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Edward Christie and Mario Holzner

What Explains Tax Evasion? An Empirical Assessment based on European Data

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Edward Christie and
Mario Holzner

What Explains Tax Evasion? An Empirical Assessment based on European Data

Edward Christie and Mario Holzner are research economists at wiiw.

This research was financed by Oesterreichische Nationalbank through its Jubilee Fund for Research (OeNB Jubiläumsfonds) Project No. 10867.

Contents

Tables and Maps

Abstract

This study computes estimates of tax compliance in selected European countries for value added tax, excise tax, personal income tax and social security contributions, using national accounts data together with data on official tax structures and revenues. These estimates are then analysed to explain the differences in compliance rates across European countries and across time.

In accordance with the classical models of Allingham-Sandmo and their successors, we find that tax evasion is positively correlated with the tax rate itself. However, we also find support for Bloomquist's hypothesis that higher income inequality leads to higher tax evasion. We also find that the quality of the judicial system plays a role in explaining VAT evasion, confirming general hypotheses on the main drivers of the shadow economy. Finally, we find that our chosen measure of tax complexity is positively correlated with tax compliance for personal income tax, leading us to doubt the soundness of 'flat tax' reforms in transition countries, at least with respect to their impact on compliance.

Keywords: taxation, tax compliance, tax evasion, income inequality, tax complexity, flat tax, transition economies

JEL classification: C80, H26, H30

Executive summary

This study computes estimates of tax compliance in selected European countries for value added tax, excise tax, personal income tax and social security contributions, using national accounts data together with data on official tax structures and revenues. The estimates are made following two main separate methodologies, one for tax evasion in consumption (value added tax, or VAT, and excise tax) and one for tax evasion in income (personal income tax and social security contributions).

For tax evasion in consumption, a detailed database was constructed covering all 25 EU member states as well four accession/candidate countries (Bulgaria, Romania, Croatia and Turkey), covering data on VAT and excise taxes (rates and revenues), as well as estimates of the precise breakdown of household consumption by type of commodity for each country and year, owing to the prevalence of different tax rates for different commodities in most countries, e.g. reduced rates of VAT and of course specific excise tax rates for specific goods such as alcohol, tobacco and fuels. Using this database, estimates of the relevant tax bases and thus of the compliance rates for VAT and excise tax were then computed for each country, leading to the computation of a new composite indicator called the Concealed Consumption Share, CCS, which is our purpose-built measure of the shadow economy from the viewpoint of consumption.

For tax evasion in income, a specific five-step method was developed, with country-specific personal income tax and social security contributions calculators at its core. In order to properly compute total tax liabilities it was indeed necessary to work on each country's income distribution and process this income distribution using the relevant country's calculator. These were compared to actual revenues and the implied compliance rates were then computed. Owing to the rather labour-intensive nature of the estimation process, these estimates were made for 14 selected European countries only, though care was taken to ensure the inclusion of both Western European and transition countries.

These estimates, for all four types of tax, were then analysed to explain the differences in compliance rates across European countries and across time.

In accordance with the classical models of Allingham-Sandmo and their successors, we found as our most general result that tax evasion is positively correlated with the tax rate itself for all four types of tax. In other words, a first very simple policy implication would be that reducing average effective tax rates should positively impact on compliance rates (though not necessarily on total revenues) for all four types of tax.

We also find strong support for Bloomquist's hypothesis that higher income inequality leads to higher tax evasion in the cases of personal income tax, excise tax and social security contributions.

Furthermore we find that the quality of the judicial system plays a role in explaining evasion for VAT, personal income tax and excise tax, confirming general hypotheses on the main drivers of the shadow economy.

Concerning personal income tax in particular, we find that our chosen measure of tax complexity is positively correlated with tax compliance, leading us to doubt the soundness of 'flat tax' reforms in transition countries, at least with respect to their impact on compliance. Our intuition for this particular result is that the attempt to widen the tax base for personal income tax that was undertaken in the Baltic states has gone too far: very low incomes are best left untaxed, as they are in Western Europe. On the other hand we also come to the view that the complexity of the personal income tax systems found in Western European countries does present a number of advantages from the point of view of compliance. Our policy recommendation for transition countries is therefore that some degree of complexity may be quite useful: social policy objectives may be blended into the personal income tax system, potentially making it easier (for a number of reasons) to extract higher revenues.

Our findings for excise tax also indicate a strong negative role of income inequality in compliance. Together with other known results about excised goods (notably what is known about smuggling of excised goods across Europe) we come to the conclusion that Western European ministries of finance are simply maximizing their revenue levels, without too much concern about compliance levels and hence about evasion and avoidance levels. However, if compliance rates were to be a target variable as well, one would need to reduce the current tax rates. On the other hand, if public health objectives are truly pursued, then there are non-fiscal measures that could prove effective, if not as fashionable.

Edward Christie and Mario Holzner

What Explains Tax Evasion? An Empirical Assessment based on European Data

Foreword

This paper is divided into two parts. The first part deals with our chosen methodology and results in estimating the size of tax evasion in selected European countries. The taxes which are analysed are value added tax (VAT), excise taxes, personal income tax (PIT) and social security contributions (SSC). In the second part of this paper we use our estimates of tax compliance to test the main hypotheses derived from the theoretical literature on tax evasion, in particular with respect to the impact of tax rates, income inequality, tax complexity, the quality of the judicial system and public satisfaction with public services. We conclude with policy recommendations based on our findings.

1 Estimates of the size of tax evasion in Europe

1.1 Literature review

The literature on tax compliance may be seen has having followed three main strands. The first strand encompasses modelling approaches based on the classical model presented in Allingham and Sandmo (1972) and extensions thereof. In these models the taxpayer is modelled as a risk-averse, expected net income maximizing agent who has the possibility of under-reporting his income, but in doing so, would face (with a given probability) the prospect of being caught and fined (on top of having to pay the full tax liability). In particular the taxpayer is modelled as being driven exclusively by the maximization of his utility function, where furthermore his utility function depends solely on his expected income net of fines. For convenience we will refer to this pedigree of models as belonging to the 'neo-classical school'.

The second strand of research is inspired mostly from behavioural theory and rejects the strictly classical approach of Allingham and Sandmo. Andreoni, Erard and Feinstein (1998) identify three main moral and social factors that are relevant in this context: moral rules and sentiments; the taxpayer's perception of the fairness of the tax system and burden; and finally the degree of satisfaction that taxpayers have with respect to the provision of public goods and services. From a classical point of view, one may admit the validity of these models if one expands on the variables that enter the taxpayer's utility function, e.g. to include such notions as guilt or shame, or some subjective assessment of public services. For convenience we will refer to this pedigree of models as belonging to the 'tax morale school'.

We give a more detailed view of these two schools of thought at the beginning of the second part of this paper. For now we focus our attention on the third strand, which concentrates on the estimation or measurement of the size of tax evasion.

In the third strand of research, the goal is to measure the size of tax evasion. This is where this part of our research fits in. Andreoni, Erard and Feinstein (1998) list five different approaches: audit data (from the tax authorities), which are in some cases matched with census data; survey data; tax amnesty data; data generated through laboratory experiments; and measurements of discrepancies found in economic statistics. The approach that we propose belongs to this last category. In this category there is typically no econometric modelling involved at all. Instead, the idea is to calculate as precisely as possible the relevant tax bases and liabilities using national accounts data, census data and/or household budget survey data together with the official rates provided by taxation laws. We start off by briefly reviewing two relevant contributions in this category (there are surprisingly few in existence) and then introduce our own approach.

Nam, Gebauer and Parsche (2003) compute estimates of the hypothetical dues in value added tax (VAT) and yield VAT evasion ratios for selected EU member states. Their approach is to compute the total theoretical VAT liability for each country using national accounts data. The basic formula they use is a weighted sum of consumption and investment made by the various institutional sectors (households, government, non-profit organizations etc.). The weights are the various applicable VAT rates (full and reduced rates). The authors use national statistics from the member states to break down household final consumption into 32 types of goods and services and compute estimates of the average VAT rate for each of them. This enables them to come up with a relatively precise estimate of the applicable rate for household final consumption. The authors also make corrections for the time lags between the creation of the tax liability and the actual payment of the tax dues, as well as corrections for the suspensions of liabilities and other types of tax waiving, e.g. due to bankruptcies. In short, Nam, Gebauer and Parsche (2003) is carefully done. One missing element in our view, however, is a sensitivity analysis which would help the reader to interpret the results.

Another contribution we wish to discuss briefly is Madzarevic-Sujster (2002), which estimates tax evasion in Croatia over the period 1994-2000 separately for each main type of tax, including personal income tax, social security contributions, corporate tax, excise taxes, sales tax and VAT. Madzarevic-Sujster uses national accounts aggregates and estimates of the non-observed economy to construct estimates of the respective tax bases for each tax. She then computes the theoretical liabilities and obtains the revenue shortfall by subtracting the actual revenues. She furthermore makes use of a certain number of scenarios, in effect a set of assumptions about tax evasion behaviour by type of firm, in order to obtain her estimates. For excise taxation she focuses on the case of tobacco.

Our own approach is similar and can be summarized as follows: using national accounts aggregates as our starting point, we construct estimates of the relevant tax bases for personal income tax, compulsory employee social security contributions, VAT and excise taxes. For each of these main types of tax in turn, we compute estimates of compliance rates for each available year, based on the taxation laws and regulations and tax revenue data. Contrary to Madzarevic-Sujster (2002) we provide overall estimates for excise tax compliance, rather than only for tobacco products. We also conduct a sensitivity analysis of our results and discuss their precision and accuracy, rather than providing only point estimates as is the case in Nam, Gebauer and Parsche (2003).

1.2 Tax evasion in consumption

1.2.1 The theoretical framework

We construct a simple model of tax evasion based on the following assumptions:

– a share (1-ε) of the value of goods purchased which should be subject to excise and VAT taxation evades both taxes simultaneously – thus ε is defined as the excise goods taxation compliance rate, which we further assume to be identical for all types of goods subject to excise tax;

– a share (1-v) of the value of goods and services purchased which are not subject to excise taxation but which should be subject to VAT evades VAT taxation – thus v is defined as the non-excised goods VAT compliance rate, which we further assume to be identical for all types of goods and services not subject to excise tax;

– the declared consumption shares for both types of goods and services (subject to excise tax and not subject to excise tax) found in official household budget survey data are correct;

– the fact that we use data from the national accounts and the balance of payments statistics in order to calculate the corresponding declared amounts of excised goods (*DEG*) and non-excised goods (*DNEG*) in value terms implies that we assume officially published national accounts and the balance of payments statistics to be correct (i.e. including estimates of the non-observed economy);

– we assume that the tax revenue data for paid excise tax and paid VAT (*PEX* and *PVAT*) as provided by the official sources for each year are correctly measured.

The mathematical formulation of the model following the assumptions above is therefore the following:

$$DEG = EG \cdot (1 + VAT^{*} \cdot \varepsilon + (1 + VAT^{*}) \cdot \varepsilon \cdot EX) \quad (1.1)$$

$$DNEG = NEG \cdot (1 + VAT \cdot \nu) \quad (1.2)$$

$$PEX = \varepsilon \cdot EX \cdot EG \quad (1.3)$$

$$PVAT = VAT \cdot \nu \cdot NEG + VAT^{*} \cdot \varepsilon \cdot (1 - f) \cdot EG \cdot (1 + EX^{*}) \quad (1.4)$$

where *EG* and *NEG* are the net of tax values of theoretically excised and non-excised goods and services respectively. Equation (1.1) states that the declared value of purchased excised goods is equal to the net value of these goods plus excise tax (*EX* which is the average weighted excise tax rate[1]) applied to the compliant share ε of the net value of these goods, as well as VAT applied to the after-excise-tax value of the same share (*VAT** which in most cases of excised goods is the standard rate of VAT). Equation (1.2) states that the declared value of non-excised goods is equal to the net value plus VAT (*VAT* represents the average weighted VAT rate, including the standard rate and the respective reduced VAT rates) on the net value of a share *v* of the net total value.

Equations (1.3) and (1.4) simply match the model's revenue equations with the observed revenues. *EX** in equation (1.4) is the average weighted excise tax rate not including the rates on the intermediate consumption of fuels by sectors which are allowed to write off VAT on excised intermediate consumption of fuels. Consequently *f* is the share of the intermediate consumption of fuels by sectors which are allowed to write off VAT on excised intermediate consumption of fuels.

Using European tax law and data from official surveys, the national accounts and the balance of payments, we calculate *DEG* and *DNEG* as the following sums:

$$DEG = \varphi \cdot HHFC + \varphi \cdot TRAVEL + FuelINT \tag{1.5}$$

$$DNEG = HHFC - DEG - IMPRENT + HHCO + FGFCF + GGFCF + NGFCF + HGFCF + RGFCF + FINT + GINT + NINT + HINT + RINT + TRAVEL + NonFGNHRfuelINT \tag{1.6}$$

The share φ is a weighted rate of consumption of tobacco, beer, wine, spirits, fuels and other excised goods in household final consumption (*HHFC*). Equation (1.5) shows the declared consumption of excised goods. This is the sum of φ times household final consumption (*HHFC*) plus φ times the travel revenues from foreign tourists (*TRAVEL*) plus the intermediate consumption of fuels (*FuelINT*). Travel income was included in order to take into consideration the expenditures of tourists on excised goods. *FuelINT* was added as we assumed that there was no excise tax refund for the consumption of fuels, be it final or intermediate, except when the fuels are used for refining or energy production purposes.

