurostat's national accounts domain also gives a breakdown of the GFCF in a given Member State carried out by each of the 31 branches of NACE. It does not, however, identify the types of assets with which the GFCF is associated with. Coverage of this dataset is reasonably good.
- (c) We have compiled data on GFCF from national sources that are generally produced within the context of national accounts. We have contacted the statistics offices of all Member States with requests for GFCF data broken down by institutional sector and by type of asset simultaneously. The availability and fineness of the data made available to us vary considerably across Member States. The UK, for example, published a breakdown of GFCF by industry and by asset type for each of the years in the period 2000-2004 (though not in more recent years) and a further breakdown of GFCF by type of asset and by institutional sector. Most Member States do not make such detailed data available.
- 200. The difference in the fineness of GFCF data available from national sources and the differences in the VAT legislation across Member States impact on the assumptions that are needed to estimate the contribution of GFCF to the theoretical net VAT liability. Section 6 spells these out.

An outline of the approach to identify net VAT liability associated with GFCF

- 201. We have estimated the net VAT liability associated with GFCF by estimating the GFCF carried out by households, non-profit institutions serving households (NPISH), financial corporations, general government; and exempt non-financial corporations. To estimate the contribution to the theoretical net VAT liability associated with GFCF of each of these groups, we:
 - (a) Identify the groups of product for which the estimated weighted average VAT was not the standard rate and for which the use tables recorded some positive amount of GFCF in the economy.
 - (b) Estimate the GFCF carried out by each of the institutional sectors for each of these groups of products.
 - (c) Attribute the difference between a sector's total GFCF and the GFCF relating to products attracting the intermediate or reduced rate to GFCF associated with products attracting the standard VAT rate.

VAT rates

- 202. To estimate the theoretical net VAT liability, it is necessary to match each of the expenditure numbers to the corresponding VAT rate. As we draw on use tables for data on expenditure, and because the data on expenditure are reported at the level of 2-digit CPA product categories, it is necessary to estimate a weighted average VAT rate to be applied to the consumption of each of the 2-digit CPA products.
- 203. In many cases, the 2-digit CPA code is broader than the level at which VAT rates are defined. For example, the group "15 Food products and beverages" consist of processed food items, alcoholic beverages and non-alcoholic beverages. The applicable VAT rates applicable are frequently different for food and for alcoholic beverages. Because of this, it is necessary to estimate a weighted average VAT rate to set against this category of products. We do so by:
 - (a) Identifying the VAT rate applicable on the consumption of goods and services defined at the lower, narrower, 4-digit CPA level.
 - (b) Applying appropriate weights to these rates to estimate a weighted VAT rate at the broader 2-digit CPA level.
- 204. Taking the products of the 2-digit CPA food and beverages sector as an example, Table 39 illustrates the added "fineness" obtained by carrying out the first step of the exercise at the 4-digit CPA level.



15.11	Fresh and preserved meat, except poultry
15.12	Fresh and preserved poultry meat
15.13	Meat and poultry meat products
15.2	Processed and preserved fish and fish products
15.31	Processed and preserved potatoes
15.32	Fruit and vegetable juices
15.33	Processed and preserved fruit and vegetables n.e.c.
15.41	Crude oils and fats
15.42	Refined oils and fats
15.43	Margarine and similar edible fats
15.51	Dairy products
15.52	Ice cream and other edible ice
15.61	Grain mill products
15.62	Starches and starch products
15.71	Prepared animal feeds for farm animals
15.72	Prepared pet food
15.81	Bread, fresh pastry goods and cakes
15.82	Rusks and biscuits; preserved pastry goods and cakes
15.83	Sugar
15.84	Cocoa; chocolate and sugar confectionery
15.85	Macaroni, noodles, couscous and similar farinaceous products
15.86	Coffee and tea
15.87	Condiments and seasonings
15.88	Homogenized food preparations and dietetic food
15.89	Other food products n.e.c.
15.91	Distilled alcoholic beverages
15.92	Ethyl alcohol
15.93	Wines
15.94	Cider and other fruit wines
15.95	Other non-distilled fermented beverages
15.96	Beer made from malt
15.97	Malt
15.98	Mineral waters and soft drinks

Table 39Breakdown of "CPA 15 – Manufacture of food and beverages".

205. In assigning a VAT rate for each of the 4-digit CPA products, we have distinguished between the VAT that would be applicable if the product were to be consumed by households, by the healthcare sector, by the education sector, by other government activities and if it were to be consumed by any other party. These distinctions will matter in cases where legislation envisages that the applicable VAT rate depends on who is doing the consumption. The distinction also matters in those cases where we believe that there are important differences between the groups listed above in relation

to how their consumption of products within a given 4-digit CPA category is distributed and that these different products attract different VAT rates.

- 206. We assigned a VAT rate for each of the 4-digit CPA products, in each Member State and for each year from 2000-2006 on the basis of information collected primarily from:
 - (a) the "Value added taxation in Europe" publication of the International Bureau of Fiscal Documentation;
 - (b) national VAT legislation; and
 - (c) various editions of the Commission document "VAT rates applied in the Member States of the European Community" published over the period 2000-2007.
- 207. While it is more straightforward to assign a single VAT rate to a set of products defined at the 4-digit CPA products rather than at the broader 2-digit level, an element of judgment remains. For example, in the UK, chocolate covered biscuits are standard rated, in contrast to food products in general which are reduced rated. The 4-digit CPA code does not allow us to uniquely identify chocolate covered biscuits, only that they are probably part of "15.84 Cocoa, chocolate and sugar confectionary". In most cases, we have not found a source of information that would allow us to construct weights at a level below the 4-digit CPA level. Where this is the case, we make an assumption based on our view of the likely contribution that a particular product makes to the overall consumption of the 4-digit CPA sector.
- 208. To estimate the weighted VAT rate at the 2-digit CPA level, the VAT rates at the 4digit CPA level are weighted according to the contribution of the products to the higher 2-digit CPA level. In most instances, we have constructed these weights on the basis of data from the more recent Household Budget Surveys of each Member State, where available, and have otherwise used data from Structural Business Statistics reported by Eurostat.

VAT receipts

- 209. The data outlined above all contribute to the estimation of the theoretical net VAT liability. To compute an estimation of the VAT gap, it is necessary to compare the estimate of that liability with the levels of VAT receipts that were actually accrued in the relevant year.
- 210. We have obtained data on these VAT receipts from Eurostat. According to paragraphs 1.57 and 4.26 of ESA 95, tax receipts are to be reported on an accruals basis, although they are collected on a cash basis. Council Regulation 2516/2000 details the rules to be followed on the timing of recording and the amounts to be recorded according to the accrual method.
- 211. The regulation allows for two ways in which to prepare data on accrued receipts:

- (a) A time-adjusted cash method, where cash received is attributed to the period when the activity took place; this is generally based on the typical time difference between when the activity took place and when the cash is received.
- (b) A method based on declarations and assessments and adjusted for amounts that are declared or assessed but unlikely to be collected.
- 212. We were informed by Eurostat that the data on accrued VAT receipts prepared by most Member States are based on the time-adjusted cash method. The reporting of the VAT receipts on an accruals basis fits in with the purpose we have at hand: we wish to compare the net VAT liability arising from the economic transactions taking place in a given year as estimated on the basis of the use tables and other sources with the VAT receipts accrued in that same year.
- 213. Eurostat data on accrued receipts are reported net of input VAT refunds to VATregistered bodies eligible to recover their input VAT. However, this does not apply to refunds that operate outside the scope of the VAT system. For example, in the UK, local authorities can claim a refund of VAT incurred on the purchase by them of contracted-out services. This refund operates outside the scope of the VAT system and, as such, we have assumed that Eurostat data on VAT receipts are reported gross of these refunds.



SECTION 6: ASSUMPTIONS

- 214. This section reviews the assumptions that our top-down analysis draws on. We focus on the set of assumptions that, in general, are common to the analysis carried out for each Member State.
- 215. Assumptions are needed to bridge the gap between the intricacies of the VAT system and the fineness of available national accounts data. The top-down approach attempts to identify all those supplies of products which give rise to a net VAT liability in a given year in a particular Member State. The approach cannot hope to arrive at a precise measurement of this liability. The impossibility of doing so stems from the fact that data are not available to us, and indeed do not exist at all, that would allow all intricacies of the VAT systems to be picked up.
- 216. An exercise of judgement is necessary to identify to what level of detail one should carry out the analysis in order to ensure that those aspects of the VAT legislation that are likely to have a material impact on VAT liability are adequately captured. We have had to make a number of simplifying assumptions. We have aimed to strike the right balance between the need to be as accurate as possible, the availability of data and the time constraints of the study.

Completeness of national accounts

217. We assume national accounts are complete in the sense that they capture all economic activity, including the shadow economy. ESA 95 requires this to be the case but they do not spell out the method statistics offices should follow. Our assumption is that the method that is followed be each statistics office, whatever it might be, is one that adequately captures the shadow economy.

Proportion of intermediate consumption on which VAT is not recoverable

218. We set out below the assumptions we make to determine the proportion of intermediate consumption on which VAT is not recoverable. We denote this parameter as *propex*. We first set out the assumption made in relation to estimating *propex* for industries in general, and then set out the assumptions that we make for the purpose of determining *propex* for some particular cases, namely for financial intermediation, for the education sector and for rental activities.

The general case

- 219. One component of our top-down method is the estimation of the proportion of the intermediate consumption by various industries that attracts irrecoverable VAT. With a few exceptions such as company cars and entertainment which we will deal with separately, this corresponds to the proportion of intermediate consumption used in the production of exempt goods and services. This concept is best explained by an example.
- 220. Consider the consumption, in Austria in 2003, by the 2-digit NACE sector "I.64 Post and telecommunications" (I.64) of the products belonging to "CPA 22 Printed matter and recording media" which was approximately EUR138 million.