Equation (1.6) enables the computation of *DNEG*. Here the idea is to estimate the VAT tax base (excised goods excluded) as precisely as possible, in accordance with VAT law. *DNEG* is the sum of *HHFC* less *DEG*, less imputed rents (*IMPRENT*), plus household construction outlays (*HHCO*). *IMPRENT* is removed as it is a notional consumption flow used as a balancing item by statisticians, not an actual consumption flow subject to VAT, while *HHCO* must be added because it corresponds to expenditures on home

[1] Including the main excise taxes on tobacco, beer, wine, spirits and fuels.

improvements beyond usual maintenance which are excluded from *HHFC* but which correspond to expenditures subject to VAT. We then add gross fixed capital formation of selected sectors, in particular of the financial sector (*FGFCF*), of government (*GGFCF*), of non-governmental-organizations (*NGFCF*), of the health sector (*HGFCF*), and of the real estate sector (*RGFCF*). We also add the intermediate consumption of the financial sector (*FINT*), of government (*GINT*), of non-governmental-organizations (*NINT*), of the health sector (*HINT*) and of the real estate sector (*RINT*). The reason for the presence of GFCF and the intermediate consumption of these sectors in the formula is that these flows are considered to be final consumption according to VAT law. In turn consumers do not have to pay VAT for goods and services provided by these sectors (this is taken into consideration by us when we compute the weighted VAT rate).

We then add travel income (*TRAVEL*) to reflect tourist expenditures subject to VAT and finally we have to add also those parts of *FuelINT* (*NonFGNHRfuelINT*) which are not already captured by the intermediate consumption of the sectors listed in the paragraph above, i.e. the intermediate consumption of fuel which is not due to the listed sectors.

DEG, *DNEG*, *VAT*, *VAT**, *EX*, *EX** as well as *PEX* and *PVAT* are measurable quantities. With the help of equations (1.1) to (1.4) we are able to calculate the values for the corresponding net values *EG* and *NEG* and the compliance rates *ε* and *ν*. The model we have constructed is therefore a classical equation system with four equations and four unknowns, which we solve as follows:

Using (3) to express ε and plugging it into (1) we obtain:

$$EG = DEG - VAT^{*} \cdot \frac{PEX}{EX} - (1 + VAT^{*}) \cdot PEX \tag{1.7}$$

Having *EG* enables us to compute ε:

$$\varepsilon = \frac{PEX}{EX \cdot EG} \tag{1.8}$$

Using (2) to express *NEG* and plugging it into (4) yields:

$$\nu = \frac{1}{VAT} \cdot \frac{PVAT - VAT^{*} \cdot \varepsilon \cdot (1 - f) \cdot EG \cdot (1 + EX^{*})}{DNEG - PVAT + VAT^{*} \cdot \varepsilon \cdot (1 - f) \cdot EG \cdot (1 + EX^{*})} \tag{1.9}$$

Finally, *NEG* can be computed as:

$$NEG = \frac{DNEG}{1 + VAT \cdot \nu} \tag{1.10}$$

The gist of the model above may be described as follows: the model separates excised goods from non-excised goods. Excised goods face excise tax and VAT. Non-excised goods face only VAT. The declared levels of consumption of each aggregate type are used and multiplied by composite theoretical average VAT and excise tax rates that we estimate using average consumption shares and given commodity-specific VAT and excise tax rates. The theoretical expected revenues are then regrouped for VAT from both aggregate types, and set against actual VAT revenues, implicitly yielding the VAT compliance rate. Expected revenues from excise tax are likewise set against excise tax revenues, yielding the excise compliance rate.

1.2.2 Data sources

Information on the VAT tax law was taken from the International Bureau of Fiscal Documentation (IBFD)'s European Tax Handbooks which covered all countries and years. Data on excise tax law was taken from the European Commission Directorate General for Taxation and Customs Union's Excise Duty Tables. The other main variables, including HHFC, its breakdown into commodity groups, travel income data, intermediate consumption of fuels, gross fixed capital formation and tax revenue data were all taken from Eurostat. However, some of the variables required special estimation procedures and specific working assumptions, notably HHCO and most of all the average weighted tax rates. For a complete description of the data processing and working assumptions please refer to the appendix.

1.2.3 Estimation results

Table 1.1 presents the main indicators of tax evasion in consumption. The figures represent averages for the period of 2000-2003 (it can be noted that the variation over the analysed years does not seem to be very strong). The first column presents the Concealed Consumption Share (*CCS*) in per cent of total consumption of taxable goods and services. *CCS* has been constructed as the sum of those parts of the net values of theoretically excised and non-excised goods and services where taxes were not paid (i.e. *EGNT* and *NEGNT*) divided by the sum of the total net values (i.e. *EG* and *NEG*). Assuming that *EG* is made up of *EGNT* and a part for which taxes have been paid (*EGT*), equation (1.11) looks as follows

$$EG = EGT + EGNT \tag{1.11}$$

Transforming and combining equations (1.1) and (1.11) yields

$$EGNT = EG - EG \cdot \varepsilon \tag{1.12}$$

The same holds true for the non-excised goods:

$$NEG = NEGT + NEGNT \tag{1.13}$$

$$NEGNT = NEG - NEG \cdot \nu \tag{1.14}$$

Thus, Concealed Consumption (*CC*) is

$$CC = EGNT + NEGNT \tag{1.15}$$

and *CCS* equals to

$$CCS = \frac{EGNT + NEGNT}{EG + NEG} \tag{1.16}$$

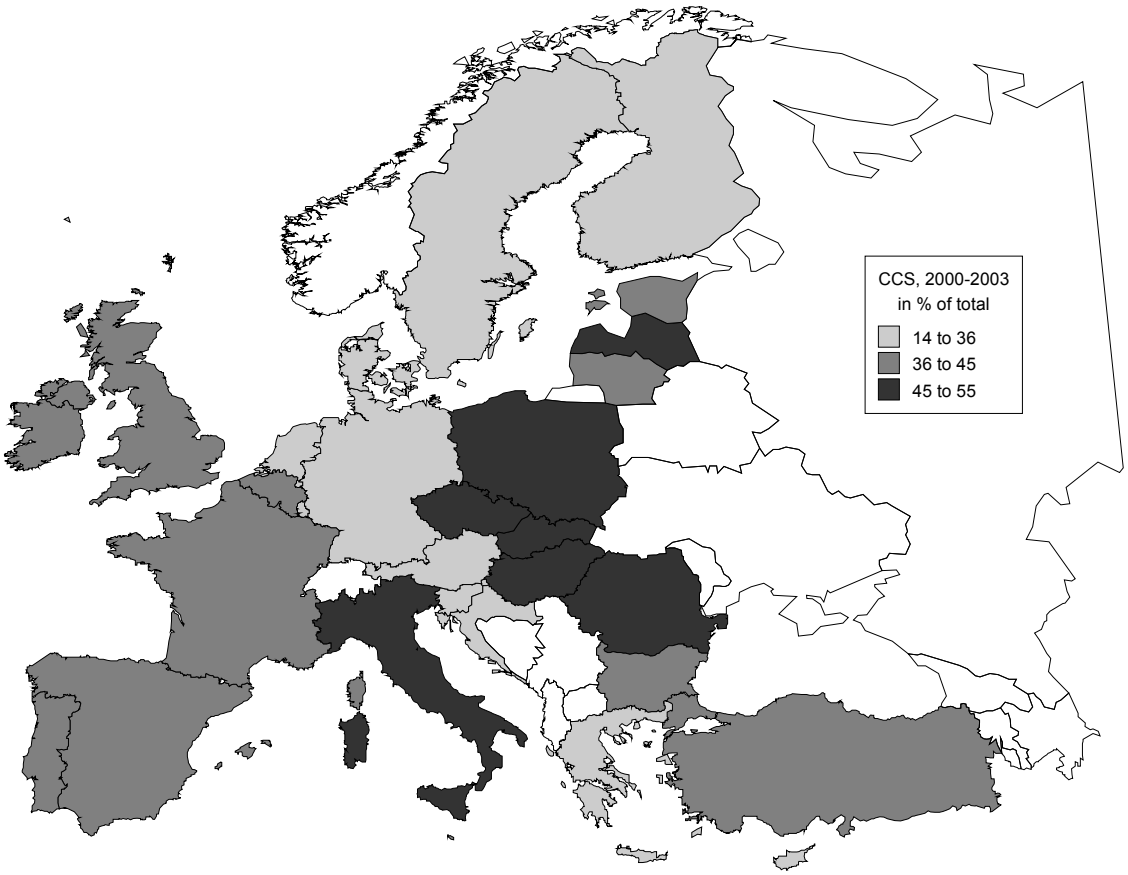
Table 1.1

Indicators of tax evasion in consumption, 2000-2003 average

	CCS	CC	VAT compl.rate	Av.weight. VAT rate	Missing VAT	Excise compl.rate	Av.weight. Excise rate	Missing Excise
	%	% of GDP	%	% of net	% of GDP	%	% of net	% of GDP
Croatia	14.2	11.1	88.4	20.3	2.7	66.9	74.0	2.3
Cyprus	21.2	19.4	80.6	8.4	1.9	59.2	77.7	2.3
Slovenia	24.1	17.0	77.5	15.9	3.1	55.8	113.9	2.7
Denmark	26.1	14.5	73.2	21.4	3.2	87.6	172.7	0.6
Greece	27.5	21.5	75.8	13.4	3.8	38.7	124.5	5.3
Germany	27.5	17.9	75.3	12.9	3.2	33.0	204.9	6.0
Netherlands	27.7	17.6	76.2	15.2	3.8	30.0	157.6	6.1
Finland	30.1	17.9	69.8	17.9	3.6	71.8	135.6	1.7
Luxembourg	30.2	18.1	76.0	13.6	3.3	37.9	122.9	7.5
Sweden	33.7	21.0	67.8	20.1	5.1	45.9	166.8	3.9
Austria	35.3	24.1	68.2	17.0	5.2	31.7	136.6	6.0
Estonia	36.3	28.6	67.5	16.8	5.2	41.7	65.0	4.4
Portugal	38.7	30.7	67.1	16.2	6.7	22.3	142.7	11.3
France	38.8	25.3	62.9	17.2	5.1	37.4	151.5	4.3
Malta	38.9	33.5	62.5	12.4	4.8	40.8	120.7	4.0
Spain	38.9	27.9	64.4	13.1	4.7	29.8	129.3	6.3
Belgium	39.0	24.9	63.2	17.1	5.0	38.4	113.1	3.9
United Kingdom	39.8	34.0	59.8	12.7	4.5	70.3	181.4	1.6
Bulgaria	42.7	34.1	55.6	17.5	6.2	75.0	77.0	1.4
Turkey	43.5	34.5	61.1	14.6	7.3	21.2	243.8	16.9
Lithuania	44.5	35.4	59.6	15.5	6.2	36.0	66.0	5.8
Ireland	44.8	29.8	56.0	17.7	6.1	43.0	213.8	4.9
Hungary	45.7	31.4	57.8	20.3	7.9	33.6	112.5	7.4
Slovakia	47.4	34.9	53.2	18.1	6.8	49.2	54.5	3.1
Latvia	47.4	36.1	53.2	16.8	6.3	49.2	55.3	3.4
Romania	47.4	34.5	57.1	17.0	7.8	15.8	208.5	14.1
Poland	53.7	42.1	48.0	17.8	8.9	34.3	120.1	7.6
Italy	54.0	38.5	47.6	18.1	8.1	28.6	145.6	6.3
Czech Republic	54.4	39.9	44.7	17.9	7.6	53.8	84.1	2.9
EU-29 average	37.7	27.5	64.5	16.3	5.3	44.1	130.1	5.3

Map 1.1

Concealed Consumption Share in Europe



Interestingly enough, in terms of *CCS* (which is our preferred indicator for the size of the shadow economy as calculated from the consumption side and which was used for the ranking of the countries in Table 1.1), we find four countries among the top ten countries with the smallest share of concealed consumption which are not commonly associated with low levels of the shadow economy: Croatia, Cyprus, Slovenia and Greece. However these countries not only have lower than average rates of VAT and/or excise tax but also rather high consumption tax revenues as compared to their tax base. It may be that this is related to the fact that these countries have a big tourism industry, while tourism revenues may be underestimated by the national statistical agencies. This in turn would lead to an underestimation of the tax bases for VAT and excise and subsequently to underestimates of the levels of *CCS*.

The remaining group of countries lying somewhere below or around a third of consumption being concealed from taxation are in general Central European and Scandinavian countries. This is perhaps less surprising as it conforms to popular prejudices. Similarly, those countries which seem to conceal the largest share (around half) of their consumption

of theoretically taxable goods and services are transition countries and Italy (Map 1.1 gives an overview of estimated *CCS* in the EU-29, splitting the countries into three groups: low, intermediate and high levels of *CCS*). The Czech Republic, Italy and Poland are estimated to have a CCS at about 54%. This is an astonishingly high share. However, relating Concealed Consumption (see *CC* in the second column of Table 1) to GDP yields shares which are more similar to what is known from the traditional shadow economy literature.

The CCS results are mainly driven by the estimated compliance rates for VAT (v) and excise tax (ε). These are displayed in columns 3 and 6 respectively in Table 1.1. The average EU-29 country has a VAT compliance rate of 65% and an excise compliance rate of 44%. Table 1 also depicts the estimated average weighted VAT and excise rates (in columns 4 and 7). Here the average EU-29 country has an average weighted VAT rate of 16% and an average weighted excise tax rate of 130%. In addition, columns 5 and 8 show the values for missing VAT and excise tax revenues in per cent of GDP. The EU-29 average for both shares is at about 5%. The three major outliers in this respect are Turkey, Romania and Portugal in terms of missing excise tax revenues in GDP. These three countries have double-digit shares. One reason, especially in the case of Turkey and Romania, might be the exorbitant level of the average weighted excise rate.