- 221. In Austria, as in other Member States, the activities relating to national post are exempt whilst activities relating to telecommunications are not. The activities of the national post are classified under the NACE code I.64.11. This sector, in turn, is a part of I.64. Clearly, some proportion of the consumption of "CPA 22 Printed matter and recording media" by the I.64 sector relates to the production of national post activities. It is this proportion of consumption by the I.64 industry that contributes to the VAT base, and which, therefore, we have to estimate.
- 222. We have attempted to estimate the value of *propex* for each of the consuming industries of the use table. In some cases, like household final consumption, *propex* will be equal to 1 as the entire consumption of this sector makes a contribution to the net VAT base. In other cases, such as when considering I.64 as a consuming sector, this number needs to be estimated. We estimate this number by setting it equal to the proportion of the value of output on national post out of the value of total output of the aggregate I.64 2-digit sector.
- 223. There is an implicit assumption behind this method: in particular, it is assumed that the share of output within a 2-digit NACE sector reflects the share of inputs used to produce that set of goods.
- 224. We use this method to compute *propex* for all exempt activities, with the exception of the financial services sector, the education sector and the rental sector. Our approach to devising a value for the *propex* parameter for these three sectors is described separately below.
- 225. We should also note that for sectors other than that classified in NACE as "J. Financial intermediation", discussed below, we assume that the intermediate consumption recorded in the use tables relates to transactions outside VAT groups. We think this is a reasonable assumption for those sectors whose intermediate consumption contributes to the net theoretical VAT liability.

Financial intermediation

- 226. In general, most activities that fall within the NACE group "J. Financial intermediation" are exempt in all Member States. However, a few Member States allow some financial services firms to "opt to tax", thereby waiving their exempt status and reclaiming some of their input VAT.
- 227. A further source of complexity relates to the treatment of "VAT groups", a matter which, for the purpose of this study, impacts on firms in the financial sector in particular. The issue raised by VAT groupings relates to the practice of allowing separate entities to be treated, for VAT purposes, as a single entity thereby not charging VAT on transactions between them. The use tables do not allow us to estimate the precise numbers that relate to "within VAT group" as opposed to "outside VAT group" transactions.
- 228. We have not found alternative sources to estimate *propex* as the actual proportion of irrecoverable VAT paid by financial service firms tends to be confidential and is not usually published.

Section 6: Assumptions

229. This lack of information, coupled with the relatively large sums of VAT revenue involved, means we have needed to make an important assumption. A report published by the European Commission provides the results of a survey carried out of financial services firms across the EU.¹⁶ This survey reports a range of 0 to 74 per cent for the proportion of VAT that is actually recovered. We have settled on an assumption across the EU that 40 per cent of VAT is recovered. We have tested the sensitivity of the overall VAT gap to this assumption; the results are presented in Section 2.

Education sector

- 230. In general, the activities of the sectors classified in NACE as "M.80 Education", are exempt across the EU as far as they relate to primary, secondary and university education. However, services such as the provision of professional training and of driving lessons are generally subject to VAT and these too are part of the category "M.80 Education". We think that the supply of these education services that are subject to VAT account for a significant share of the output of the wider "M.80 Education". In the light of this, it is necessary to form an estimate of the *propex* associated with the "M.80 Education" sector.
- 231. We have not come across published data that would allow us to compute the value of the "propex" for "M.80 Education" directly. We do, however, have data on the final consumption of education services by the government and by NPISH, and we also have data on the intermediate consumption by other industries of education services. By making the rough assumption that all government and NPISH consumption of education services relate to exempt education and that all intermediate consumption by other industries and direct consumption by households relate to "market" education services that are subject to VAT, we have arrived at an EU-wide assumption that 20 per cent of the input VAT of "M.80 Education" is recoverable. We have tested the sensitivity of the overall VAT gap to this assumption; the results are presented in Section 2.

Rental activities and the option to tax

- 232. Letting and leasing activities of immovable property is generally exempt with an option to tax, if the lessor chooses. Where that is the case, we have assumed that the lessor would choose to remain exempt when the lessee or tenant is an exempt entity, for example households. Likewise, we assume that the lessor would opt to tax where the lessee or tenant is a business that can recover its input VAT.
- 233. We have computed the proportion of intermediate inputs of the rental sector that gives rise to irrecoverable VAT to be equal to the share of the final consumption by households, government and NPISH and intermediate consumption by financial services, education and healthcare in the total output of the rental sector. We have

¹⁶ Report prepared on behalf of DG TAXUD, available from

http://ec.europa.eu/taxation_customs/resources/documents/common/publications/studies/Financial_Services_Study_Main Report_en.pdf, accessed on 3 August 2009.

deducted imputed rents from both the numerator and denominator. Data on imputed rents are available from Eurostat.

Interpreting the data on final consumption

234. We turn to a discussion of assumptions made in the use of data on final consumption expenditure by households, NPISH and government. These assumptions are restatements of some of the guidelines of ESA 95 and, as such, these assumptions are subsumed within the earlier assumption that national accounts are prepared in accordance with ESA 95. All the same, we choose to set them out here explicitly.

Purchases on the domestic territory by non-residents and by national residents abroad

235. In line with ESA 95 guidelines, we assume that the data reported in the use tables under "Final consumption by households" include the value of purchases made in the domestic territory, by both residents and non-residents, and exclude purchases made by residents abroad. As an example, it is assumed that expenditure by French tourists staying in a hotel in Malta is included in the Maltese use tables under "Final consumption by households" on the product category "H55 Hotels and restaurant services".

Purchase of goods by mail-order

- 236. We assume that mail-order goods sold to final consumers based in the EU by a supplier based in another EU Member State are recorded as household consumption in the Member State where the supplier is based.
- 237. On the other hand, our estimation assumes that if the mail-order goods are purchased from a supplier that is outside the EU then that purchase is reflected in the household consumption of the Member State where the consumer is located.

Purchase of e-services

- 238. We assume that purchases of e-services by consumers based in the EU are recorded as household final consumption in the use tables of the Member State in which the e-service provider is registered for VAT purposes. For example, the purchases of e-services by a Danish resident from a provider registered for VAT in Luxembourg are assumed to be included in the value of household final expenditure reported in the Luxembourg use tables and not in the Danish ones.
- 239. If a supplier of e-services is in a country outside the EU and is not registered for VAT in any Member State, we assume that the VAT it remits to a single tax authority under the simplified scheme, is allocated appropriately to each Member State and that the associated consumption values are recorded by those Member States in their use tables.

Final consumption by households on alcohol and tobacco is accurately reported

240. The data on household final consumption reported in use tables are based, in part, on household budget surveys. It is known that in such surveys, consumption of goods

such as alcohol and tobacco tends to be significantly under-reported, and that adjustments are made to this as a correction.

- 241. We assume that the data reported in the use tables for household final consumption of products relating to "D15 Food products and beverages", which include alcoholic drinks, and to "D16 Tobacco products" reflect the consumption of these products accurately so that any corrections for under-reporting and smuggling will have been made. This is in keeping with the ESA 95 guidelines.
- 242. Consistent with our definition of tax losses, we assume that the VAT lost on the consumption of illicit alcohol or tobacco, is the VAT that would have been paid, had the same amount of money been spent on legal excise duty-paid tobacco or alcohol.

Gross capital formation

243. ESA 95 defines gross capital formation (GCF) as gross fixed capital formation (GFCF) plus changes in inventories plus net acquisitions of valuables. GFCF is by far the more significant component of GCF. In this subsection we turn to a review of assumptions relating to the contribution of each of these components to the net theoretical VAT liability.

We do not consider changes in inventories

- 244. The purchase of products underlying any recorded change in inventory would, if carried out by a party unable to reclaim VAT, make a contribution towards the net VAT liability. However, in our analysis we have not considered this contribution. This choice is grounded on the following reasoning:
 - (a) We have not found published data that allow us to break down changes in inventory by both type of asset and by type of consuming industry. The use tables published by Eurostat report a single economy-wide number for the change in inventory associated with a given product category; information on whose inventory it is that is changing is not provided and, consequently, we are unable to isolate the changes in inventory carried out by parties that cannot reclaim VAT.
 - (b) Our judgement is that stocks are by far more likely to be held by businesses that are not exempt rather than by exempt ones. That is to say, we expect inventories, and changes in inventories, held by public administration, health and education institutions and financial corporations to account for a very small share of the changes in inventories in the economy as a whole.
 - (c) Typically, changes in inventories of a given product category account for a small share of the total intermediate consumption across the economy of that product category and, accordingly we think the impact on the estimated net theoretical VAT liability to be small.
- 245. The direction of the (relatively small) error in our estimate caused by not taking account of the changes in inventories carried out by exempt sectors will depend on whether the observed change in inventory is positive or negative. If, in a given year

the change in the inventories held by an exempt sector of a given product category is positive then, by not taking account of changes in inventories, we will be underestimating the theoretical VAT liability. Conversely, we would be overestimating the liability when the observed change in inventory is negative. Because changes in inventories fluctuate between being positive and negative with no clear trend, and because these magnitudes are relatively small, we do not expect that our approach induces us in any consistently significant under- or over-estimation of the net theoretical VAT liability.

We consider changes in valuables

- 246. As noted above, changes in valuables (ESA 95 code P.53) are one of the components of GCF. Valuables are defined at paragraph 3.125 of the ESA 95 manual as "non-financial goods that are not used primarily for production or consumption, do not deteriorate (physically) over time under normal conditions and that are acquired and held primarily as stores of value." Valuables include precious stones and metals, precious jewellery, pearls, antiques and art objects such as paintings and sculptures. We note that agent or dealer margins associated with the acquisition and disposal of valuables will contribute to the value recorded against changes in valuables.
- 247. The data in the use tables reported by Eurostat, and in published national accounts more generally, break down the changes in valuable by type of assets but not by the type of industry that is acquiring and disposing of these valuables. All the same, we do take account of the changes in valuables for the purpose of estimating the theoretical net VAT liability as we think that it is reasonable to assume that the VAT paid on these acquisitions of valuables cannot be reclaimed.
- 248. In estimating the contribution to the theoretical net VAT liability we have set against the reported value of changes in values the standard VAT rate relevant to the Member State and year under consideration.
- 249. Finally, we note that some Member States do not report changes in valuables separately and, instead, include this within the figures for GFCF.