For purposes of comparison, Nam, Gebauer and Parsche (2003) find estimates of VAT compliance rates ranging from 65.5% to 97.6% for selected EU-15 countries for the average of the years 1994-1996. In particular they find 95.2% for Germany, 65.5% for Italy, and 97.6% for the Netherlands. Clearly our own estimates are systematically lower for all countries: we obtain (for 2000-2003) 75.3% for Germany, 47.6% for Italy and 76.2% for the Netherlands. In light of this comparison (though it remains purely indicative as the years are not the same), it would seem that our methodology overestimates the theoretical liabilities. On the other hand, the results of Nam, Gebauer and Parsche (2003) also seem rather extreme. Even in the best of cases it is hard to imagine that VAT compliance could be much above 90% even in countries such as Germany or the Netherlands. Also, it may be said that Nam, Gebauer and Parsche, in a separate section of their paper in which they construct a full time series of German VAT compliance for 1994-2001, find a clear increasing trend of VAT evasion over time. This is compatible with the results of Schneider and Klinglmair (2004), who observe a general increase in the size of the shadow economy in Europe over the 1990s. In sum, therefore, it would appear that our results are not necessarily overestimates of what is going on.

We conclude this section by doing a sensitivity analysis. We find that our results are rather sensitive with regard to the data inputs. We redid the calculations for two cases. In the first one we assumed that the national accounts data are systematically overestimated by 15% and in the second one we assumed the opposite. Also, we assumed tax revenue data as well as household budget survey data (in relative terms) to be correct. Thus we changed

mostly *DEG* and *DNEG* (and to some extent also the average weighted tax rates). The result is that in the first case, where we decreased the tax base by 15%, we receive an average deviation of the VAT compliance rate for all analysed countries and years of +21% as compared to the original calculations and an average deviation of the excise compliance rate of +36%. In the second case, where we increased the tax base by 15%, we obtained an average deviation of -15% and -21% for the VAT and the excise compliance rate respectively.

1.3 Tax evasion in income

1.3.1 The theoretical framework

In principle the method could be quite simple and would be as follows: we would have at our disposal the true distribution of gross income for each country and each year. We would then feed this distribution into a personal income tax (PIT) and social security contributions (SSC) calculator, yielding for each level of gross income the theoretical liabilities for PIT and for SSC. We would then aggregate these liabilities to the national level and compare them to the actual revenues for PIT and for SSC, thus yielding estimates of the compliance rates. This rather simple approach is unfortunately not feasible. First of all we only have distributions of net income, not gross income. Secondly, we do not know what share of gross income has been declared by the taxpayers to the tax authorities, in other words, we do not know the income declaration rate. For these two reasons we are forced to adopt a slightly more complex procedure, which is carried out following five successive steps. We start off by stating what these five steps are in general terms, and then proceed to explain each step in detail.

The first step is to compute the net amount corresponding to the gross amount which is the tax base for personal income tax and social security contributions. This net amount is based on an estimate of total net household income (net of PIT and SSC) which is then reduced by exempt incomes.

The second step is to construct a PIT and SSC calculator. This calculator is an Excel file which, for any given level of gross income, computes the theoretical PIT and SSC liabilities. The calculator can also be used in reverse mode to go from net to gross incomes.

The third step in our method is to acquire an estimate of the country's net income distribution and to fit the income distribution onto the national tax and social security base estimated in step 1.

In the fourth step, the net income vector from step 3 is fed into the PIT and SSC calculator, working in reverse mode (net to gross instead of gross to net), so as to yield a first estimate

of the distribution of gross income. This estimated gross income distribution is then re-scaled so as to fit the estimate of the gross value of the basic tax and social security contributions base so as to yield a better estimate of the true gross income distribution.

Fifthly and finally, the corrected gross income distribution found in step 4 is fed into the PIT and SSC calculator, this time working in forward mode (gross to net) in order to yield, for each income point, the theoretical PIT and SSC liabilities. These are then aggregated to yield the national total theoretical liabilities for PIT and for SSC. These totals are then compared to the actual revenues for PIT and SSC respectively, yielding the (revenue-based) compliance rates for PIT and SSC. We also calculate the theoretical effective rates for PIT and for SSC respectively by taking the ratio of the theoretical liabilities to the gross tax base. This will enable us to determine the impact of the theoretical effective rate on the compliance rate later on in the analysis.

Steps 4 and 5 imply that the calculator is used twice. We call this aspect of the method the 'double-feed' of the income distribution, and we will explain it in detail below using a worked example. We now turn to more detailed descriptions for each step of the method in turn.

Step 1 – Estimating the net equivalent of the tax base

We construct an estimate of net total household income (*NTHI*) based on household final consumption (*HHFC*)[2], from which we remove imputed rent (*IR*), which is included in *HHFC* according to SNA norms, but which is not linked to real monetary income. We must then add household construction outlays (*HHCO*) which we computed earlier in the section on VAT and excise tax compliance. Finally, we must also add household savings (*S*).

$$NTHI = HHFC - IR + HHCO + S \tag{1.17}$$

We then take away from *NTHI* estimates of incomes which are exempt from PIT and SSC. These incomes are different across countries and years. In most cases exempt incomes are certain social benefits, which we refer to as exempt social benefits (*ESB*) below. This yields the net equivalent of the tax base (*NETB*).

$$NETB = NTHI - ESB \tag{1.18}$$

The gross equivalent of this amount, the common gross tax base (*CGTB*), which is used at the end of step 5 to calculate the notional general tax base, is defined as:

$$CGTB = NETB + PPIT + PSSC \tag{1.19}$$

[2] The alternative would be to add up all the separate types of income, i.e. wages and salaries plus household business income, plus household property income, plus social benefits etc. This is in practice difficult due to the correct splitting up of household mixed income, hence our preference for a consumption-based estimate.

where *PPIT* is actually paid PIT and *PSSC* is actually paid SSC by employees and the self-employed.

Step 2 – Constructing the PIT and SSC calculators

Each calculator incorporates the PIT schedule (band limits and rates) and the amounts for allowances, deductions and tax credits, as well as the rates, floors and ceilings for SSC. The effect of the allowances, deductions and credits are multiplied by corrective ratios (e.g. estimate of the average number of dependent children per taxpayer) so as to apply them uniformly to all income levels (the assumption being that we have, at each income level, a representative taxpayer). The various elements of SSC are computed and added up in a separate column. If SSCs are PIT exempt, these are subtracted before the PIT computation takes place. For PIT the calculator subtracts the total of allowances and deductions, applies the schedule, and then removes the credits, yielding the final theoretical liability.

For the reverse mode (gross to net), a separate worksheet is used. The computations in the forward mode are first made for a large number of possible gross income points (700-1000). The net distribution is then stacked onto the initial net vector, and the rows are sorted in ascending order of net income. The corresponding estimated gross income points are then estimated by linear interpolation. This procedure has an acceptable degree of precision if the number of initial gross income points from sheet 2 is large enough; e.g., if the net income level for which one needs to know the corresponding gross income level is 12,340, the result is taken as a linear interpolation between the gross incomes corresponding to 12,300 and 12,400.

Step 3 – Constructing an estimate of the net income distribution

The net income distributions initially consisted of several thousand income points, each associated with a given (demographic) weight. These distributions were obtained from the Luxembourg Income Study (LIS) project and were available for most countries covered in our analysis, but generally only for one year.[3] From each distribution we extracted the corresponding quantiles for 200 separate income points. This number of quantiles was a practical compromise, ensuring a sufficiently precise description of the income distribution while sticking to vectors that would remain easy to handle.

The other operation that was necessary in this step was to determine to what population base the income distribution should apply. This issue was solved on a case-by-case basis,

[3] For those countries where a distribution was available, we used the same distribution for all years. For those countries where a distribution was not available at all, we used the distribution of another country.

depending on what was included by law in taxable income and on what population had been surveyed by LIS in the first place. If, for instance, many types of social benefits were subject to taxation, then it could be assumed that economically inactive persons living on social benefits should be part of the considered population, so the distribution was fitted onto the entire adult population. If all benefits for inactive persons were exempt, we fitted the distribution to employed persons and pensioners only.

Steps 4 and 5: The double-feed feature and its usefulness

In order to give an easily understandable explanation of steps 4 and 5 we have chosen to set up a worked example of a simplified (imaginary) country. Let us assume that the income distribution of imaginary country X is made up exclusively of the following five (true) gross annual income levels: 1000; 3000; 5000; 8000; and 35,000. Assume further that the numbers of persons earning each income level are, respectively, 500,000; 1,200,000; 600,000; 250,000; and 50,000. In other words, we have a country with a total number of earners equal to 2.57 million, with a typical (but here very simplified) asymmetric long-tailed income distribution. Now we assume that each taxpayer has an identical income declaration rate of 80%, and we assume that the taxpayers face a typical income tax schedule as shown in Table 1.2.

Table 1.2

Sample personal income tax schedule

Floor	0	700	2,100	6,000
Rate	0%	10%	20%	40%

Such a schedule can be seen as an average European schedule. In practice the number of rates varies from 2 to 7 depending on the country, if one includes the 0% income band.

Table 1.3

Declaration rate and actually paid PIT

True gross incomes	Persons	Declaration rate	Declared income	Theoretical PIT liability	Actually paid PIT
1,000	500,000	0.8	800	30	10
3,000	1,200,000	0.8	2,400	320	200
5,000	600,000	0.8	4,000	720	520
8,000	250,000	0.8	6,400	1,720	1,080
35,000	20,000	0.8	28,000	12,520	9,720

With this setup, and bearing in mind the declaration rate of 80%, we find the theoretically payable amounts of tax and the lower actually paid amounts of tax to be as described in Table 1.3. From the table we can compute the following weighted sums: total theoretical PIT liability = 1.5114 billion and total actually paid PIT = 1.0214 billion. From these results the implied compliance rate is therefore 1.0214 / 1.5114 = 67.6%. This result is the goal of the entire estimation exercise. However, we do not have access to the true income levels, nor do we have access to the declaration rates (which may vary across income levels). What we do have from income distributions is the distribution of net income. This (true) actual net income distribution in our worked example is shown in the third column of Table 1.4.

Table 1.4

Actual net incomes

True gross incomes	Actually paid PIT	Actual net incomes
1,000	10	990
3,000	200	2,800
5,000	520	4,480
8,000	1,080	6,920
35,000	9,720	25,280

We recall here that we do not have the first two columns of Table 1.4, only the third column. Now if we used this third column as it is and fed it through the PIT calculator (working in reverse mode, from net to gross), we would be implicitly assuming that the declaration rate was 100% and computing what gross income levels would correspond to the given net income levels assuming 100% declaration. This would lead to an overestimation of the gross incomes, as well as to an overestimate of the true PIT liabilities, since these would be based on higher gross incomes. In our example, this would lead to the results of Table 1.5.

Table 1.5

Overestimation of PIT liabilities

True gross incomes	True net incomes	Implied gross incomes	Implied PIT liabilities	Correct theoretical PIT liabilities
1,000	990	1,025	35	30
3,000	2,800	3,175	375	320
5,000	4,480	5,275	795	720
8,000	6,920	9,075	2,155	1,720
35,000	25,280	39,700	14,420	12,520

In other words, we would be assuming, for example, that the PIT liability for someone earning 990 in net terms was 35 instead of 30.[4] In the aggregate view, we would obtain a total PIT liability of 1.77165 billion and conclude that the compliance rate was only 57.7% instead of the correct result of 67.6%, in other words, we would be making a strong overestimate of the theoretical liability.

Table 1.6

Overestimation of Total Gross Income

True gross incomes	Persons	Weighted true gross incomes	Implied gross incomes	Weighted implied gross incomes
1,000	500,000	500,000,000	1,025	512,500,000
3,000	1,200,000	3,600,000,000	3,175	3,810,000,000
5,000	600,000	3,000,000,000	5,275	3,165,000,000
8,000	250,000	2,000,000,000	9,075	2,268,750,000
35,000	20,000	700,000,000	39,700	794,000,000
TOTALS		9,800,000,000		10,550,250,000

In order to mitigate the effects of the unknown declaration rate, we opt for the double-feed method: we keep the first step (the single feed) but we then re-scale the vector of implied gross incomes so that its weighted sum equals the correct gross income. We know the correct gross income (its total, not its distribution) as it is equal to total net income (known) plus total actually paid PIT (known as well). From Table 1.6 we find a total implied gross income of 10.55 billion instead of 9.8 billion, thus the rescaling ratio is 9.8 / 10.55 = 0.929. We now feed the corrected gross incomes vector into the PIT calculator and obtain the corresponding theoretical liabilities as shown in Table 1.7.

Table 1.7

Rescaling of implied gross incomes

True gross incomes	Re-scaled gross incomes	PIT on re-scaled gross incomes	Weighted PIT on re-scaled gross incomes
1,000	952	25	12,600,000
3,000	2,949	310	371,760,000
5,000	4,900	700	420,000,000
8,000	8,430	1,892	473,000,000
35,000	36,877	13,271	265,416,000
TOTALS			1,542,776,000

[4] In particular we see that this overestimate is particularly high for the higher incomes which face a higher average and marginal tax rate. The overestimate is also larger for lower declaration rates and would be zero if the declaration rate were 100%.

Thus we obtain an estimate of the theoretical total PIT liability of 1.54 billion using the double-feed method. This estimate is much closer to the correct theoretical liability of 1.51 billion than the result of the single-feed method, which was 1.77 billion.