A general assumption on the data on GFCF

- 250. The figures for GFCF reported in national accounts represent net flows. That is to say, they represent the difference between acquisitions and disposals of fixed capital goods. This raises a difficulty in identifying the value of transactions that may give rise to a VAT liability.
- 251. To see this, consider the case where the institutional sector defined as "government" sells EUR 1 million worth of existing office buildings to "non-financial corporations", and invests in EUR 11 million worth of new buildings. In the sector accounts reported in national accounts, in relation to office buildings, the government account would report a GFCF of EUR 10 million, and the account of the "non-financial corporations" would report EUR 1 million. The acquisition of existing buildings by businesses would not attract VAT, as they would be second-hand goods. However, we have computed the VAT liability on the GFCF of EUR 10 million in buildings the data recorded in national accounts rather than on the EUR 11 million.

- 252. On the other hand, we would not be able to distinguish between the purchase by the government of an existing building previously owned by a "non-financial corporations" and the acquisition by the government of a new building. Both expenditures would have the same impact on the government's GFCF account.
- 253. We would have problems of a similar nature when dealing with Member States where a significant number of residential dwellings have been transferred from the Government to private non-financial corporations.
- 254. To correct this it would be necessary to access GFCF data that report acquisitions and disposals of capital separately and that identify the sectors between which capital is acquired from or disposed to. We have not found such data in published national accounts. We have therefore been unable to estimate the impact on our calculation of the net theoretical VAT liability of considering net GFCF rather than separating out the acquisition and disposal of capital of each of the institutional sectors. In this respect, we think our VAT liability estimate related to GFCF might be lower than it should be.

Set of assumptions on the contribution to VAT liability from GFCF that are common across Member States

255. The differences in the nature of the data on GFCF available across Member States, as well as the differences across national VAT legislation, do not allow us to follow the exact same procedure across Member States when estimating the contribution of GFCF to net theoretical VAT liability. But there are a number of assumptions that we do make which are common across all or most of the Member States. We set these out below.

1: GFCF associated with agricultural, forestry and fishing products are assumed not to attract VAT

- 256. Across all Member States the use tables report some positive value for the GFCF associated with products of agriculture, forestry and fishing (corresponding to the 2-digit CPA product categories codes "A.1 Products of agriculture, hunting and related services", "A.2 Products of forestry, logging and related services" and "B.5 Fish and other fishing products; services incidental of fishing" respectively). We assume that the GFCF associated with these products do not reflect the supply of products on which VAT would be applied.
- 257. The assumption is based on our view that the GFCF associated with these products is likely to reflect the increase in the value of existing cultivated assets (orchards, forest trees, herds of cattle, flocks of sheep, shoals of fish used in fish farming) rather than the creation of new forms of capital that will have been acquired from other sectors. ESA 95 specifies that GFCF should incorporate changes in the value of such cultivated assets. Admittedly, positive values of the GFCF associated with these product categories could also come about through the importation of these types of fixed capital. Our assumption is that GFCF through the development of existing domestic capital of this sort is likely to account for a far greater proportion of total GFCF than that driven by imports.

258. In turn, the increase in the value of an existing orchard, herd of animals or shoal of fish used for production do not reflect any economic supply and so would not attract any VAT and therefore does not contribute to net VAT liability.

2: GFCF associated with medical equipment

- 259. Medical equipment attracts a reduced or intermediary VAT rate in many, though not all Member States, and some of the GFCF recorded against the product category "DL33 Medical, precision and optical instruments, watches and clocks" relate precisely to such medical equipment. Further, we expect that a significant fraction of the GFCF associated with medical equipment is carried out by parties, namely providers of health services, that are VAT exempt. Because of this, it is necessary to estimate the portion of GFCF associated with the purchase of these types of assets.
- 260. The use tables available from Eurostat do not allow us to do this directly; medical equipment is part of the wider 2-digit CPA product category "DL33 Medical, precision and optical instruments, watches and clocks" and it is the total GFCF on this set of products that is reported. However, more detailed national accounts for the UK and for France provide us with information on:
 - (a) For the UK for 2000-2004, the GFCF associated with the purchase of assets in the product category DL33 by the industry categorised as "hospitals and health care".
 - (b) For France for 2000 and 2001, the GFCF associated with the purchase of assets classified as "Fabrication de materiel medico_chirurgic" by "Le secteur des Administrations publiques" (APU).
- 261. We think it is reasonable to assume that the data described above for the UK and France relate to the purchase of medical equipment and instruments by hospitals and health care providers. For the remaining Member States, for which we have been unable to find similarly detailed data, we estimate the value of the GFCF on medical equipment by hospitals and health care providers as follows:
 - (a) Using the data available for France and the UK, we compute the ratio of the GFCF on medical instruments by hospitals and health care providers to the value added by the health and social work sector (NACE code N) as reported in the Eurostat use tables. We then compute an average of this ratio across these two Member States for the years for which data are available.
 - (b) For each of the other Member States and for each of the years in the period 2000-2006, we estimate the value of GFCF associated with the purchase of medical equipments by hospitals and health care providers by multiplying the average ratio described above by the value added of the health and social work sector as reported in the relevant use table.
- 262. The approach outlined assumes that ratio between GFCF on medical equipment by hospitals and health care providers and the value added associated with health and social care is (approximately) common across Member States.

3: GFCF associated with dwellings and other buildings

- 263. GFCF associated with dwellings is a substantial component of the GFCF on which VAT sticks. The VAT legislation on transactions that relate to GFCF in dwellings tends to be particularly complex in many Member States. For example, a different rate applies to the renovation of dwellings in Belgium depending on the age of the dwelling, and in Italy the VAT rate on the purchase of new dwellings depends on whether it is a first or second home, luxury or not.
- 264. Lack of relevant data does not allow us to examine these and all other intricacies of the relevant VAT law. We attempt, however, to distinguish between, on the one hand investments in new dwellings, and on the other, expenditure on major improvements to existing dwellings. Both of these expenditures contribute to GFCF associated with dwellings and, in some Member States, these two types of supply attract different VAT rates.
- 265. We have contacted the national statistics offices of those Member States for which the split between the two types of GFCF on dwellings is relevant to our analysis with requests for data that would allow us to compute the relevant ratio. Some Member States were able to provide us with these data.
- 266. For those Member States for which relevant data are not available to us, we assume that of the total GFCF in dwellings, half relates to investment in new buildings and half to major improvements in existing buildings. This assumption is broadly based on figures for this share for the UK where the split was estimated to be 42 per cent on new dwellings and 58 per cent on major improvements and for France where the split over the period 1990-2000 is close to 50 per cent for each component.
- 267. We make this assumption in the estimate of the net theoretical VAT liability of those Member States where, on our interpretation, the VAT rate applicable on investment in new dwellings differs from that applicable to major improvements to existing dwellings and for which we do not have national data that might have provided a more precise estimate of the split.
- 268. In most Member States the supply of existing buildings buildings that are not newly built does not attract VAT, but in some (e.g. Italy) it does. We have not taken this contribution to VAT liability into account in our analysis as we do not have the data to identify the value of such transfers. We note that the supply of non new buildings do not contribute to gross fixed capital formation figures in national accounts, other than through the transfer costs that they originate (such costs we have taken into account).
- 269. Given the significance of GFCF on dwellings, we examine the sensitivity of our estimate of the overall VAT gap to the assumptions on how GFCF on dwellings is split between the two categories considered. The results are presented in Section 2.



Section 6: Assumptions

4: We have sought to take account of other taxes on transfer of real property

- 270. Taxes on the transfer of real property (stamp duty) are considered to contribute towards GFCF. Such taxes do not attract VAT, and it is necessary, therefore, to exclude these amounts from the GFCF figure before applying the relevant VAT rate.
- 271. We are not able to identify the relevant tax head for some Member States, namely Estonia, Hungary, Lithuania, Luxembourg, Latvia and Malta. We are also aware that stamp duty may also apply to the transfer of goods other than the transfer of real property; where that is so, and where data relating to stamp duty on real property alone is not separately identified, we may have deducted an excessive amount.
- 272. For the purpose of our analysis, it is necessary to apportion the receipts relating to taxes on transfer of real property across the relevant consuming sectors/industries. This is usually done on the basis of the GFCF associated with new dwellings and other buildings carried out by each sector/industry (where such information was available) or on the basis of each sector/industry's GFCF on construction more generally.



SECTION 7: ADJUSTMENTS

- 273. In this section we describe a number of adjustments we use for the purpose of capturing particular aspects of the VAT system which impact on estimates of the theoretical net VAT liability. These adjustments relate to business entertainment expenditure, company cars, "tank tourism" in Luxembourg and exemption granted to small business.
- 274. We also identify in this section a small number of features for which we make no adjustment.

Business entertainment expenditure

- 275. In general, across the EU, the VAT on expenditure incurred by businesses on entertainment is subject to restrictions on the right of deduction, even if the business is not engaged in an exempt activity. We have not come across any data sources that allow us to estimate this expenditure.
- 276. These restrictions may make a significant contribution theoretical VAT liability. To account approximately for them we assume that the VAT on all intermediate consumption of the product category "H.55 Hotels and restaurant services" is irrecoverable. We exclude from this, self-supplies to the industry "H.55 Hotels and restaurants", to the sector "I.63 Supporting and auxiliary transport activities; activities of travel agencies" and consumption by exempt sectors which we account for elsewhere.

Company cars

- 277. In general, across the EU, some restrictions apply to the right to deduction on VAT incurred on the purchase of company cars. The scope and extent of these restrictions vary considerably across Member States. The restrictions depend not only on who is making the purchase but also on the nature of use.
- 278. We have not been able to find published data sources on the precise proportion of VAT incurred on such expenditure that is recoverable in any Member State. In the absence of this data, we are compelled to make a very rough assumption. We assume that, across the EU, an amount equivalent to 50 per cent of the total gross fixed capital formation (acquisitions less disposals) in the economy on products of the sector "DM34 Motor vehicles, trailers and semi-trailers" is subject to the restriction on the right to deduct input VAT.
- 279. We test the sensitivity of the overall gap estimates to this assumption and the results are presented in Section 2.

"Tank tourism"

280. "Tank tourism" refers to the practice of foreign haulage and transport businesses filling up their trucks in a Member State to take advantage of less expensive fuel there.

Section 7: Adjustments

- 281. "Tank tourism" is a significant activity in Luxembourg. A significant share of petrol and diesel sold in Luxembourg is accounted for by the consumption of foreign vehicles. It is estimated that in 2006, around 80 per cent of diesel and 70 per cent of gasoline sold in Luxembourg was in fact "exported.¹⁷ Other than possible logistical reasons, the low price of fuel in Luxembourg relative to those in neighbouring countries will have been an important factor behind this. From 2000 to 2006 prices at the pump for automotive diesel were, on average, around 30 per cent higher in Germany than in Luxembourg, in the Netherlands and France they were around 25 per cent higher and in Belgium 16 per cent.¹⁸
- 282. Technically, the consumption of fuel in Luxembourg by private cars from other Member States should count as household consumption and should be presented as part of household consumption in Luxembourg. We assume that this is indeed the case and that there is therefore no need for a special adjustment in this regard.
- 283. Consumption of fuel by business vehicles from other Member States, on the other hand, count as exports from Luxembourg, and should be treated as such by the Luxembourg use tables. Such consumption attracts VAT in Luxembourg. In theory, businesses registered in other Member States can apply for a refund of the VAT paid in Luxembourg. We have no information on what portion of this VAT goes unclaimed. We assume that all exports of the products related to "DF23 Manufacture of coke, refined petroleum products and nuclear fuel" are subject to Luxembourg VAT that is not refunded. This assumption potentially overstates the VAT liability arising from "tank tourism" in Luxembourg. We do not make this adjustment for any other Member State.
- 284. We test the sensitivity of our assumption on the VAT gap for Luxembourg and we present the results in Section 2.

Exemption granted to small businesses

285. The VAT Directive allows Member States to exempt taxable persons whose annual turnover is below some threshold. The value of these thresholds, as of May 2008, is set out in Table 40.

¹⁷ Ministère de l'Environnement, Luxembourg (2008) "Luxembourg's National Inventory Report 1990-2006 – Submission under the United Nations Convention on Climate Change and voluntary submission under the Kyoto Protocol", Table 3.44. Available from

http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/4303.php, accessed on 3 August 2009.

¹⁸ The average relative prices are calculated as the average, across the 14 six-monthly observations covering the period 2000 to 2006, of the relevant price ratio. Price data relate to prices including all taxes. The data were obtained from Eurostat's "Energy Statistics" domain.

Member State	Threshold	Member State	Threshold
AT	€ 30,000	IT	None
BE	€ 5,580	LT	€28,962
CZ	€37,622	LU	€10,000
DE	€17,500	LV	€14,347
DK	€6,705	MT	€37,000, €24,300, or €14,600
EE	€15,978	NL	None
ES	None	PL	€13,883
FI	€8,500	РТ	€9,976 or €12,470
FR	€76,300 or €27,000	SE	None
GR	€9,000 or €4,000	SI	€25,000
HU	€19,700	SK	€44,642
IE	€70,000 or €35,000	UK	€87,098

Table 40Thresholds for application of special scheme for small businesses, May 2008

Source: http://ec.europa.eu/taxation_customs/resources/documents/taxation/vat/traders/vat_community/vat_in_EC_annexI. pdf, accessed on 15 May 2008.

- 286. Taxable persons with a turnover falling below the applicable threshold are exempt from VAT. It follows that:
 - (a) The sale of the goods or services produced by these taxable persons does not attract VAT.
 - (b) These taxable persons are not able to recover the input VAT that they will have paid.
- 287. To take account of the small business exemption on our estimation of the theoretical VAT liability it is necessary to deduct an element equal to product of the value added by those taxable persons falling below the small business threshold times and the relevant VAT rate.
- 288. We have not found data reporting the value added of business by level of turnover. To overcome this we have contacted all relevant Member States to ask for data on the VAT foregone due to the exemption to small business. Table 41 reports the 2006 values for those that responded.

Table 41 Estimated VAT revenue foregone due to small business exemption

	2000	2001	2002	2003	2004	2005	2006
UK (GBP million)	100	400	400	450	300	900	950
Ireland (EUR million)	42.61	25.27	40.3	37.3	59.83	41.96	37.56
Estonia (EEK million)	154.9	175.5	196.9	220.8	243.3	453.4	358.7
Hungary (HUF million)	n.a.	2,047	n.a	2,659	10,607	14,752	8,667
Malta (EUR million)	5.87	6.68	7.14	7.40	9.53	9.58	10.03

Source: UK HM Treasury" Chapter A: Budget Measures, of the "Financial Statement and Budget Report", several years; and data received from Irish Revenue and the Ministries of Finance of Estonia, Hungary and Malta.

Section 7: Adjustments

- 289. For Ireland, Estonia, Malta and Hungary the values reported in Table 7 do not relate to all of the VAT foregone due to the exemption granted to small businesses. Rather, the values are those that were submitted as part of the relevant VAT own resource calculations. As such, the values relate to the VAT foregone due to the exemption granted to business with a turnover below the threshold stipulated by national legislation set out for 2006 in Table 44 and above €10,000. As such, the values used for these Member States will be an underestimate of the VAT receipts that are foregone due to the exemption granted to small businesses. Because the values in question are relatively small, we do not consider this to have a material impact on our overall estimate of the VAT gap.
- 290. For those Member States for which we were not able to collect relevant data, we estimate the foregone VAT by applying a percentage to our estimated theoretical net VAT liability. The percentages applied are informed by the data that we did receive from some of the Member States and by the relative size of the thresholds. For Belgium, Denmark, Finland, Greece, Luxembourg, Poland and Portugal we assume the foregone VAT to be 0.1 per cent of liability, for Austria, Germany, Latvia and Slovenia we apply 0.3 per cent, and for the Czech Republic, France, Lithuania and Slovakia a percentage of 0.5 per cent.

Supplies in domestic territories with different VAT regimes

- 291. The VAT regimes applicable to the supply of goods and services in specific territories of some Member States differ from those applicable in the rest of the national territory. This is the case, for example, of the Portuguese archipelagos of the Azores and Madeira where the applicable VAT rates are lower than those in mainland Portugal. Some national territories are outside the scope of the VAT directive altogether and no EU VAT applies. This is the case, for example, of the Canary Islands (Spain) and of French Guiana (France).
- 292. We have adjusted our estimate of the theoretical net VAT liability of the relevant Member States to take account of the special regimes that apply in Madeira and Azores (Portugal), Corsica and in the Overseas Departments (France) and in Lesbos, Chio, Samos, Dodecanese and the Cyclades and on the Aegean Islands of Thassos, Northern Sporades, Samothrace and Skiros (Greece). We have also adjusted our estimate of the VAT liability of Spain to take account of the fact that VAT does not apply in the Canary Islands. We have made no other territorial adjustment.
- 293. In all cases the adjustment to the estimated liability was estimated on the basis of the VAT rate differentials and on the region's share of national GDP. Implicit in this computation is the assumption that the economy of each of these territories is a "scaled down" version of the economy of the relevant Member State as whole. In the adjustment done for the Canary Islands it was further necessary to deduct from the VAT receipts figures the revenues associated with the Impuesto General Indirecto Canario (IGIC) as this is included within the VAT receipts reported by Eurostat. Data

on the IGIC receipts were obtained from the "National List of Taxes" publication made available by DG TAXUD.¹⁹

Adjustments that have not been carried out

294. We do not make adjustments to reflect the special schemes provided to farmers and others, purchases on the domestic territory by non-residents or mail order purchases from suppliers based outside the EU. We set out below the reasoning for our approach.

Special schemes provided to farmers and others

- 295. Across a number of Member States special schemes are in place for specific sectors of the economy. The special flat rate scheme for farmers is perhaps the most common example and is provided for where the application to farmers of the "normal VAT arrangements or the special scheme [for small enterprises] is likely to give rise to difficulties."²⁰
- 296. A farmer under the flat rate scheme does not make a claim for the VAT he will have paid on his inputs. Instead, the farmer is compensated by a percentage that is applied to his sales of agricultural goods and services. The percentage is fixed by each Member State operating such a scheme and the VAT Directive specifies, in Article 298, that the percentage is to be "calculated on the basis of macro-economic statistics for flat-rate farmers alone for the preceding three years" and, in Article 299, that it "may not have the effect of obtaining for flat-rate farmers refunds greater than the input VAT charged." In addition, the directive also specifies, in Article 296 that "every flat rate farmer may opt [...] for application of the normal VAT arrangements".
- 297. On the basis of the above, we think it is reasonable to assume that the percentages that are fixed for flat-rate farmers are such as to render the scheme neutral in fiscal terms. That is to say, we think it is reasonable to assume that the compensation percentages are estimated such that flat-rate farmers are compensated for the VAT input that they will have paid. Given this, flat-rate farmers, like all other non-exempt intermediary sectors in the economy, make no net contribution to the theoretical VAT liability and it is not necessary, therefore, to examine their activity with any greater attention.

Purchases in the domestic territory by non-EU residents

298. We make no adjustment for the purchases made in the domestic territory by non-EU residents on which VAT has been reclaimed. Again, we believe that what would be gained in terms of the accuracy of our estimates would be too small compared to the significant efforts required to source the data necessary to make these adjustments.

¹⁹ Accessed from

http://ec.europa.eu/taxation_customs/resources/documents/taxation/gen_info/economic_analysis/tax_structures/2009/2009 _NTL_en.xls on 3 August 2009. ²⁰ Article 296 Council Directive 2006/112/EC of 28 November 2006 on the common system of value added tax. Available

²⁰ Article 296 Council Directive 2006/112/EC of 28 November 2006 on the common system of value added tax. Available from http://eur-lex.europa.eu/LexUriServ/site/en/oj/2006/1_347/1_34720061211en00010118.pdf, accessed on 3 August 2009.