We have just shown that the double-feed approach is preferable to the single-feed approach in the case of this specific worked example. It can be shown that this is always the case with declaration rates strictly below 100%. However, before we proceed it is necessary to have a brief discussion on possible alternatives to the double-feed method and on its various caveats.

In trying to design alternatives, one could seek to circumvent the problem posed by the unknown declaration rate in a different way. One alternative would be to conduct a simultaneous estimation of the declaration rate, or perhaps a step-wise estimation procedure which would extract an estimate of the declaration rate from the double-feed method, and then use this implied estimated declaration rate to re-compute estimates of the gross incomes based on the true net incomes. In fact there is a solution to this problem, but it is computationally rather demanding: one would have to set up the PIT calculator so that it includes a fixed declaration rate and one would then sequentially look for the declaration rate which is such that the implied total PIT liability on declared income is equal to the total actually paid PIT. However, such a refinement would not necessarily constitute an improvement because it would have the significant caveat of imposing an identical declaration rate on all taxpayers, which is something that our double-feed method, in spite of its inherent approximations, does not do. Beyond this point, we could further refine the method by assuming a functional relationship between the declaration rate and the income level, but we would then increase the number of unknowns and would need additional data to help determine the parameters entering the assumed functional form. In short, there does not seem to be an easy way out of this problem. There is a trade-off between the various possible working assumptions, and there is no perfect solution given the available data.

1.3.2 Data sources

The data used for the computation of net total household income (*NTHI*) and the corresponding net equivalent of the tax base (*NETB*) were taken from Eurostat and the OECD. Household savings rates were estimated using Eurostat and OECD data. Demographic data were taken from Eurostat, while the income distribution data points were extracted from the LIS database (Luxembourg Income Study Group).

Finally, the detailed descriptions of the PIT and SSC systems were taken from the IBFD's European Tax Handbooks for each country and year. In some cases additional information was sought from national sources.

More detailed information on data sources and specific assumptions can be found in the appendix.

1.3.3 Estimation results

In this section we present our estimation results for each country in turn. We strove to produce estimates for a relatively diverse set of European countries, though there were constraints on the total number of estimates we were able to produce, partly linked to difficulties with some of the data and partly due to difficulties in correctly interpreting aspects of PIT or SSC legislation. In the end we produced estimates for 14 countries for several points in time, though we chose to limit ourselves to single point estimates for the Netherlands and Germany and to just two point estimates for Italy and France. We start off by looking at the results for the United Kingdom.

Table 1.8

PIT and SSC results for the United Kingdom

Country	Year (UK fiscal year 6 April to 5 April)	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
UK	1995-1996	60.95%	65.42%	5.79%	18.01%
UK	1996-1997	61.36%	64.99%	5.76%	17.41%
UK	1997-1998	63.45%	69.80%	5.76%	17.02%
UK	1998-1999	62.76%	75.60%	5.80%	17.01%
UK	1999-2000	65.26%	77.73%	5.49%	17.03%
UK	2000-2001	64.67%	79.23%	5.43%	17.50%
UK	2001-2002	64.15%	80.76%	5.35%	16.69%
UK	2002-2003	64.89%	77.97%	5.36%	16.89%

We see that the compliance rates, in particular for the later years, are reasonably high, especially for PIT. It is particularly remarkable that the compliance rate for PIT has grown quite considerably over the period. In parallel, it must also be said that PIT revenues as a share of GDP have grown steadily over the same period, averaging 9.4% for the first four years against 10.6% for the last four years, an increase of 12.6%. If one looks at the actual tax system, there have not been any major changes over the period, only the usual adaptation of the floors and ceilings of the income bands year after year and some tweaking of the rates and allowances and credits. However, the sum of these small progressive changes has been to steadily lower the theoretical effective rate. This evolution is closely matched by a strong increase in revenues which outdid the growth in the total PIT liability over most of the period. But, one should also point out that the central period 1997-2000 had a stable theoretical effective rate while both compliance and

revenues soared. Even if one allows for a lagged effect of the theoretical effective rate, it seems clear that the tax collection process itself has been improved over the period.

Table 1.9

PIT and SSC results for Austria

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
Austria	2000	93.19%	78.12%	14.20%	17.87%
Austria	2001	90.90%	77.22%	14.05%	18.75%
Austria	2002	88.46%	77.13%	14.50%	18.64%
Austria	2003	90.79%	74.80%	14.14%	18.95%

Our results for Austria show high compliance rates, among the highest of our entire sample in fact, in particular with respect to social security contributions. Concerning PIT, the estimates for Austria proved to be quite a challenge, as the IBFD handbooks did not provide a proper explanation of the special treatment of the 13th and 14th salaries typically paid out to employees. Turning to the theoretical effective rate, the small jump after 2000 is mainly due to the fact that accident benefits (*Unfallrenten*) became a taxable income in 2001 (this was changed back in 2004). Overall, though the variance in both the theoretical rates and the compliance rates is smaller than, e.g., in the UK case, there seems to be also in the Austrian case a negative relationship between theoretical effective rates and compliance rates.

Table 1.10

PIT and SSC results for the Czech Republic

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
Czech Republic	1996	62.87%	68.64%	12.76%	13.11%
Czech Republic	1997	61.78%	65.52%	12.76%	13.38%
Czech Republic	1998	61.95%	68.37%	12.76%	13.02%
Czech Republic	1999	62.22%	71.28%	12.76%	11.90%
Czech Republic	2000	64.17%	73.84%	12.76%	11.82%
Czech Republic	2001	63.99%	73.96%	12.76%	11.66%
Czech Republic	2002	66.13%	73.99%	12.76%	11.88%
Czech Republic	2003	67.48%	76.62%	12.76%	12.08%

The results for the Czech Republic display a general pattern not unlike that seen in the case of the UK: steadily increasing compliance rates for both SSC and PIT, accompanied by a steady decrease of the PIT theoretical effective rate. The SSC theoretical effective rate remained unchanged however, simply because the rates were not changed during the

period combined with the fact that there are no floors or ceilings for the computation of SSCs, at least according to the IBFD handbook. But coming back to PIT, we notice that there is a quite abrupt fall in the theoretical effective rate in 1999, after which the rate stays relatively stable around 11.9%, compared to values of over 13% prior to 1999.

The main driver for this change was an adaptation of the personal allowances as well as of the floors of the income bands of the PIT schedule that went far beyond nominal wage inflation. While wages and salaries (1993 SNA definition) rose by 3.3%, and while our own measure of net total household income (NTHI, defined in equation 1.17) grew by just 2.3% from 1998 to 1999, the basic allowance rose by 9%, the dependent child allowance rose by 20%, and the income band floors rose by 11.5% for the first two floors and by 13.8% and 34.2% respectively for floors 3 and 4, while the rates remained constant. The effect of this targeted reduction in the theoretical effective rate seems to have borne fruit, yielding improvements in compliance, although one should of course analyse the Czech case in more detail to see whether other reforms, e.g. of tax administration procedures, may have been introduced simultaneously.

Table 1.11

PIT and SSC results for Italy

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
Italy	1998	78.99%	63.70%	6.00%	22.78%
Italy	2002	82.71%	62.49%	6.00%	22.68%

We now focus our attention on Italy. Here there were certain problems due to the incomplete description of the PIT system given in the IBFD handbook. Crucially, there is a special separate table which enables employees to look up the amount of a rather substantial income deduction (in the case of 1998) or of a rather substantial tax credit (in the case of 2002, Italy having switched from an income deduction-based system to a tax credit-based system). There is no simple mathematical formula which corresponds to the values in the table: it is a step function with 22 different bands (for 2002) of variable width. After a number of enquiries with private contacts in Italy, we managed to get hold of the relevant table for 2002. For 1998 we made an estimate of the effect of the table based on the minimum and maximum deductions which were mentioned in the IBFD handbook. The estimation results show relatively high SSC compliance but relatively low PIT compliance. We also note that the PIT theoretical effective rate is higher than in most other countries.

Belgium has the highest PIT theoretical effective rates we have found among the 14 countries we have made estimates for. This is mainly due to the high headline rates and the strong progression of the PIT schedule (up to 55%), combined with an additional

municipal tax (around 7%) and a so-called austerity charge (depending on the year, a surcharge of up to 3% on the amount of tax). To mitigate this, the Belgian system has a complex system of allowances, deductions and tax credits which substantially reduces the tax liabilities down to more reasonable levels. There is a deduction for employees based on a schedule system similar to a PIT schedule, with four bands, there is of course a series of allowances based on the family situation of the taxpayer, and, importantly in the case of Belgium since the rate of home ownership is very high, there is a relatively complicated system of deductions linked to mortgages. In spite of all these reductions in the final PIT liabilities, the theoretical effective rates, as can be seen in Table 1.12, remain quite high. On the other hand, PIT compliance in Belgium is rather high. This is a first indication for us that a purported relationship between the theoretical effective rate and the compliance rate may not hold after all, at least not on a cross-country basis. A glance at the (short) time series for Belgium however does seem to indicate that changes over time of the theoretical effective rate are correlated with opposite changes in compliance.

Table 1.12

PIT and SSC results for Belgium

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
Belgium	1998	68.14%	71.27%	10.89%	24.99%
Belgium	1999	67.94%	69.06%	10.89%	25.25%
Belgium	2000	68.53%	68.74%	10.88%	25.95%
Belgium	2001	70.83%	67.66%	10.87%	26.34%
Belgium	2002	69.37%	70.15%	10.88%	25.38%

We now turn our sights to a completely different case. Latvia has an extremely simple PIT system, based on a single rate of 25% (unchanged throughout the period) and a very low income allowance (the basic personal allowance is 21 lats per month, roughly 36 euros in 2002). Very few types of incomes are exempt from tax, and there are no separate rates for 'special' types of income. Taken together, this gives us a system with a very wide tax base, with comparatively high theoretical effective rates for persons on low incomes, and with comparatively low theoretical effective rates for persons on high incomes. This means that the overall theoretical effective PIT rate is in fact relatively high, at least as compared to other transition countries, since the single rate (25%) is not that low. In any case, what our estimates show is that compliance in Latvia is extremely low. Of course there are plenty of reasons one may think of which could account for the low compliance found in Latvia. It is, after all, a transition country. Tax morale may be low, there may be issues concerning the efficiency of the tax collection process, the size of the underground economy is certainly large, and there may be issues linked to corruption as well. In any case, sticking to a more narrow view based solely on the tax system, it would seem that the 'flat rate' system in Latvia does not bring about particularly high compliance. We suspect that this may be in

part due to the fact that the basic allowance is far too low, much lower in relative terms (as compared to some reasonable notion of a minimum survival income) than in most other countries. This matters because, in practice, there is always in every country a very large number of only partially active persons on very low incomes who 'scrape through' partly thanks to informal networks and partly thanks to secondary, part-time or occasional incomes. The fact that in the Latvian system most of these people are in principle liable to pay income tax is rather unusual, and of course extremely difficult to enforce in any country, let alone a transition country. Following on the results for Latvia, we have a look at the results for Estonia, which are in fact quite similar, though with higher compliance rates.

Table 1.13

PIT and SSC results for Latvia

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
Latvia	1999	56.17%	46.81%	6.77%	17.71%
Latvia	2000	55.23%	46.61%	6.77%	18.09%
Latvia	2001	53.02%	45.30%	6.77%	18.50%
Latvia	2002	53.20%	44.84%	6.77%	18.93%

Estonia's taxation system is very similar to that of Latvia, essentially a single rate (flat rate) system with a wide base (low allowances) and a low degree of complexity. In spite of this, we also find compliance to be relatively low. As for the impact of the theoretical effective rate, there is no clear pattern.

Table 1.14

PIT and SSC results for Estonia

Country	Year	PIT compliance	PIT theoretical effective rate
Estonia	1996	60.07%	21.26%
Estonia	1997	58.36%	22.00%
Estonia	1998	59.14%	22.50%
Estonia	1999	59.69%	22.62%
Estonia	2000	58.48%	21.16%
Estonia	2001	58.54%	20.58%
Estonia	2002	56.29%	21.10%
Estonia	2003	55.73%	21.57%

Moving on, we consider the results for France, Germany and the Netherlands. The number of estimates for each of these three countries is limited, as each of these countries posed specific problems during the estimation procedure (unclear tax legislation – at least based

on what was available from the IBFD handbooks – being the major stumbling block). In any case, we do find for all three countries relatively good compliance rates.

Table 1.15

PIT and SSC results for France, Germany and the Netherlands

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
France	1997	78.16%	60.26%	3.68%	15.57%
France	1999	72.35%	75.38%	3.79%	16.47%
Germany	2002	84.03%	67.72%	17.79%	17.72%
Netherlands	1998	NA	72.84%	NA	13.25%

For Portugal we find a more familiar pattern: a steady improvement in PIT compliance accompanied by a steady reduction of the PIT theoretical effective rate, similarly to what we found for the UK. It is also noteworthy that SSC compliance has improved over the period in spite of a fixed SSC theoretical effective rate. Thus Portugal finds itself in 2002 with 'decent' compliance levels, approaching, e.g., the levels found in Belgium.

Table 1.16

PIT and SSC results for Portugal

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
Portugal	1998	56.91%	54.66%	7.69%	14.38%
Portugal	1999	59.91%	61.26%	7.69%	13.20%
Portugal	2000	60.19%	60.76%	7.69%	13.61%
Portugal	2001	63.12%	65.71%	7.69%	12.51%
Portugal	2002	66.02%	68.09%	7.69%	12.09%

For Slovakia we find that SSC compliance is rather high, and substantially higher than PIT compliance. Simultaneously the theoretical effective rates are of similar magnitude for both types of tax, which is an unusual situation. Clearly this suggests that the theoretical effective rate is not interchangeable in analytic terms if one is looking at different types of taxes.