Mail-order purchases from suppliers based outside the EU

299. We make no adjustments for special arrangements that might apply to low-value consignments supplied from locations outside the EU. For example, the UK operates a low-value consignment relief scheme whereby inbound packages valued below a threshold set by HMRC are exempt from VAT upon importation. We do not have access to data that would allow us to make an adjustment for such schemes.



SECTION 8: DEFINITIONS OF THE VAT GAP

300. This section considers possible definitions of the VAT gap and sets out the reasoning for the definition adopted by this study.

Possible definitions of the VAT gap

- 301. We have identified two issues that have a material bearing on the definition of the concept of the VAT gap:
 - (a) In cases where tax evasion leads to an increase in consumption or economic activity (albeit illegal activity), should the amount of tax that ought to have been levied on the additional activity be included in the tax gap (even though that activity only occurs because tax is not collected)?
 - (b) When VAT has been evaded on a transaction, should the actual expenditure that is observed be deemed to be inclusive of VAT or exclusive of VAT?
- 302. We do not think it possible to construct a sufficiently robust estimate of tax losses that answers the first question in the affirmative. The change in the behaviour of traders and consumers more generally that results from there being tax evasion is not observed. To estimate such a change requires knowledge about the responses of suppliers and consumers, e.g. the elasticity of demand. There are also further consequential effects of compliance, such as consumers substituting between products, which will further affect the tax that is collected. Our assessment is that estimating these effects across the whole economy is too vulnerable to missing or inaccurate information about the consequences of compliance making such an exercise unreliable and impractical.
- 303. This leaves only the second identified issue remaining, and leads to three possible definitions of tax losses:
 - (a) The "tax not remitted" definition measures the tax that would not have been remitted had all fraud taken the form of traders not submitting their VAT returns and payments. This definition assumes that the fraudulent transaction amount is inclusive of VAT. Thus, observing a black market transaction worth 120 on which 20 per cent VAT should have been charged will be deemed to correspond to a loss of 20, the VAT element of the 120 paid by the consumer.
 - (b) The "tax not collected" definition measures the tax that would not have been collected had all fraud taken the form of VAT not being charged on transactions where it should be. This definition assumes that the fraudulent transaction amount is exclusive of VAT. Thus, observing a black market transaction worth 120 on which 20 per cent VAT should have been charged will be deemed to correspond to a loss of 24 because the consumer should have paid 144, of which 24 would have been VAT.
 - (c) The "full recovery" definition measures the amount that would be recovered through enforcement action by the VAT collection agency if it had perfect information about past frauds, and if there were no losses due to insolvencies.

Section 8: Definitions of the VAT gap

304. This full recovery definition requires transaction specific information about the type of fraud that has been committed in each case. The tax not remitted and tax not collected definitions do not require this transaction specific information. Instead, these definitions only need data on consumption, on the relevant VAT rate and on actual VAT receipts in order to estimate the VAT gap.

Worked examples of the differences between the definitions for the VAT gap

305. We now describe how the three candidate definitions would be applied in four stylised examples each reflecting different types of tax losses. This will, we think, clarify the above definitions and clarify the reasoning for our adopted definition. We will see that the estimate of the amount of tax lost may depend on the definition adopted.

Worked example 1: VAT evasion with complicity of the final customer

306. The first worked example involves the following fraud scenario:

A trader undertakes some work for a consumer. The work is, in law, liable for VAT at 20 per cent. At the instigation of the consumer, the trader does not account for VAT and charges 120 on a cash-in-hand basis.

- 307. Under the tax not remitted definition, it is assumed that the transaction (120) includes VAT. Under this definition the VAT associated with this transaction that ought to have been remitted is 20. In contrast, under the tax not collected definition which assumes the fraudulent transaction is exclusive of VAT, the amount of VAT deemed not to have been collected is 24.
- 308. Assuming full recovery by the tax authorities, the consumer would have been made to pay 24 of VAT to the authorities, unless there was no evidence that he initiated the fraud. If no such evidence were available, the proceeds of enforcement (excluding penalties) would only be 20 as a result of compulsory registration/assessment of the trader's liability. This illustrates how exact knowledge of the fraud is required to assess the VAT loss under the full recovery definition.

Worked example 2: VAT evasion by a trader, without complicity of the final customer

309. The second worked example involves the following fraud scenario:

A wholesaler purchases goods worth 120 including 20 of VAT, and sells them on to retailers for 240 including a stated VAT amount of 40. The wholesaler submits a fraudulent VAT return which does not include these transactions and does not pay any VAT associated with the goods. Retailers sell the goods on for 300, including VAT of 50, and remit VAT of 10 to the tax authorities in the ordinary way.

310. In this example, the net VAT receipts in respect of these goods are 30.

- 311. Under the tax not remitted definition, the level of VAT that ought to have been remitted is estimated to be 50. Compared to the actual level of VAT receipts of 30, this would imply that the level of VAT not remitted was 20.
- 312. Under the tax not collected definition it would be estimated that, given the observed VAT receipts of 30, final consumption should have been 180. However, given that observed final consumption was actually 300, this would mean that there would have been 120 of fraudulent consumption which should have attracted additional VAT of 24. Under this definition, therefore, VAT receipts should have been 54 (24+30). This gives estimated VAT losses of 24.
- 313. Under the full recovery definition, the level of VAT that ought to have been remitted is estimated to be 50. Compared to the actual level of VAT receipts, this would imply that the level of VAT not remitted was 20.

Worked example 3: MTIC fraud

314. The third worked example involves the following fraud scenario:

A trader "A" acquires goods worth 120 from a legitimate trader registered for VAT in another Member State. The legitimate trader charges no VAT on the transaction. The acquirer then sells the goods, possibly via intermediaries, to another trader "B", issuing a VAT invoice for 120 plus VAT of 24 (assuming the VAT rate is 20 per cent). Trader "A" goes missing without settling any VAT. Trader "B" supplies the same goods to a trader based in another Member State for 150 plus zero VAT. Trader "B" then applies for a refund of his input VAT of 24 supposedly paid to trader "A". This input tax claim is valid under the European Court of Justice ruling in Optigen (http://www.reckon.co.uk/item/e225e8e4). There is zero final consumption of the goods in this example.

- 315. The VAT effects of the fraud are as follows:
 - (a) The intra-community acquirer, trader "A", pays no VAT and receives no VAT refund.
 - (b) The intra-community supplier, trader "B", receives a VAT refund of 24, this being the VAT on the 120 that it paid on the goods to trader "A".
- 316. Under the tax not remitted definition, net VAT receipts that ought to have been remitted are zero, and therefore the estimated tax losses are 24. The same estimates are produced under the "full recovery" definition.
- 317. Under the definition of tax not collected a different measure of tax loss is computed to be 28.8, the calculations underlying this figure are set out in Table 42. Identifying the level of deemed fraudulent consumption is not as straightforward as the previous examples. In this MTIC example, as was the case in worked example 2, the measure of tax loss associated with the tax not collected definition is one that we cannot reconcile with any interpretable measure.

Worked example 4: Fraudulent consumer import

318. The fourth worked example involves the following fraud scenario:

An individual acquires 120 worth of goods from another Member State, allegedly for business purposes and, accordingly, he provides his business' VAT number. It is classified as an intra-community acquisition and does not attract the 20 per cent VAT that would otherwise be paid. The goods are in fact put to personal rather than business use and no VAT is declared.

- 319. Under the tax not remitted definition, it is estimated that there should have been a VAT payment of 20 associated with the observed final consumption of 120. In the context of this worked example, this measure of tax loss cannot easily be interpreted as the type of fraud does not fit with the specified definition.
- 320. Under the tax not collected definition, the tax loss in respect of the fraudulent transaction would be calculated to be 24. This corresponds to the VAT that the consumer should have been charged had he not fraudulently claimed to be importing the goods for business purposes.
- 321. Using the full recovery definition, the estimated tax loss would also be 24.

Tax losses calculations in the worked examples

322. Table 42 overleaf shows the different tax gap definitions for the worked examples.

	Worked example 1: Evasion with complicity	Worked example 2: Evasion without complicity	Worked example 3: MTIC carousel fraud	Worked example 4: Fraudulent consumer import
V Applicable VAT rate	20%	20%	20%	20%
A VAT receipts	0	30	-24	0
B Final consumption (including VAT)	120	300	0	120
C = B*V/(1+V) Tax that ought to have been remitted	20	50	0	20
$\mathbf{D} = \mathbf{C} - \mathbf{A}$ Tax not remitted	20	20	24	20
E = A*(1+V)/V Consumption implied by VAT receipts	0	180	-144	0
$\mathbf{F} = \mathbf{B} - \mathbf{E}$ Deemed fraudulent consumption	120	120	144	120
G = F*V Tax not collected	24	24	28.8	24
H Full recovery	24 (only 20 if no evidence of consumer complicity)	20	24	24

Table 42 Calculation of different definitions of the VAT gap in worked examples

- 323. The worked examples described above and summarized in Table 42 illustrate the limits of the appropriateness of each of the possible definition of the VAT gap considered:
 - (a) Measure D, "tax not remitted", yields estimates that are not meaningful in the case of fraud where goods are imported allegedly for business use but are actually put to personal use (worked example 4). In the case of VAT evasion where the consumer is complicit (worked example 1), measure D gives an indication of the tax loss that the tax authority would be able to recover from the trader without having to prove the complicity of the consumer himself. This may understate the amount recoverable by the tax authorities.
 - (b) Measure G "tax not collected" yields estimates that are not meaningful and that cannot be interpreted in the case of VAT evasion by a trader (worked example 2) and in the MTIC case (worked example 3).

- (c) Measure H "full recovery" cannot be estimated on the basis of macroeconomic data alone. They require transaction-specific information or assumptions.
- 324. We think that measure G "tax not collected" is not appropriate. The case against this measure is the erroneous results that it gives in worked examples 2 and 3.

Choice of definition for the study

- 325. In this study we choose to focus on "tax not remitted" estimates based on macroeconomic data.
- 326. The "tax not remitted" definition provides a simple and clearly-defined measure, with the following features when used to analyse different types of fraud:
 - (a) It provides the natural measure of the value of fraud in cases of MTIC and wholesale evasion, and a reasonable measure in the case of retail evasion.
 - (b) It provides the correct measure of the value of fraud in cases of consumer fraud provided the data on final consumption incorporate adjustments made to reflect tax evasion where consumers are complicit (in the spirit of worked example 1).
 - (c) It does not provide a correct measure of the value of fraud in cases of consumer fraudulently importing goods for non-business purposes.
- 327. The "tax not remitted" definition appears to be the one used in estimates of the VAT gap by some national tax collection agencies. However, it is not universally adopted by researchers in the area of tax fraud. For example, the calculations carried out in Christie and Holzner (2006) imply a definition of tax losses in line with the "tax not collected" definition set out above.²¹

²¹ Christie, E and Mario Holzner (2006) "What explains tax evasion? An empirical assessment based on European data", wiiw Working Papers 40, available from http://www.wiiw.ac.at/pdf/wp40.pdf, accessed on 3 August 2009.

SECTION 9: REVIEW OF PUBLISHED ESTIMATES OF VAT FRAUD AND THE VAT GAP

- 328. This section provides a brief review of estimates of VAT fraud and VAT losses (or VAT gap) published by national tax authorities, other government agencies or departments, and research institutes. It reviews, in turn, top-down estimates, and bottom-up estimates which, by constructing an estimate of overall VAT fraud on the basis of the VAT fraud associated with different types of fraudulent activity, offer a characterisation of VAT fraud as a whole.
- 329. We have complemented our own search of relevant publications by contacting stakeholders in all Member States inviting them to point us to published studies that estimate VAT fraud.
- 330. This section is structured as follows. First, we present the results of published topdown estimates of the VAT gap for some Member States. Second, we review two bottom-up studies, one by the UK's HM Revenue and Customs and another by the Swedish Skatteverket, which provide estimates of the contribution of different types of fraudulent activities to total VAT fraud. Third, and closing this section, we review some published estimates of MTIC fraud, one of the components of VAT fraud that has attracted most attention in recent years.

Published top-down estimates of the VAT gap

331. We have found published estimates of the VAT gap for some of the years overlapping with our period of analysis for Denmark, Germany, Italy, Sweden and the UK. These have been prepared by Danmarks Statistik, the Ifo Institut for Economic Research in Munich, the Italian Agenzia delle Entrate, the Swedish NCB/NR and by HMRC respectively. The estimates of the VAT gap produced by these institutions are reported in Table 43, alongside our own For the period between 2000 and 2006, we have not come across published top-down estimates for other Member States.



				Alternative	estimates		Reckon es	timates	
Member state	Source of estimate	Units	Year	Liability	Receipts	Gap	Liability	Receipts	Gap
DE	Ifo	EUR	2000	155.6	141.6	14.0	158.6	140.0	18.5
	Institute for	billion	2001	156.5	138.5	18.0	160.4	139.1	21.4
	Economic		2002	156.5	138.5	18.0	157.7	136.8	20.9
	Research		2003	156.5	138.5	18.0	158.4	137.2	21.2
	Munich		2004	154.2	135.7	18.5	159.4	137.4	21.9
			2005	156.5	138.5	18.0	160.7	139.8	20.9
			2006	157.9	142.9	15.0	164.1	147.1	17.0
DK	Danmarks	DKK	2000	132.2	123.8	8.4	135.6	123.8	11.9
	Statistik	billion	2001	136.6	128.5	8.0	140.9	128.5	12.4
			2002	141.1	132.4	8.7	143.5	132.4	11.1
			2003	144.3	135.1	9.2	145.2	135.1	10.1
IT	T Agenzia delle Entrate	EUR	2000	106.4	73.5	33.0	99.9	77.5	22.4
			2001	110.2	72.9	37.4	103.4	78.1	25.3
	Enuate		2002	111.8	76.7	35.1	106.1	80.4	25.7
SE	E NCB/NR	SEK	2000	198.7	194.9	3.8	208.0	194.9	13.2
		billion	2001	208.7	204.6	4.1	217.0	204.6	12.4
			2002	217.3	215.7	1.6	225.2	215.7	9.5
UK HM Revenue & Customs	GBP	2000	n.c.	n.c.	10.0	76.5	64.2	12.3	
	billion	2001	n.c.	n.c.	11.3	80.4	67.1	13.3	
		2002	n.c.	n.c.	12.2	85.3	71.1	14.3	
		2003	n.c.	n.c.	9.9	90.3	77.3	12.9	
			2004	n.c.	n.c.	10.3	95.6	81.6	14.0
			2005	n.c.	n.c.	13.4	101.6	83.4	18.2
			2006	n.c.	n.c.	12.8	106.1	87.8	18.4

Table 43Other published estimates of the VAT gap

Note: We believe receipts and liability figures of HMRC are not comparable (n.c.) principally because these are net of re-payments to eligible public bodies. HMRC estimates for the UK are computed on the financial rather than calendar year. The figures given in the table for the estimate by HMRC for the UK for, say, 2000 relate to the estimate for 2000/2001. The figures from Danmarks Statistik are gross of deduction for debtors.

Sources: Nam and Parsche (2007) "Trotz 19% Mehrwertsteuer wird für 2007 ein weiteres, Absinken der Ausfallquote erwartet", ifo Schnelldienst 10/200, pp41-42; Danmarks Statistik (2007) "Danish National Accounts: Sources and Methods 2003"Table 3.71; Agenzia delle Entrate (2006) "Le basi imponibili IVA Aspetti generali e principali risultati per il periodo 1982-2002"; Swedish National Tax Agency (2008) "Tax Gap Map for Sweden: How was it created and how can it be used?", Report 2008:1B Table 6; HMRC (2007, 2005) "Measuring indirect tax losses".

Our estimates will differ from those published by national tax agencies and other institutions

332. We understand the estimates of the various institutions reported in the table above have been arrived at on the basis of a top-down approach, broadly similar to that which we ourselves have followed. We are aware, all the same, of some differences between the approaches which will account for some of the differences between the set of estimates.

Section 9: Review of published estimates of VAT fraud and the VAT gap

- 333. First, there will be differences in the set of national accounts data we used and that used by each of the above institutions, in terms of their coverage and detail. Where data were not available to us in sufficient detail, we have made assumptions, some of which have a material impact on our estimates of the VAT liability. We have described the set of assumptions in Sections 2 and 6, and report in Section 2 on the sensitivity of our results to the most significant of these. Further, national accounts are often subject to revisions by the national statistics agency and it is possible that the "edition" of the data we drew on is not the same as that which underlies the estimates of the institutions listed above.
- 334. Second, other than for Denmark, our data series on VAT receipts are also different from those used by each of the other institutions in their estimations of the VAT gap. With the exception of the UK, we do not have an explanation for these differences. We received written comments from the UK HMRC in June 2009 suggesting that the VAT receipts for the UK reported by Eurostat (and reported in the published UK national accounts) are net of some refunds to National Health Service Trusts; we do not have a published source of information that would allow us to adjust our estimates to reflect this.
- 335. The above differences come about from differences in the data used or in the way estimates are reported, and do not reflect differences in the general approach followed. In terms of differences in approach, we are aware of just the following three points.
- 336. For Germany, we understand that an adjustment is made to the receipts figure to reflect VAT that has not been remitted due to insolvencies. Our own estimate of the VAT gap has not sought to exclude the effect of VAT not remitted due to insolvencies. For Denmark, Danmarks Statistik publishes estimates of the theoretical liability both with and without adjusting for deductions for debtors. To make the comparison with our estimate on an equal footing, we report the estimate where such deductions have not been adjusted for. For the UK, HMRC does not include VAT losses associated with smuggled alcohol and tobacco in its estimate of the VAT liability. To the extent that these illegal activities are captured by national accounts, these losses are included in our estimates of the VAT liability and VAT gap.
- 337. As reported in Table 43, our estimates of the German VAT gap are consistently higher than those reported by Ifo although the differences are relatively small. The trend in our estimates of the VAT gap mirrors that of the estimates produced by Ifo.
- 338. Similarly, our estimates of the VAT gap for Denmark are consistently higher than those published by Danmarks Statistik. Unlike Germany, however, the trend in our estimated VAT gap does not mirror the trend in the estimates produced by Danmarks Statistik.
- 339. Our estimates of the VAT gap for the UK are also higher than those published by HMRC. For the reasons outlined above we are not able to compare the reported data on VAT receipts and estimated liability.
- 340. In contrast, Table 43 reveals that our estimates of the VAT gap for Italy are consistently lower than the one published by the Agenzia delle Entrate. One factor

contributing to this is the fact that the series of VAT receipts used by the Agenzia delle Entrate differs from the one we obtained from Eurostat and used. We cannot reconcile the difference in the receipts data; whilst they may have been compiled differently they are both meant to reflect a notion of accrued receipts.

341. Lastly, our estimates of the Swedish VAT gap are considerably higher than those produced by NCB/NR. We have not found a published description of the top-down approach used by NCB/NR to explore this further. We do note, however, that these very low estimates of the VAT gap by NCB/NR have been commented on by Skatteverket as appearing to be unreasonably low.²²

Bottom-up quantification of the components of VAT fraud

- 342. We have not carried out a bottom-up estimate of the VAT gap ourselves as we have not found a satisfactory way of estimating the relative contribution of different types of VAT fraud on the basis of publicly available data. Producing a bottom-up estimate of the level of VAT fraud starts from identifying the different types of fraud and then proceeds to estimate the size of each of these components. Invariably, this requires operational data that are typically only held by national tax authorities and are confidential.
- 343. We focus, instead, on reviewing published bottom-up studies of VAT fraud. Ahead of presenting this review we make two observations. First, we have found only two studies that attempt to estimate the overall level of VAT fraud by identifying the size of different categories of fraud; one was completed by the UK's HMRC in 2002 and the second by the Swedish Skatteverket in 2008. Second, other studies of relevance that we are aware of focus on estimating the value of a particular form of VAT fraud, MTIC which has attracted the most attention in recent years.