Table 1.17

PIT and SSC results for Slovakia

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
Slovakia	1998	71.04%	55.61%	9.60%	14.23%
Slovakia	2001	69.74%	61.54%	10.27%	11.25%
Slovakia	2002	69.21%	55.76%	10.21%	11.17%

For Poland, where we computed results only for PIT given that employees, up to 1998, were not liable to SSC, we found reasonable results up to 1998. However, in spite of a steady decrease of the theoretical effective rate, we see a collapse in compliance starting from 1999 (not shown above). This result is directly driven by a sharp *nominal* fall in official PIT revenues for Poland (from 45 billion zlotys in 1998 to 31 billion zlotys in 1999). This fall came in spite of the fact that the PIT schedule and the main exemptions and deductions did not change significantly between 1998 and 1999. Part of the explanation is that there have been significant reforms of the Polish social security system starting from 1999. However, we were unable to find sufficiently complete information on the new system and we remain uncertain about whether the official data on personal income tax revenues really measure the same thing for the period prior to 1999 compared to the period after 1999. We suspect that there may be some automatic allocation of PIT revenues to SSC funds, but in the absence of more precise information we prefer to refrain from making and using compliance estimates for the later years. However, as far as the results for 1996-1999 are concerned, we find the expected pattern of increasing compliance combined with a decreasing theoretical effective rate.

Table 1.18

PIT and SSC results for Poland

Country	Year	PIT compliance	PIT theoretical effective rate
Poland	1996	61.65%	20.91%
Poland	1997	62.07%	19.99%
Poland	1998	66.22%	18.62%

For Hungary we find the opposite result: compliance is higher for PIT than it is for SSC, and the theoretical rates are very different for the two types of taxes. As the SSC rates are much lower than the PIT rates, while compliance is higher for PIT than for SSC, we see further evidence that the theoretical effective rates operate at quite distinct levels between the two types of taxes. More generally, we find that the PIT compliance rates are reasonable, while the PIT theoretical effective rates are relatively high compared to what they are in the other transition countries covered in this section.

Table 1.19

PIT and SSC results for Hungary

Country	Year	SSC compliance	PIT compliance	SSC theoretical effective rate	PIT theoretical effective rate
Hungary	1999	61.64%	68.10%	8.67%	20.42%
Hungary	2000	60.31%	69.35%	8.61%	21.16%
Hungary	2001	62.30%	69.64%	8.52%	21.16%
Hungary	2002	63.59%	69.79%	8.47%	21.10%

An overview of the results we have found can now be made. First of all, Western European countries typically display higher compliance rates for both PIT and SSC than do transition countries. As we have seen, Western European countries have PIT compliance rates ranging from around 60% to around 80%, while transition countries have PIT compliance rates ranging from around 45% to around 75%. For SSC the compliance rates are in the 70-95% range for Western European countries (a bit lower for Belgium, the UK and Portugal) and in the 50-75% range for the transition countries. Second, the theoretical effective rates seem to be negatively correlated with the compliance rates if one looks at the country time series individually. A cross-section relationship is, however, less immediately obvious. Finally, one finds quite striking results for Latvia and Estonia, where the compliance rates are really rather low. This is an interesting finding given both countries' very simple 'flat rate' system of income tax.

A sensitivity analysis of selected results

We conclude this section by a brief sensitivity analysis. This is a necessary component of our work given that we have approached the issue of compliance in a non-stochastic way. We therefore do not have any standard assumptions about the distribution of possible estimation or measurement errors, though such errors may be present at several stages of our procedure. The income distributions used may be inappropriate, our modelling of the tax systems may have overlooked certain important elements, or indeed some of the inputted data may be imperfectly measured. In practice it is, however, difficult to set up a deterministic sensitivity analysis using objective criteria. We do not have in our possession examples of 'true' results that we could compare to our own data, leading us to formulate stylized facts about the type, sign and magnitude of the errors that would typically arise. The task is also made rather complex by the fact that each estimate relies on a large number of inputs: the income distribution may have the wrong variance, the wrong skewness factor, the wrong kurtosis, perhaps it should have a different number of modes, perhaps the tails should be completely different. When interpreting the effect of the tax system we may have overestimated the average number of dependents per taxpayer, the average mortgage interest payment, or the average life insurance premium payment. In building the tax base, NTHI may exclude incomes generated in the shadow economy, while our estimate of the net equivalent of the tax base (NETB) may be in certain cases mistaken because we used incorrect estimates of certain exempt incomes.

These difficulties being stated, we nevertheless feel that the most important insights concerning the sensitivity of our results may be achieved by re-estimating a selected result with targeted deviations introduced on one main variable at a time. To do this, we choose the case of Belgium for 2002. This choice is motivated by the fact that Belgium's PIT system should be quite sensitive to changes in inputs given its strong progression. In other words, we would like to illustrate a kind of worst-case scenario (flat-rate systems such as

the Latvian or Estonian systems would be much less sensitive). We first take a look at what the estimated compliance rates would be if we allow for a +/- 10% variation of the net equivalent tax base (NETB) while holding everything else constant. Secondly, we consider what the compliance rates would be if we changed the shape of the distribution, though it is fitted to what (we assume) is the correct NETB.

Table 1.20

Sensitivity analysis for Belgium (2002) – changes to the tax base

NETB	PIT compliance	SSC compliance
Minus 10%	80.5%	74.9%
Central value	70.1%	69.4%
Plus 10%	61.9%	64.7%

As we can see, the results for PIT are much more sensitive than those for SSC. This should come as no surprise given the progressiveness and higher rates of PIT, which imply a much stronger reaction of liabilities (the revenues are held constant here) to changes in the mean of the income distribution.

In Table 1.21 we look at the effects of using strongly modified (fictional) income distributions. The 'high equality' distribution is based on the standard distribution, but the first 40 income points (first two deciles) all have exactly the same income, equal to the average of the first two deciles of the original distribution, and the last 40 income points also have exactly the same income, equal to the average income of the last two deciles of the original distribution. It is thus a much more equal distribution. The 'high inequality' distribution starts off with very low amounts, with less than 100 euros per month at the 1st quartile, and then slowly rises, but always remaining below the corresponding income level in the standard distribution, up to the 185th income point (out of 200). Thereafter the distribution catches up on the total of the standard distribution with very high incomes.

Table 1.21

Sensitivity analysis for Belgium (2002) – changes to the income distribution

Distribution	PIT compliance	SSC compliance
High equality	66.9%	70.1%
Original	70.1%	69.4%
High inequality	56.2%	70.3%

Not unexpectedly, though the tiny scale of the change is perhaps surprising, the results for SSC hardly change at all. The picture is quite different with PIT compliance however.

Interestingly, compliance is lower for both extreme distributions. In the case of the less equal distribution, this was to be expected as we concentrated larger chunks of income in the hands of the top decile: these 'displaced' incomes, arriving on top of already quite large incomes, are thus taxed at the highest marginal rate of the schedule. The case of the more equal distribution is explained more due to its very odd shape (a histogram would show the distribution starting and ending with two very high columns, with the truncated centre of the usual distribution in between the two). Both ends of the distribution (top end: less income at the highest marginal rate, bottom end: more income above the threshold) contribute to the result.

In any case, while it is clear that both of these distributions are exaggerations of possible real distributions, so that our results are in fact less sensitive than the table above suggests, we are forced to admit that our PIT compliance estimates do respond quite strongly both to changes in the overall tax base and to the income distribution. This should be borne in mind. Concretely this implies that considerable care must be taken for this type of estimation exercise in order to obtain reasonably precise results. On the other hand, the sensitivity analysis also suggests that there is an inherent instability related to personal income tax due to its progressive structure. Also, the example we have given above suggests that the income distribution itself is less problematic and less crucial than the correct level of the tax base. Concerning the latter, we must admit here that errors of around 5%, and perhaps as much as or even a bit above 10% are not impossible. Reported household final consumption in certain transition countries may deviate from its true value by a few percentage points due to the (national accounts unincorporated) non-observed economy. If this error is compounded, e.g. by incorrect estimates of the savings rate and of the level of exempt incomes, one may easily obtain quite large errors in the compliance rates, even if everything else is correct.

2 Empirical analysis of the determinants of tax evasion

2.1 Introduction

We start by reviewing the key components of models of the neo-classical school. The model presented in Allingham and Sandmo (1972) provides us with a number of implications which are testable empirically. The model may be summarized thus (following Sandmo, 2004):

Let W be the gross income of the taxpayer. There is a proportional income tax of rate t. Noting evaded (concealed) income as E, reported income is thus W-E. If the tax evasion is not detected by the tax authority, the net income of the taxpayer is:

$$Y = W-t(W-E) = (1-t)W+tE \quad (4.1)$$

If, however, it is discovered that the taxpayer has underreported his income, he will pay a penalty rate of tax, θ, on the evaded amount, so that his net income in this case is:

$$Z = (1-t)W+tE-\theta E = (1-t)W-(\theta-t)E \quad (4.2)$$

The taxpayer is modelled simply as a risk-averse and rational expected utility maximizer. The taxpayer faces an audit with probability p, such that his expected utility is:

$$V = (1-p)U(Y)+pU(Z) \quad (4.3)$$

Since the taxpayer is assumed to be risk-averse, U must be increasing and concave. The taxpayer chooses how much income to conceal (E) in order to maximize his expected utility. Solving the taxpayer's problem yields a solution for E as a function of W, p, t and θ. Suffice it to point out here the key (and rather obvious) properties of the model:

a. E is decreasing in p: an increase of the audit rate decreases evasion
b. E is decreasing in θ: an increase in the punishment rate decreases evasion
c. E is increasing in W if the taxpayer has decreasing absolute risk aversion

Interestingly, the model does not provide an unambiguous result concerning the effect on evasion of a rise in the (statutory) tax rate t itself. One additional insight which came soon after the original Allingham-Sandmo paper is found in Yitzhaki (1974). Yitzhaki (1974) modifies the original model so that the penalty is imposed not on the evaded (concealed) income but on the amount of evaded tax (the author was inspired by US and Israeli legislation). In this case the effect is unambiguous: a higher tax rate provokes more evasion:

d. E is increasing in t: an increase in the tax rate increases evasion (Yitzhaki model)

However, the empirical evidence to date, as quoted notably in Andreoni, Erard and Feinstein (1998) and in Sandmo (2004), shows that the Allingham-Sandmo model (or the Yitzhaki model) predicts a much higher incidence of evasion than what is observed. This may be seen, for example, by comparing the prevalent audit and punishment rates in various

countries and contrasting them to the extent of evasion. Sandmo (2004) offers a first possible explanation, still based on his original model: since the taxpayer makes his own estimate of the audit rate, the probability p which enters equation (4.3) is in fact a subjective probability which need not be equal to the actual audit rate. It could be that taxpayers systematically over-estimate the probability of an audit. While there is some evidence that this may be true, one may object from a theoretical point of view: in a more complete model rational taxpayers could, in a repeated sequential game, start to correct their subjective probability assessment upward. But be that as it may, Sandmo (2004) himself argues that the above modification to the interpretation of p is not, by itself, sufficiently convincing. He points out that people refrain from tax evasion also due to social and moral considerations, not just risk aversion. In light of this, Sandmo proposes another modification to his model, which is to introduce a disutility term which he labels 'bad conscience', such that (4.3) becomes:

$$V = (1-p)U(Y)+pU(Z)-B(E) \qquad (4.4)$$

where B(E) is the disutility term, which is assumed to be increasing in E and convex in E. The presence of this term has the desired effect, in that it reduces the extent of evasion, other parameters being equal.

Interestingly, as Sandmo points out, this modification to his model makes raising the penalty rate less effective in reducing evasion. This is simply because an increase in the penalty rate decreases E, which in turn decreases B(E). This example, and the perceived need to model taxpayer behaviour beyond a utility function which depends only on expected income, leads us to look at the contributions of the tax morale school.

Torgler (2003) finds that a closer link between taxpayers and the authorities (e.g. through democracy, more local government, more direct democracy) is conducive to higher tax morale. As for Andreoni, Erard and Feinstein (1998), they identify three main moral and social factors that are relevant in this context (we stick to their choice of words for convenience from now on): moral rules and sentiments; the taxpayer's perception of the fairness of the tax system and burden; and finally the degree of satisfaction that taxpayers have with respect to the public authorities, notably with respect to their satisfaction with respect to the provision of public goods and services.

These additional aspects enable us to formulate testable hypotheses as well:

– taxpayers with stronger moral sentiments will evade less
– evasion is higher if the taxation system is perceived as less fair [5]
– evasion is higher if taxpayers are less satisfied with public goods and services

[5] Fairness of the taxation system is difficult to proxy for. In principle it should refer to the absence of discretion in the fixing of liabilities, i.e. that tax liabilities are set following a rule-based system which treats identical cases in an identical way. In European countries this is generally the case, but it is the perception of fairness which matters, rather than some formal definition of fairness.

We introduce the following notations for proxies of these additional variables:

M: a proxy measure of moral standards

F: a proxy measure of the perceived fairness of the tax system

S: a proxy measure of the satisfaction with public goods and services

This enables us to formulate the three hypotheses above in similar form as what was described earlier:

e. E is decreasing in M

f. E is decreasing in F

g. E is decreasing in S

Finally, we take this opportunity to incorporate the recent contribution of Bloomquist (2003) on a possible influence of income inequality on tax evasion.

Bloomquist (2003) observes that the increase in income inequality in the US over the past years has been associated with a growth in the share of 'non-matchable' incomes as well as with an increase in tax evasion. Bloomquist argues that income inequality is an important factor and a nexus between the two main approaches to modelling tax evasion, i.e. classical models à la Allingham-Sandmo and models which incorporate social and psychological norms. Empirical results reviewed in Bloomquist (2003) as well as his own estimates show that compliance is highest among middle-class taxpayers and lowest both among the very poor and the very rich. Bloomquist points out that this inverted-U shape of compliance with respect to income may be explained by both approaches. The expected utility approach may be defended by pointing out that the probability of detection of evasion is highest for middle incomes because they have the highest share of 'matchable income', i.e. incomes that can be traced back and matched to recorded operations such as pay slips. The share of matchable income is much lower for low incomes due to the higher prevalence of informal economic activity, and it is also lower for high incomes due to the higher proportion of entrepreneurial income and to better access to tax experts who may help to conceal incomes. The behavioural approach may be defended by the impact of, on the one hand, financial stress on low incomes (the relative desire to evade is strong, while low income taxpayers may also feel that their general situation is unfair), and, on the other hand, a perceived inequity on the part of high-income taxpayers, who feel that they are paying much more into 'the system' than what they get out of it in terms of public services.

A third explanation may be posited, which we will refer to here as the Holzner Conjecture:

Assuming that the penalty for evasion is not a simple share of either the amount of evaded income or the amount of evaded tax, but instead equals a (relatively large) fixed lump sum plus a share of evaded income or evaded tax, and assuming further that the authorities

may not enforce fine or debt repayments on low incomes which would force them below a threshold of absolute poverty[6], it becomes the case that:

– those on the lowest incomes are less risk-averse than the average taxpayer as they have much less to lose in relative terms than the average taxpayer, but potentially much more to gain in relative terms (thus the risk assessment is asymmetrical);
– those on the highest incomes are also less risk-averse than the average taxpayer as they can easily afford payment of the lump sum fine, while the variable part of the fine is assumed not to be excessive, so that they likewise have little to lose in relative terms;[7]
– those on or close to average incomes have potentially a lot to lose in relative terms as their incomes are sufficiently high to be forced to pay the full fine, but not high enough for them to be (relatively) unaffected by the resulting shortfall in purchasing power.

Without providing a more formal treatment here, it should be added that the share of evaded income or tax used for the variable part of the fine needs to be relatively small in order for the Holzner Conjecture to be verified at both ends of the income distribution.

Taken together, we see that we have three possible rationales for expecting income inequality to be positively linked to tax evasion, so that, noting income inequality as I, we may formulate an additional testable hypothesis:

h. E is increasing in I

What other variables may conceivably have an impact on tax evasion? As illustrated by the recent debate on the introduction of the so-called flat tax, the degree of complexity of taxation systems, if not directly connected to evasion in the models one generally finds in the literature, may also play a role, though it is an ambiguous one. One may argue that a complex taxation system creates more situations of information asymmetry between the taxpayer and the tax authorities, in both directions. Firstly, a complex taxation system may prevent taxpayers from making a precise estimate of their theoretical liabilities, were they to declare their full incomes. Secondly, tax complexity may be used by the tax authority to exercise discretionary power over taxpayers. In the extreme case, if it is practically impossible for the taxpayer to make a full and exact declaration, the authority may impose fines in an arbitrary fashion, since no taxpayer is entirely in compliance with the law. Thirdly, in the more standard case, tax law is understandable and it is possible to fully comply with it, but this requires a significant effort on the part of the taxpayer. A second trade-off then appears, between the uncertainty linked to a hastily filled-in tax return and the cost of submitting a correct declaration, be it an opportunity cost based on the amount of time spent on that task, or be it the fee paid to a tax expert for that same task. Fourthly,

[6] For example, in many countries a minimum living wage cannot be seized.

[7] One immediate policy implication would therefore be to introduce strongly progressive fines in order to overcome this structural problem.

tax complexity also generates costs and uncertainty for the tax authority itself. A larger number of regulations, exemptions and special cases may increase the range of possibilities for (legal) tax avoidance thanks to the larger number of potential loopholes. Fifthly, and finally, a more complex tax system generates additional problems for the authorities (as well as for external analysts and economists): total revenues are more difficult to forecast and the level of compliance is more difficult to estimate.

The overall effect of tax complexity on compliance is thus not intuitively clear. Of course a theoretical model could be set up to model any of the elements mentioned above, but this would go beyond the remit of this report. Thus we prefer to treat the question of complexity as a purely empirical question here.

2.2 Empirical model and variables

The hypotheses discussed above were the following:

a) E is decreasing in p: an increase of the audit rate decreases evasion
b) E is decreasing in θ: an increase in the punishment rate decreases evasion
c) E is increasing in W if the taxpayer has decreasing absolute risk aversion
d) E is increasing in t: an increase in the tax rate increases evasion
e) E is decreasing in M: higher moral standards imply lower evasion
f) E is decreasing in F: a fairer taxation system implies lower evasion
g) E is decreasing in S: higher satisfaction with public services implies lower evasion
h) E is increasing in I: higher income inequality increases evasion
i) Tax complexity X: effect uncertain

However, we chose here not to test for the effect of gross income (*W*) as we do not have estimates of tax compliance by individual taxpayers. Instead, we chose to work with the tax compliance rate: *comp* = 1 - (*E* / *W*). With the exception of hypothesis c, all the hypotheses listed above hold true for *comp* as well as for *E*.

This leads us to propose the following empirical model (expected signs of the estimated coefficients given below):

$$comp = \alpha + \beta_1 p + \beta_2 \theta + \beta_3 t + \beta_4 M + \beta_5 F + \beta_6 S + \beta_7 I + \beta_8 X + \varepsilon \qquad (4.5)$$

$$\qquad\quad + \quad + \quad - \quad + \quad + \quad + \quad - \quad ?$$

We estimate this model on the panel data set constructed from our estimates of tax compliance presented in part 1. From there we have the various compliance and tax rates. In addition we looked for empirically measured variables that would correspond to or proxy the theoretical variables mentioned above. For the audit rate we found a crude (fixed factor) proxy (*jlei*) in the Judicial/Legal Effectiveness Index for 2004, as published by

Kaufmann (2004). This is the percentage of firms in the country giving satisfactory ratings (answers 5, 6 or 7) to questions on judicial independence, judicial bribery, quality of legal framework, property protection, parliament and police effectiveness. Higher numbers mean better judicial/legal effectiveness.

With respect to the punishment rate, we could not find any proper indicator, thus one might see the *jlei* variable as a combined proxy for both p and θ. Concerning moral standards, we used an indicator acquired from the World Value Survey (WVS) project[8] – *cheattax*. This (fixed factor) variable is based on the negative answers (answers 1-5) to the question (F116 of the 1999 survey wave) whether one thinks that it can be justified to cheat on taxes if one has a chance to do so. The data reflects the percentage of the surveyed persons. The missing values for Cyprus were filled with Greek data.

We also could not find an appropriate proxy for the perceived fairness of the taxation system. However, we decided to obtain two candidate proxies for the perceived satisfaction with public services. First of all we generated the (fixed factor) variable *morelocal*. This was done with the help of the WVS data set, where we used the positive answers to the question (E021 of the 1999 survey wave) whether one wants more power for the local authorities (answer 1). This variable also has the advantage of relating to the findings of Torgler (2003) on the positive relationship between tax morale and more democracy, more local government and more direct democracy. From the same source we extracted our indicator for explaining the satisfaction with public services – *confhealthcare*, which is a fixed factor for all the years as well. This variable was generated using the positive answers (answers 1-2) to the question of how much confidence one has in the health care system. For both variables data were missing for Cyprus. We used the values for Greece instead.

For income inequality we chose to test two alternative measures. The first obvious choice was the GINI coefficient (*gini*) which we obtained from Eurostat and the World Development Indicators 2005. We also decided to use a related measure, obtained from Eurostat and which we labelled *quintileratio*, which is the ratio of the income of the richest quintile (top 20%) over the income of the poorest quintile (bottom 20%). For both cases there were some missing values in the data set, which were filled in by using preceding or subsequent data points within countries.

We also decided to test for a pure poverty motive. This was done in order to disentangle the expected effect of income inequality stemming from the bottom end of the income distribution from the effect stemming from the top end of the income distribution and also in view of the fact that all three theoretical arguments for the negative impact of income inequality on tax compliance can be split into arguments indicating a negative impact of

[8] www.worldvaluessurvey.org

poverty as well as a negative impact of the existence of high incomes. In light of this we selected from Eurostat data the poverty indicator which had the best coverage in terms of countries and years, namely the share of persons 'at risk of poverty' (we labelled the variable *povertyrisk*), defined as the share of persons whose income after social transfers is below 60% of median equivalized income after social transfers.

Finally, the tax complexity variable was proxied by various indicators for the respective type of tax. For the VAT tax we developed two indicators – *nvatr*, which is the number of VAT rates other than zero plus 1 (this is necessary due to subsequent use of logarithms for those cases where the basic data have the value zero), and *nvatrprod*, which is the number of product groups underlying lower VAT rates than standard plus 1. For the excise taxes it was hard to find a proper indicator. Thus we ended up using *nvatexprod*, the number of non-VATed excised product groups, if existing, plus 1. For PIT and SSC we defined *complexpit* and *complexssc*, which depict the number of calculation steps necessary for an individual (using pen and paper) to compute his personal income and social security tax liability respectively (again we used the calculation steps plus 1).

Furthermore we introduce a variable (*ticpi*) for corruption, proxied by the Transparency International Corruption Perception Index. We also want to control for the level of development, using *rgdpl* – real GDP per capita in purchasing power parities at 1996 international USD from the Penn World Table 6.1, extended for the recent years using Eurostat data. With regard to the surprising results of high VAT and excise compliance rates of tourism-dependent countries such as Croatia (and as discussed in part 1 of the study) we also want to check for the share of travel revenues in % of GDP – *travely*. The source of the data are the national accounts and balance of payments statistics of the respective countries.

All the variables enter the following regressions in log form.

2.3 Tax compliance in consumption

We start off by testing for the significance of the tax rates only, and discuss estimation issues and tests with respect to the distribution of the error term. Once this is done, we proceed with the inclusion of the other variables.

We estimated the following equations using our consumption panel data for the EU-29 for the years 2000-2003:

$$vatcomp_{it} = \alpha_v + \beta_v \cdot vat_{it} + \gamma_{vit} \quad (4.6)$$

$$excomp_{it} = \alpha_e + \beta_e \cdot ex_{it} + \gamma_{eit} \quad (4.7)$$

where $vatcomp_{it}$ is the log of the VAT compliance rate, vat_{it} is the log of the average weighted VAT rate, $excomp_{it}$ is the log of the excise compliance rate and ex_{it} is the log of the average weighted excise rate in country i, in year t.

We estimated equations (4.6) and (4.7) in a panel data random effects setting, using Intercooled Stata 8.2 software. Random effects were chosen after conducting a Hausman specification test. In the first case the null-hypothesis in favour of the random effects model could not be rejected, while in the second case the test could not be performed as the asymptotic assumption of the Hausman test were not met. The results of the estimations can be seen in Table 4.1.

Table 2.1

Tax compliance and tax rates in consumption I

Estimations:	**A1**	**A2**
	Dependent variables	
Independent variables	**vatcomp**	**excomp**
Constant	-1.031	-0.845
	(-5.88)***	(-10.98)***
vat	-0.316	-
	(-3.35)***	-
ex	-	-0.289
	-	(-1.72)*
R^2 within	0.091	0.026
R^2 between	0.092	0.151
R^2 overall	0.091	0.141
Number of observations	116	116
Number of groups	29	29

Note. Z statistics are in parentheses. The superscripts *, ** and *** following the z statistics represent a 10, 5, and 1% significant level, respectively.

Estimation A1 in Table 4.1 presents the results for the estimation of equation (4.6). As expected the coefficient of the explanatory variable is negative and highly significant. This implies that a one per cent increase of the average weighted VAT rate results in a decrease of the VAT compliance rate of about 0.3%. However, the overall R^2 is only at 0.09. Thus, the model explains only about 9% of the variation of the dependent variable. This indicates that there are still additional important variables to explain VAT tax compliance.

Estimation A2 presents the results of equation (4.7). Similarly to estimation A1, the coefficient of the explanatory variable is negative and also of similar order. However, the

coefficient is only significant at the 10% level. Nevertheless, in this case the overall R^2 is higher at 0.14. Thus, estimation A2 has a somewhat higher explanatory power.

Testing the model with regard to the underlying assumptions of panel data analysis for heteroskedasticity and autocorrelation has yielded the following results. To test for autocorrelation of panel data the Wooldridge test was used. In the first case, the null-hypothesis of no first-order autocorrelation had to be rejected, while this was not the case for estimation A2. Thus we observe autocorrelation of the errors across various points in time in estimation A1. With regard to heteroskedasticity we employed a likelihood-ratio test. In both cases the null-hypothesis of homoskedasticity had to be rejected. Thus in estimation A1 as well as A2 the model's variables error term has a non-constant variance (i.e. is heteroskedastic). The consequence is that in both estimations the standard errors are biased and thus the significance tests on the parameters are incorrect.

Table 2.2

Tax compliance and tax rates in consumption II

Estimations:	**B1**	**B2**
	Dependent variables	
Independent variables	**vatcomp**	**excomp**
Constant	-1.050	-0.829
	(-5.60)***	(-27.47)***
vat	-0.328	-
	(-3.24)***	-
ex	-	-0.372
	-	(-4.25)***
R^2	0.514	0.141
Number of observations	116	116
Number of groups	29	29

Note. Z statistics are in parentheses. The superscripts *, ** and *** following the z statistics represent a 10, 5, and 1% significant level, respectively.