Bottom-up estimates of VAT losses in the UK and in Sweden

344. We have found only two published studies that have sought to construct a bottom-up estimate of VAT losses. The HM Customs & Excise (HMCE) in the UK published a note of their estimate on this in 2002 and, more recently, the Skatteverket have published a very detailed report outlining the results of their bottom-up estimates. We review each in turn.

HMCE (2002) estimates of VAT losses in the UK

345. The note prepared in 2002 by the UK's HM Customs & Excise, later HM Revenue & Customs (HMRC), on "Measuring indirect tax losses" (HMCE, 2002) presented estimates of VAT losses associated with (i) missing trader (inter-community) fraud (MTIC), (ii) avoidance and (iii) general non-compliance.²³ The first two are self-explanatory and the third, general non-compliance, is described as "the failure of

²² Skatteverket (2008) "Tax gap map for Sweden — How was it created and how can it be used?", Report 2008:1B, p31. Available from http://www.skatteverket.se/download/18.225c96e811ae46c823f800014872/Report_2008_1B.pdf, accessed on 3 August 2009.

<sup>accessed on 3 August 2009.
²³ HM Customs & Excise (2002) "Measuring indirect tax losses". Available from http://www.hm-treasury.gov.uk/d/admeas02-297kb.pdf, accessed on 3 August 2009.</sup>

businesses to pay the right amount of VAT at the right time" and is defined at paragraph 2.37 of the note to include "errors and omissions on tax returns, including failure to submit returns, late payment, non-payment or incomplete payment and deliberate mis-declaration of input or output tax on tax returns".

- 346. HMCE drew on different approaches to estimate each of the three types of losses. Estimates of losses due to MTIC fraud were prepared on the basis of trade data. The exercise centred on comparing the data on exports to the UK declared in other Member States with the imports from other Member States declared in the UK.²⁴ Further details of the approach is described in the section on MTIC fraud below. Estimates of the losses due to general non-compliance are based on operational data. Finally, losses due to avoidance were estimated by drawing on:
 - (a) An estimate of how much businesses spend on VAT avoidance schemes (between £250 and £300 million a year);
 - (b) An assumption that this spending refers to the fees paid to accountancy firms managing tax avoidance fees; and
 - (c) An assumption that accountancy firms' fees for such services are 10 per cent of the tax saved.
- 347. The estimates put forward by HMCE against each of these types of VAT losses are set out in Table 44. This table also reports the estimate for overall VAT fraud HMCE arrived at through its top-down approach, as reported in its 2002 publication "Measuring indirect tax losses".

	Period covered	Lower estimate	Upper estimate
Bottom-up estimate			
Missing trader fraud	2001/2002	£1.75 billion	£2.75 billion
Avoidance	Annual — no specific year	£2.5 billion	£3 billion
General non-compliance	Annual — no specific year	£2.9 billion	£4.5 billion
Total		£7 billion	£10 billion
Top-down estimate	2001/2002	£10.4	billion

Table 44HMCE bottom-up and top-down estimates of VAT losses

Note: The top-down estimate of £10.4 billion, reported in HMCE's 2002 publication, has been revised in subsequent "Measuring indirect tax losses" publications.

Source: HMCE (2002) "Measuring indirect tax losses"

348. Commenting on the figures presented in Table 44, HMCE (2002) notes that the bottom-up figures provide "a useful corroboration" for the top-down estimate. According to the bottom-up estimates, VAT losses are roughly between £7 billion and £10 billion. These are in the same neighbourhood as the £10.4 billion top-down estimate.

²⁴ HM Customs and Excise (2001) "Measuring indirect tax fraud". Available from http://customs.hmrc.gov.uk/ channelsPortalWebApp/downloadFile?contentID=HMCE_PROD_011638, accessed on 16 September 2009.

- 349. Given the uncertainty surrounding its estimates, HMCE (2002) adds that a great deal of caution is necessary when interpreting the figures, particularly so for the estimates of the losses due to general non-compliance and from avoidance.
- 350. HMCE/HMRC, did not publish estimates of the fraud associated with general noncompliance (or with avoidance) in later years as it reasoned that it was "difficult to construct estimates of their relative contribution to overall revenue loss" (HMRC, 2005, page 6).²⁵

Skatteverket (2008) estimates of the VAT gap in Sweden

351. Skatteverket published in 2008 its study "Tax gap map for Sweden — How was it created and how can it be used?" which outlines the approach and results of its research into the tax losses in Sweden.²⁶ The study adopts a different definition from the taxes not remitted definition we have adopted. In particular, Skatteverket (2008) define the tax gap in the executive summary to the report:

as the difference between the tax that would have been determined if all those liable for tax reported all their business and their transactions correctly and the tax that actually is determined after the efforts of the National Tax Agency to ensure compliance.

- 352. The notion of tax losses used reflects in part, therefore, the knowledge of the tax authority and does not consider whether taxes have actually been paid or not.
- 353. The study reports on losses across various types of tax, including VAT. For each tax, the study estimates the losses associated with three broad categories of activity: international, undeclared employment and other national. With respect to VAT, the activities found to contribute to the "international" component of the tax loss refer to ones involving import/export, trade with other EU Member States, carousel trade and trading of cars and boats. The "undeclared employment" component of the VAT gap relates primarily to the VAT losses arising from the non reporting of sales by companies and, to a less extent, to undeclared services and good provided to private individuals. Finally, the activities contributing to the "national" component of VAT losses relate to errors in VAT reporting, including on the tax position of company cars.
- 354. Skatteverket (2008) draws on a number of different sources to derive the above estimates. With regards to the VAT gap associated with international transactions, the estimates are based on calculations by Swedish customs and we understand that the estimates on the tax gap associated with undeclared employment are based on a number of sources including survey results and national accounts data, the latter being used, we understand, to develop a top-down estimate of the gap. The sources of data used to estimate the "Other national" element of the VAT gap include inspection projects and outcomes of audit work by Skatteverket itself.

²⁵ HM Revenue & Customs (2005) "Measuring indirect tax losses". Available from www.hmrc.gov.uk/pbr2005/mitl2005.pdf accessed on 3 August 2009.

²⁶ Skatteverket (2008) Tax gap map for Sweden, Report 2008:1B. Available from http://www.skatteverket.se/download/18.225c96e811ae46c823f800014872/Report_2008_1B.pdf, accessed on 3 August 2009.

355. Skatteverket (2008) estimates the total VAT tax gap to be SEK 35.3 billion. As reported in Table 45, VAT losses associated with transactions associated with undeclared employment account for almost half of the total VAT gap, and within this, it is the VAT gap relating to unreported sales in companies that is the most significant.

Nature of fraud	Tax gap, SEK billion
International transactions	11.8
Import/export	3.6
EC trade	3.0
Carousel trade	1.0
Trade with cars, boats etc	1.1
Other	3.2
Undeclared employment	17.1
Unreported sales in companies	13.6
Undeclared services between private individuals	1.3
Black market goods to private individuals	0.8
Other	1.5
Other national	6.4
Micro-companies	2.1
Small and medium-sized companies	2.0
Large companies	0.9
Public sector associations etc	3.8
Total	35.3

Table 45	Swedish VAT	tax gap reported in	Skatteverket (2008)
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Source: Skatteverket (2008, p. 62)

356. Skatteverket (2008) comments that its estimates of the international component of the VAT gap is subject to significant uncertainty and notes that it has been in relation to the VAT gap, more generally, that it has found it hardest to find reliable data for estimation and that "the general opinion of those working on VAT controls is that the gap is great, but in most cases it has been hard to back up that impression with facts".²⁷

Published estimates of MTIC fraud

- 357. Missing trader intra community (MTIC) fraud is a criminal activity that takes advantage of the zero-rating of cross-border intra-EU trade to evade VAT or to fraudulently claim input VAT refunds.
- 358. There are broadly two types of MTIC fraud, acquisition fraud and carousel fraud. In acquisition fraud, a VAT-registered trader purchases goods from a seller in another EU Member State. This transaction attracts no VAT as cross-border transactions are zero-rated for VAT purposes. The trader then sells these goods onwards, charges VAT on them and disappears without remitting the tax collected to the tax authority.

²⁷ Skatteverket (2008), p.64.

- 359. In its initial stages, carousel fraud is similar to acquisition fraud. A VAT-registered trader imports goods from another EU Member State, paying no VAT on this transaction. The goods are sold onwards, possibly via a number of intermediaries or buffer traders, until the final link in this chain exports these goods to an intermediary based in another EU Member State. This exporter submits an input VAT refund claim to the tax authority, to reclaim the VAT supposedly paid by him to his supplier. The original importer disappears without paying the VAT due on his sales. The goods could be re-imported by the original importer and the whole cycle repeated many times before the importer disappears, thereby giving this type of fraud its name.
- 360. MTIC fraud, being an illegal activity, is inherently difficult to measure. Apart from the numbers for a few individual EU Member States covered in this review, we are not aware of a single EU-wide estimate of MTIC.
- 361. To the best of our knowledge, the two most significant research efforts on measuring MTIC fraud that have been published are those led by the UK's HMRC and by the Belgian Finance Ministry. We review each in turn.

HMCE and HMRC's estimates of MTIC fraud in the UK

- 362. Since 2001, HMCE, and later HMRC, in the UK has published annual estimates of MTIC fraud in the UK. (For ease of exposition, we will refer in this section to HMRC to mean both HMCE and HMRC, except when referencing publications.) The documents provide few details on what lies behind the calculations although an overview of the approach is provided. The approach itself has changed over time.
- 363. From 2001 to 2005, HMRC estimated the extent of MTIC fraud on the basis of trade data. The exercise centred on comparing the data on exports to the UK declared in other Member States with the imports from other Member States declared in the UK. Discrepancies between these two figures are regarded as an upper estimate of MTIC as it is thought that there would be other factors, such as the submission of incorrect information by traders that could drive a wedge between the two sets of numbers.
- 364. We understand that in its 2001 and 2002 calculation, HMRC produced a lower estimate of MTIC fraud by applying to the upper estimate a factor based on estimates of carousel fraud in Belgium and the Netherlands (HMCE, 2001, page 18).²⁸ Because the factor only reflected carousel fraud and because it did not take into account the fact that VAT registration is easier in the UK than in those two Member States, HMCE regarded this as the lower estimate.
- 365. In 2003, HMRC changed its approach to calculating the lower estimate. It considered that the factor applied, based on estimates of carousel fraud in Belgium and in the Netherlands in the late 1990s, was unlikely to continue to produce sufficiently robust estimates. Its revised methodology used a subset of the data used to estimate the upper limit. The subset of data used was such that HMRC believed that all that it captured was MTIC fraud, but that it did not capture all MTIC fraud.