Nevertheless, it is possible to estimate panel corrected standard errors. The parameters are estimated by Ordinary Least Squares (OLS) or Prais-Winsten regression (depending on the options specified). When computing the standard errors and the variance-covariance estimates, the disturbances are, by default, assumed to be heteroskedastic and contemporaneously correlated across panels (each country being one panel data set). Thus we re-estimated model A1 assuming heteroskedasticity and first-order autocorrelation and we re-estimated model A2 assuming only heteroskedasticity. Table 4.2 exhibits the results of the new estimations B1 and B2.

The results of the two estimations B1 and B2 are not that different from the original estimations. However, the size of the coefficients of the independent variables increased to a certain extent and in the case of estimation B2 the significance of the explanatory variable increased. Thus for now we conclude that, for the EU-29 over the observed period of time, higher VAT and excise tax rates are significantly correlated with lower levels of tax compliance.

In the following we would like to extend the equations 4.6 and 4.7 by introducing the explanatory variables as defined in chapter 4.2. Here we want to stick to the panel corrected estimation methods as they were used in the estimations B1 and B2 for the VAT and the excise compliance rate respectively. We used a stepwise variable selection methodology, maximizing the R^2 at every step.

Table 4.3 presents the results of our preferred equation C1, which was estimated by correcting for autocorrelation and heteroskedasticity. The model was also recalculated as a random effects model and the subsequent tests confirmed the necessity for the corrections. Estimation C1 has an R^2 of 57%.

Table 2.3

Tax compliance in VAT taxation

Estimation:	**C1**
	Dependent variable
Independent variables	**vatcomp**
Constant	-1.297
	(-4.72)***
vat	-0.239
	(-2.50)**
jlei	0.107
	(2.79)***
morelocal	-0.181
	(-2.60)***
travely	0.053
	(2.11)**
R^2	0.573
Number of observations	116
Number of groups	29

Note. Z statistics are in parentheses. The superscripts *, ** and *** following the z statistics represent a 10, 5, and 1% significant level, respectively.

In estimation C1 we receive a model that explains the VAT compliance rate *vatcomp* by the following four explanatory variables, which are all significant and have the expected sign.

The average weighted VAT rate remains an important explanatory variable (vat). A one percent increase of the VAT rate leads to a 0.2% decrease of the VAT compliance rate. On the other hand, higher judicial/legal effectiveness as indicated by the variable *jlei* leads to more VAT compliance. The coefficient of the variable *morelocal*, which might be seen as a proxy for the wish for a fairer taxation/subsidy system at least within a regional/federal context, appears to be negative. If people are unhappy with the current state of taxation/transfers, they will have an additional incentive to evade taxes. Thus these results fit well into traditional economic rationale which operates within the framework of a carrot-and-stick game. Finally, the introduction of the *travely* variable confirmed our initial speculation on the reasons why countries such as Croatia and Cyprus lead in VAT compliance among the EU-29 countries. Countries with a higher level of tourism revenues have also higher VAT compliance rates. This might be due to an underestimation of tourists' consumption and/or e.g. different evasion patterns of tourists as compared to the local population.

The outcome of the estimations on excise compliance as presented in Table 4.4 is revealing too. Given the relevant tests the model was corrected for heteroskedasticity only. Estimation D1 has a slightly lower R^2 (of 47%) than C1. The estimated coefficients are all significant and show the expected sign.

Table 2.4

Tax compliance in excise taxation

Estimation:	**D1**
Independent variables	**Dependent variable excomp**
Constant	1.105
	(1.30)
ex	-0.594
	(-9.36)***
ticip	0.420
	(4.12)***
gini	-0.720
	(-3.22)***
cheattax	1.378
	(5.24)***
R^2	0.468
Number of observations	116
Number of groups	29

Note. Z statistics are in parentheses. The superscripts *, ** and *** following the z statistics represent a 10, 5, and 1% significant level, respectively.

Similarly to the model above, the average weighted excise tax rate (*ex*) proves to have a negative coefficient which has more than double the size of the tax rate coefficient in C1. Thus, given that excise tax rates are generally much higher than VAT rates, it appears that there are increasing returns to tax evasion in consumption. In estimation D1 the corruption index variable *ticpi* seems to work. It has probably a similar role as the *jlei* variable in C1 but it can obviously also be interpreted as an additional tax burden. Less corruption (which refers to a higher index number in the Transparency International Corruption Perception Index) is observed together with a higher excise tax compliance rate (*excomp*).

So far the excise compliance case was quite similar to the VAT compliance case. However, the following two results provide some new perspectives on the topic. First, higher income inequality as indicated by the GINI coefficient (*gini*) yields less excise compliance and second, a more moral population (as indicated by the variable *cheattax*), which declares not to cheat taxes even if it had the possibility to do so, results in higher excise compliance. It might be that both cases are actually poverty driven, given that especially excised goods such as alcohol and tobacco are heavily consumed by poorer people. With regard to the variable *gini* this is rather straight forward. With respect to the variable *cheattax* it might be assumed that it is easier to be a moral person if you are not poor. In fact replacing both variables by the *povertyrisk* indicator yields a similar result (the coefficient is negative and significant), though the R^2 is now somewhat lower. For this reason we prefer to stick to estimation D1. Interestingly enough, the tourism variable *travely* does not work in this setting however.

2.4 Tax compliance in income

In this section we analyse the factors that are likely to explain the compliance rates for personal income tax (PIT) in a panel regression. The variables we have tested are those listed earlier. In addition we tested two additional variables to try to capture interactions between the PIT schedule and the income distribution by constructing an estimate of the theoretical effective tax rate faced by the bottom 50% (in terms of number of persons) of the income distribution, as well as an estimate of the theoretical effective tax rate faced by the top 10% of the income distribution. These estimates were constructed for each country and for each year from the PIT calculators described in part 1 of this report. These variables were labelled *pitlb50* and *pitlt10* respectively. The final variable selection and the corresponding regression results are shown below.

We found the overall theoretical effective rate to be insignificant. However, we do find the theoretical rate for poorer taxpayers to be significant and of the expected sign. The insight for this result was already touched upon when we discussed the results for Latvia and Estonia, the two 'flat-rate' countries of the sample, which both have rather low compliance with a system based on wide tax bases (in terms of the share of persons liable for PIT).

This led us to believe that a form of poverty motive may be at play. Interestingly, we find that not only is the poverty level (*povertyrisk*) negative and significant, but that the rate which poorer taxpayers face is significant as well. Taken together this result offers, we believe, strong evidence in favour of the poverty motive for explaining tax evasion.

Table 2.5

Tax compliance in personal income taxation

Estimation:	**E1**
	Dependent variable
Independent variables	**pitcomp**
Constant	-0.492
	(-2.61)***
pitlb50	-0.124
	(-1.79)*
complexpit	0.115
	(3.42)***
ticip	0.123
	(2.02)**
povertyrisk	-0.164
	(-3.36)***
R^2	0.850
Number of observations	58
Number of groups	14

Note. Corrected for AR(1) and heteroskedasticity. Z statistics are in parentheses. The superscripts *, ** and *** following the z statistics represent a 10, 5, and 1% significant level, respectively.

Further to this result, we also find the corruption index (*ticip*) to be significant and positive as expected (the higher the index, the lower the level of corruption) in explaining compliance. This index obviously captures several key aspects and may be correlated with unobserved variables, however, we hold the view that it represents, on the one hand, an additional (informal) taxation linked to the payment of bribes, and, on the other hand, that it proxies for the effectiveness and reliability of the legal and administrative systems. One would therefore expect this variable to be positively correlated with the audit rate and/or with a notional nested probability of being fined in the event of an audit uncovering concealed income. In a country with a high index, an audit uncovering concealed income would lead to officially sanctioned punishment and crucially to the amount of unpaid tax being forcefully recovered by the tax administration, thus entering official data on tax revenues. On the other hand, in a country with a low index, an audit uncovering concealed income would more likely lead to the taxpayer having to pay a bribe which the auditor would pocket for himself.

Finally, we find that our measure of tax complexity is significant and positive. This is an interesting result which goes somewhat against the received wisdom of proponents of simpler tax systems. Looking at our results more closely, we see that, typically, it is the transition countries that have the simplest taxation systems, while several major Western European countries have rather complex tax systems, in particular France, Belgium, Germany and Italy. Could there simply be an underlying link with development levels? We tested for this by introducing the GDP per capita variable into the regression alongside our complexity indicator, but we then found GDP per capita to be insignificant. On the other hand, GDP per capita is significant if introduced alone into the regression, and we also found GDP per capita and tax complexity to be correlated. Our conclusion is therefore that tax complexity itself has more explanatory power than GDP per capita.

Our interpretation of this result is more subtle however. We do not necessarily take the view that the level of complexity of the PIT system is in itself a major determinant of the evasion decision, but rather that the subtle structure of incentives that a complex tax system creates, as well as, in a sense, the illusion of a 'present' or 'relief' impressed upon taxpayers when they see on their tax return forms the many deductions, allowances and credits that they are granted may help them to 'swallow the pill' of paying relatively high taxes. This concept also relates to the issue of the perception of tax fairness: taxpayers may be pleased to feel that certain expenses they 'must' undertake, such as commuting to their workplace, paying interest on their mortgage loans or paying alimony due to a divorce are explicitly recognized by the tax authorities as burdens that they must face. Most taxpayers may also find it quite acceptable that specific categories of taxpayers, e.g. the disabled, the elderly, those with dependent children, single mothers, benefit from higher deductions or credits than themselves. These same taxpayers may also find it difficult to voice opposition to these special treatments, particularly in the public sphere.

Complex tax systems thus incorporate distributional elements that are more subtle and more fine-tuned to individual circumstances than is possible with a monolithic tax schedule which would tax someone with a 'difficult life' in the same way as someone with an 'easy life' with the same gross income and may thus be perceived as more fair not only by the main beneficiaries of the various relief schemes but also by the 'standard' taxpayer. In fact in most Western economies the income tax system plays a major role in social policy in the widest possible sense, since tax relief exists, depending on the individual country, for a very extensive range of specific individual circumstances.

The other central issue connected with tax complexity concerns the cost for the taxpayer of acquiring and processing the relevant information required in order to correctly understand the structure of allowances, deductions and credits. Depending on the exact set-up of the tax system, it may be that the information and declaration costs are shifted purposefully by the tax administration onto the taxpayers. For example, in Austria an employee has the

right to claim deductions connected with further education and training. However, the typical situation will be that the employee pays his income tax at the source in a PAYE (Pay As You Earn) system administered by his employer, where these additional costs are initially undeclared, so that he initially pays more in tax than he is liable to. It is then up to this employee to fill in a declaration of deductible costs and submit it with the necessary supporting documents (that he must gather himself) to the administration in order to get back the excess amount of tax he paid. As is argued in Andreoni, Erard and Feinstein (1998), this set-up will leave a certain number of taxpayers 'chilled', i.e. not wanting to go through the trouble of either claiming the deduction or credit or of seeking tax advice, while other taxpayers may become 'gamblers' and seek to exploit any loophole the system may have to offer. However, on balance Andreoni, Erard and Feinstein (1998) suspect that the overall effect is to bring in more revenues rather than less, and that tax administrations knowingly introduce such systems on purpose, expecting the total of unclaimed reimbursements to exceed the total of lost revenues due to avoidance schemes.

Table 2.6

Tax compliance in social security I

Estimations:	**F1**
	Dependent variable
Independent variable	**ssccomp**
Constant	-1.963
	(-3.12)***
ssc	-0.637
	(-2.48)**
R^2 within	0.153
R^2 between	0.105
R^2 overall	0.110
Number of observations	46
Number of groups	11

Note. Fixed effects. T statistics are in parentheses. The superscripts *, ** and *** following the z statistics represent a 10, 5, and 1% significant level, respectively.

Our results for social security compliance are presented in two separate tables. The reason for this choice is that our final selection of variables does not include the theoretical effective rate as an explanatory variable, although it is significant and of the expected (negative) sign in a simple regression without any other variables. This is shown in Table 4.6. Turning now to the main results from Table 4.7, we see that complexity is again significant and positive, income inequality as measured by the Gini coefficient is negative and significant at the 10% level, the tax morality indicator (*cheattax*) is significant and positive, as expected, and real GDP per capita is significant and positive.

Table 2.7

Tax compliance in social security II

Estimation:	**G1**
	Dependent variable
Independent variables	**ssccomp**
Constant	-2.133
	(-4.14)***
complexssc	1.400
	(5.83)***
gini	-0.168
	(-1.75)*
cheattax	1.057
	(6.10)***
rgpl	0.234
	(5.73)***
R^2	0.846
Number of observations	46
Number of groups	11

Note. Corrected for AR(1) and heteroskedasticity. Z statistics are in parentheses. The superscripts *, ** and *** following the z statistics represent a 10, 5, and 1% significant level, respectively.

These results point to a more classical explanation than for personal income tax. There may be a poverty motive at work here too, though the superiority of the inequality indicator over the poverty indicator hints at the fact that evasion may be higher at both ends of the distribution, not just at the bottom end. GDP per capita gives further partial evidence for a poverty motive, though in this case on a cross-country basis and over the average income rather than specifically on the poorest segment of earners. The *cheattax* variable, which is an indication of the prevalence of tax evasion of others as judged by interviewed persons, was clearly expected to be significant, although it is interesting to note that it is significant in this regression but not in the other models. Why exactly this is the case is difficult to explain, however, we are of the view that several of our variables capture certain common unobserved effects, and that in any case the prevalence of evasion is always nested in a rather complex web of interactions so that, for some series of estimates, a particular indicator may 'work better' in the regression, while for another dependent variable describing another type or category of tax non-compliance it may be insignificant once other 'better' variables have been thrown in.