²⁸ HM Revenue & Customs (2001) "Measuring indirect tax losses".

- 366. In 2006, HMRC changed its approach altogether.²⁹ The use of trade data was discontinued, on the grounds that the fraudsters' new modes of operation rendered such an approach "unreliable". We share HMRC's view that trade data are inadequate to identify the effect of MTIC: there is simply too much noise in trade data to allow this to be the case. The figures put forward by HMRC in 2006 were, instead, reported to be "based on operational evidence"; details of what evidence is used and how it is used are not provided.
- 367. Table 46 reports the estimates of MTIC for the period 2000/2001 to 2006/2007.

Year	Lower Limit (£ billion)	Upper Limit (£ billion)
2000/2001	1.31	2.47
2001/2002	1.72	2.53
2002/2003	1.54	2.34
2003/2004	1.06	1.73
2004/2005	1.12	1.90
2005/2006	3.50 (2.0)	4.75 (3.0)
2006/2007	2.25 (1.0)	3.25 (2.0)

Table 46HMRC estimates of attempted MTIC fraud, 2000/2001-2005/2006

Note: All numbers pertain to attempted fraud. Figures in brackets are estimates of the impact on VAT receipts Source: HMRC (2005, 2006 and 2007) "Measuring indirect tax losses"

368. The figures reported in Table 46 relate to the value of MTIC fraud *attempted*. For 2005/2006, HMRC estimated that, because some of these attempted frauds are stopped, the impact of MTIC fraud on actual receipts was between £2 and £3 billion. On the basis of HMRC's top-down estimate of the VAT gap for that year, £12.4 billion, the estimates for MTIC imply that this type of fraud accounted between 16 to 24 per cent of total VAT fraud.

Belgian Finance Ministry study using Eurocanet data

- 369. This study is subtitled "Spread of the phenomenon [MTIC fraud] in the EU". Its focus is on identifying differences between countries as to their vulnerability to MTIC fraud.
- 370. The paper reports the following elements as being part of a "macro economic approach":
 - (a) The larger economies (Germany, UK, France, Italy and Spain) are likely to be more vulnerable to acquisition fraud since they have a large domestic market.
 - (b) There is a correlation between economy size and the importance of electronic goods in the economy which further increases the risks of MTIC fraud in the larger countries.

²⁹ HM Revenue & Customs (2006) "Measuring indirect tax losses".

- (c) Some countries appear to make proportionately much greater VAT repayments than others, even after adjusting for the importance of exports to the national economy. This is taken to mean that the UK, France and Spain may be particularly affected by MTIC fraud, over and above the factors noted above.
- (d) A Belgian estimate of EUR 1.1 billion for the cost of MTIC fraud in 2001 (probably based on operational data collected during the subsequent implementation of a carousel fraud prevention strategy, but no source or method is given) is used to estimate at 5.1 per cent the proportion of intra-community trade in goods which is associated with MTIC fraud.
- (e) The UK HMRC's top-down estimate of the total VAT gap and estimate of MTIC fraud based on trade data.
- 371. These elements are presented as the backdrop for the main contribution of the paper, which is a micro-economic approach based on an extrapolation of data collected through the Eurocanet information exchange network.
- 372. The micro-economic approach is based on the mirror flow method, which compares (for individual traders) the exports reported through EC sales list with the information provided by the purchasers about the acquisition VAT accounted for. A possible broader approach which considers "profiles" of transactions rather than individual traders is touched on but not described in detail.
- 373. To extrapolate these transaction-specific data to an estimate of carousel fraud for the whole economy, the paper relies on two hypotheses:
 - (a) All carousel fraud takes place through methods known to the tax authorities, and the proportion of fraud using different methods is the same in the sample of cases that have been investigated as for carousel fraud as a whole. This hypothesis is justified by a review of operational experience, in particular the small number of modes of operation for carousel fraud that have emerged over the last 10 years.
 - (b) There is no correlation between the mode of operation of a carousel fraud and the time it takes to detect it. This hypothesis is also supported by operational data.
- 374. Based on these hypotheses and on data about detected carousel fraud from the Eurocanet network (analysed through a mirror flow method), the Belgian Finance Ministry reports the following results.
- 375. The largest detected fraudulent transactions relate to UK carousel fraud using goods traded through Dubai. These transactions were reported in Eurocanet with a variety of destination countries (in particular Spain) but according to the Ministry correspond to fraud against UK VAT only.
- 376. Other types of carousel fraud (which are spread across all EU countries) account for medium-size detected fraudulent transactions. The minority of non-fraudulent transactions included in Eurocanet are at the smaller end.

- 377. Omitting carousel fraud using good traded through Dubai, the VAT lost in the adjusted Eurocanet dataset is distributed as follows for the five largest EU countries (2005/2006 data):
 - (a) The UK bears 25.4 per cent of total EU carousel fraud losses.
 - (b) Spain bears 17.3 per cent of total EU carousel fraud losses.
 - (c) Italy bears 15.7 per cent of total EU carousel fraud losses.
 - (d) Germany bears 13.2 per cent of total EU carousel fraud losses.
 - (e) France bears 10.2 per cent of total EU carousel fraud losses.
- 378. No other country is estimated to bear more than 5 per cent of total EU carousel fraud losses.
- 379. These figures are consistent with the review of factors affecting fraud (size, importance of electronic goods, level of VAT repayments, etc.) reviewed above.
- 380. Adding back the fraud using goods traded through Dubai to the Eurocanet dataset also trebles the fraud estimate for the UK (the method assumes that all Dubai-method fraud is against UK VAT).
- 381. The report also provides illustrative "ceiling" financial estimates for losses due to VAT carousel fraud. These estimates are based on an extrapolation of the Eurocanet data using the assumptions that total non-Dubai carousel fraud amounted to EUR 14.8 billion across the EU.
- 382. This figure is an average of four estimates or assumptions based for the most part on trade data matching; as a proportion of GDP, it is higher than HMRC's estimate (even though HMRC's estimate relates to total MTIC fraud and the EUR 14.8 billion figure relates only to non-Dubai carousel fraud). These assumptions lead to an illustrative MTIC fraud loss figure of EUR 8.85 billion for the UK, of which:
 - (a) EUR 3.75 billion is non-Dubai fraud: a 25.4 per cent share of the assumed EUR 14.8 billion EU-wide figure.
 - (b) EUR 5.1 billion is Dubai-method fraud: extrapolated from the proportion of Dubai and non-Dubai fraud in the Eurocanet dataset and the assumed EUR 14.8 billion EU-wide figure for non-Dubai fraud.
- 383. This estimate is several times higher than HMRC's estimates of MTIC fraud for the UK. We do not find a reasonable basis on which the study draws to estimate the overall estimate of the amount of MTIC fraud that is, in a subsequent step of the analysis, allocated to a set of Member States.



Appendix

APPENDIX

Table 47EU-25 Member States

Code	Country
AT	Austria
BE	Belgium
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
GR	Greece
ES	Spain
FI	Finland
FR	France
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	The Netherlands
PL	Poland
РТ	Portugal
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom



Appendix

Table 48List of 2-digit CPA products

01-Products of agriculture, hunting and related services 02-Products of forestry, logging and related services 05-Fish and other fishing products; services incidental of fishing 10-Coal and lignite; peat 11-Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying 12-Uranium and thorium ores 13-Metal ores 14-Other mining and quarrying products 15-Food products and beverages 16-Tobacco products 17-Textiles 18-Wearing apparel; furs 19-Leather and leather products 20-Wood and products of wood and cork (except furniture); articles of straw and plaiting materials 21-Pulp, paper and paper products 22-Printed matter and recorded media 23-Coke, refined petroleum products and nuclear fuels 24-Chemicals, chemical products and man-made fibres 25-Rubber and plastic products 26-Other non-metallic mineral products 27-Basic metals 28-Fabricated metal products, except machinery and equipment 29-Machinery and equipment n.e.c. 30-Office machinery and computers 31-Electrical machinery and apparatus n.e.c. 32-Radio, television and communication equipment and apparatus 33-Medical, precision and optical instruments, watches and clocks 34-Motor vehicles, trailers and semi-trailers 35-Other transport equipment 36-Furniture; other manufactured goods n.e.c. 37-Secondary raw materials 40-Electrical energy, gas, steam and hot water 41-Collected and purified water, distribution services of water 45-Construction work 50-Trade, maintenance and repair services of motor vehicles and motorcycles; retail sale of automotive fuel 51-Wholesale trade and commission trade services, except of motor vehicles and motorcycles 52-Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods 55-Hotel and restaurant services 60-Land transport; transport via pipeline services 61-Water transport services 62-Air transport services

Appendix

- 63-Supporting and auxiliary transport services; travel agency services
- 64-Post and telecommunication services
- 65-Financial intermediation services, except insurance and pension funding services
- 66-Insurance and pension funding services, except compulsory social security services
- 67-Services auxiliary to financial intermediation
- 70-Real estate services
- 71-Renting services of machinery and equipment without operator and of personal and household goods
- 72-Computer and related services
- 73-Research and development services
- 74-Other business services
- 75-Public administration and defence services; compulsory social security services
- 80-Education services
- 85-Health and social work services
- 90-Sewage and refuse disposal services, sanitation and similar services
- 91-Membership organisation services n.e.c.
- 92-Recreational, cultural and sporting services
- 93-Other services
- 95-Private households with employed persons