Turning now to the issue of tax complexity, the interpretation is slightly different in the case of social security than it is in the case of personal income tax. First of all, social security systems are in almost all countries considerably simpler than income tax systems. Countries with very simple social security systems typically have a single all-encompassing

contribution rate, with a contribution ceiling, or in some cases even no ceiling at all. More complex systems, again found mostly in Western European countries, will typically be made up of several different rates, each referring to a different function of social security, e.g. pensions, unemployment insurance, accident and disability insurance, health, maternity. However, even then one could hardly say that such a system is really complex. Most taxpayers would still find it quite easy to calculate their contribution levels, and there is generally speaking no such thing as a credit with respect to social security contributions that one may have to claim back using special forms. Here the impact of complexity lies more in the fact that the (official) function and use of the social security funds is openly announced and the break-down is shown. This may have a similar effect on taxpayers as do the social policy elements of income tax that were mentioned earlier in this section, in that taxpayers may find it easier to accept paying contributions if they believe that the funds will be used for 'worthy purposes'. In a similar vein, it may be difficult for taxpayers to argue against financing specific funds, again especially in the public sphere, as it may be indefensible, socially speaking, to argue against supporting maternity leave or the disabled. Beyond the inter-personal dimension, it is also clear that contribution payers fund a social security system which, if it functions as it should, they will later need (health, pensions), or which they or their spouses may need in specific circumstances (disability, maternity, unemployment), so that social security contributions will be seen as contributions to recognizable mutual insurance schemes. Of course it is critical, in this case, that the contribution payers believe that, in time of need, they will actually receive benefits from these schemes. In this sense our interpretation would be strengthened if the health system variable had been significant. However, the perceived quality of social security-linked services is evidently correlated with GDP per capita and with the complexity variable in our sample.

Finally, coming back to the fact that the inequality indicator dominates the poverty indicator in this model, it may be argued that persons at the top end of the income distribution have strong incentives to (illegally) opt out of compulsory (often state-run) social security schemes, as their incomes enable them to pay for entirely private provision of health care and to finance their own private pension schemes, as well as any other form of insurance they may choose to acquire. Persons on higher incomes are of course aware of the fact that part of their contributions go towards financing the contributions of less wealthy contributors, while they themselves may not be satisfied with the quality of social services (e.g. waiting lists for operations, low state pension payments) provided by the compulsory system and may have no wish to use them. From their point of view, if they have already decided that they will anyway pay for their own social services privately, it is clear that there is not much incentive to contributing to the state-run schemes. More generally, this argument could also be made on the attitudes of high earners with respect to income tax, although our regression results found that neither the inequality indicators (Gini and ratio of top to bottom quintiles) nor the theoretical effective PIT rate faced by the top decile of

earners were significant. This particular result could be due to a number of factors. First of all, income tax finances pure public goods as well, so high earners may feel that state provision does contribute to their welfare (e.g. security, national defence, public lighting, general infrastructure). Consequently there is no realistic equivalent vision as to how, or indeed as to why, high earners might opt out of the entire state system, at least not in the countries of our sample.

2.5 Overview of the results

The first major conclusion we arrive at upon considering all of our results is that tax rates matter. The tax rate is significant and negative with respect to compliance for all four types of taxes we have analysed. This may sound like a very commonplace statement, but in fact it is not, given the high degree of heterogeneity of the countries we have analysed, and given the never-ending feud between proponents of the neo-classical school and those of the tax morale school. This result, which is our strongest, lends support to the neo-classical school.

Income inequality and poverty risk also turn out to matter, the former in our regressions on excise tax and social security, the latter in our regression for personal income tax. These results lend support to all three supporting arguments for the role of income inequality reviewed earlier, i.e. the Bloomquist hypothesis of the U-shaped curve of the share of matchable income, the tax morale school's view of the combination of a poverty motive with a dissatisfaction with public services on the part of high earners, and finally the Holzner Conjecture of the lump-sum component of the punishment of evaders. In the particular case of personal income tax, the evidence was specifically in favour of the poverty motive only, with no evidence for high evasion from high earners, which is interesting given the high marginal rates of income tax that they face. This result goes partly against what is predicted by the neo-classical school, as especially high earners facing high marginal rates should have a high incidence and rate of evasion.

Thirdly, indicators concerning corruption or the quality of the legal system were also significant for three out of our four types of taxes (VAT, PIT and excise). Corruption and a poor legal system together contribute to informal means of regulating relations between citizens and the state, in particular due to the problem of bribery which, from the private citizen's point of view, replaces taxation and/or a possible punishment in case of an audit.

Fourthly, we need to mention the specific role of tax complexity, which has already been discussed with respect to the results on personal income tax and social security. Tax complexity is a specific concept and makes sense mainly in the context of personal income tax. In fact it is precisely with respect to PIT that demands are sometimes made for simplification. For example, proponents of flat-tax reforms in the US such as Hall and

Rabushka (1995) are always keen to discuss their vision of a simple single-rate system under which any taxpayer could quickly calculate his liability 'on the back of an envelope'. This is an attractive sound-bite (and it would make our compliance estimates much easier to do), however, our results point to rather disappointing results for the two countries in our sample that do have such a system, and to surprisingly good compliance results for countries that have unnecessarily complicated systems[9] such as Belgium or France. In short, we stand by our result that tax complexity is good for PIT compliance. Our rationale for this, beyond our empirical results, has already been discussed ('chilling' of taxpayers, overcharging employees through a PAYE system, reimbursement illusions and, arguably, implied moral pressures to support social policy goals).

2.6 Policy recommendations

Our goal is to formulate concrete policy recommendations that are likely to increase compliance rates. We are not primarily concerned with maximizing revenues *per se*, nor with determining what the optimal tax rates should be from a more general macroeconomic or growth viewpoint.

What our results have shown is that, in the case of PIT, there seems to be a number of gains for compliance that are made by taxing citizens 'by stealth', e.g. using a PAYE system and letting taxpayers claim credits later, designing relatively complex systems that incorporate elements of social policy so as to signal to the taxpayer some of the distribution effects that are in force. On the other hand, our results with respect to income inequality and poverty show that it is unrealistic to try to widen the personal income tax base too much. At the low end of the income distribution, one finds a range of persons on occasional, informal or secondary incomes who have incomes that are, to take Bloomquist's terminology, not easily matchable. Indeed the low PIT compliance rates we found for Latvia and Estonia, two countries that have PIT systems with very wide PIT tax bases and relatively high rates even for very low earners, indicate that the lower end of the distribution will easily evade income tax. Conversely, many Western European countries have basic allowances or credits that are such that a substantial share of the adult population does not pay any income tax whatsoever. Thus income tax is in fact levied from a relatively narrow base (in terms of the number of persons), and nevertheless yields high compliance rates. Of course there is a structural reason for this, since PIT is progressive and income distributions are long-tailed, so that a substantial share of revenues is brought in by the top 1-2 deciles of the distribution. In light of this, our recommendation for transition countries is to narrow the PIT tax base. This recommendation applies particularly to Latvia

[9] Unnecessarily complicated in the sense that the number of computational steps could be roughly halved and yet achieve almost exactly the same outcome in terms of differentiated taxation for selected groups of persons.

and Estonia and should perhaps be borne in mind by other countries interested in introducing similar PIT schedules.

We now turn to excise taxes. Several phenomena are important with respect to compliance and revenue levels.

Our estimates of excise compliance do not correct for avoidance, so our discussion is based on the combined effect of evasion and avoidance. Both exist and each of them is of significant magnitude. First of all, thanks to EU internal market regulations consumers may buy in principle unlimited amounts of duty-paid goods (e.g. alcohol and cigarettes) in one EU member state for private consumption in another EU member state. There are notional limits set by certain member states but these are high enough not to matter in practice (e.g. the UK limits are 160 packets of cigarettes, 110 litres of beer, 90 litres of wine and 10 litres of spirits per person per shopping trip). This is a form of tax avoidance, as it is perfectly legal but exploits a loophole in the law so as to reduce tax liability below what it would be given 'standard' behaviour patterns. Second, there is also (illegal) tax evasion connected to organized criminal gangs (smuggling rings).

It is clear that excise taxation is purported to pursue several policy objectives simultaneously. Firstly, all these taxes are sources of revenues for national treasuries. Secondly, there are public health policy objectives for tobacco and alcohol. Thirdly, there is the more classical public morality or 'sin tax' argument, though some perceive it as a touch *passé* in Europe. Separately there are also environmental policy objectives with respect to fuels. These latter objectives should in principle aim at a reduction in consumption and thus partly conflict with the revenue objectives. On the other hand, achieving both lower consumption levels and higher revenues may to some extent be achieved with high rates, but this in turn reduces compliance, mitigating the desired outcomes for both objectives. There is therefore a subtle balance to be struck in setting the most appropriate rates. The analysis is further complicated by the fact that non-compliance is not automatic, as there seems to be a relatively strong home bias in the average consumer's shopping patterns. Indeed the average rational UK smoker should never pay UK duty on cigarettes, but instead fly twice a year to Spain and legally bring back 3200 cigarettes each time. The evidence from UK excise revenues on tobacco indicates that this optimized behaviour is far from systematic. Finally, as tax systems as a whole are supposed to participate in social policy objectives, it merits recalling that excise taxes work against the redistributive effects of personal income tax.

Taking all these elements together, and basing ourselves on our results and on our knowledge of the existing patterns of excise rates and illegal flows across Europe, we conclude that it is the revenue objective that has, thus far, been the most influential in determining policy. It seems that the levels of both avoidance and evasion have been

evaluated as being a tolerable nuisance which, thanks notably to the home bias of consumers, have not dented revenues to the extent that a neo-classical model would predict. Also, as classical taxation theory predicts, it is very profitable for the tax authorities to target goods for which demand is very inelastic. This is strongly the case, at least in the short run, for tobacco, alcohol and petrol. What we can say is that the secondary policy objectives, e.g. health policy, may be more effectively pursued using non-price mechanisms. As for compliance, it is really up to the tax administrations to decide the extent to which they tolerate non-compliance when pursuing the maximization of revenues. In any case, our results are clear: if compliance is to increase, then tax rates must fall.

We now turn to VAT, which is a crucial part of the system and contributes to a substantial share of revenues, especially in the transition countries: in many Western European countries PIT accounts for roughly 130-200% of the level of revenues brought in by VAT. In transition countries this ratio is practically reversed. The reason why this is the case is that VAT revenues are far easier to collect than PIT revenues once the VAT system has been set up and, most crucially, VAT compliance is not affected by issues of inequality or poverty, neither from the point of view of the consumers (this is something we tested in our regressions, and we found all three indicators of inequality and poverty to be insignificant), nor is there an equivalent to the role and impact of income inequality with respect to PIT to be found among the distribution of firms with respect to VAT. In other words, it is feasible with VAT to establish a very wide base with the same rate without suffering the problems faced when attempting the same thing with PIT. And indeed, VAT systems throughout our sample have very wide bases, and this is what drives the high revenues. In parallel, our results have also shown that the VAT rate is important, and that the quality of the judicial/legal system (*jlei* variable) was also a significant factor. This relates to the fact that VAT evasion must happen in concert with the corporate sector, since it is firms, not individuals, who are responsible for administering VAT. In this context it comes as no surprise that a solid legal system is a key element which is necessary to make sure that firms remain compliant.

The case of social security contributions is an interesting one. We found that compliance was positively linked to a higher level of complexity. As we argued earlier, this type of 'complexity' cannot be compared to PIT complexity. Our intuition, however, is that a clear and visible split of SSC and revenues by function may encourage contributors to view social security funds for what they are, i.e. mutual insurance schemes which they have an interest in joining, unless their incomes are so high that they wish to opt out of state provision altogether. Interestingly, at this stage it is worth considering the fact that social security contributions are the only type of tax we have analysed that has (in many countries) set ceilings: past a certain income, the social security payment is fixed at a given value (the rate multiplied by the ceiling). In other words, past the maximum income the marginal rate of SSC is zero and the average rate of SSC is decreasing. This makes sense

if one feels that one needs to placate the desires of high earners to opt out of the system. In fact, in several countries SSC liabilities are zero up to a given floor, so that the lowest earners do not contribute large amounts. In spite of these special arrangements which should mitigate any adverse effects due to income inequality, we nevertheless found the Gini coefficient to be significant. This seems to indicate that social security contributions would be much more difficult to collect if they were calculated on the basis of something more approaching a progressive schedule, or simply a schedule without a ceiling. The implication therefore is clearly that social security contributions should be computed on the basis of such a system (a floor, a single rate, a ceiling), and that the breakdown by function might play an important psychological role.

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Appendix: Data processing and working assumptions

For estimating tax evasion in consumption (complement to 1.2.2)

Information on the VAT tax law was taken from the International Bureau of Fiscal Documentation (IBFD)'s European Tax Handbooks which covered all countries and years. Data on excise tax law were taken from the European Commission Directorate General for Taxation and Customs Union's Excise Duty Tables.

HHFC and its breakdown by COICOP[10] 3-digit categories was available from Eurostat for most countries and years. This included imputed rents. At the 3-digit level, many excised goods are grouped together into broader categories, e.g. alcoholic drinks. In order to compute the exact value for φ, it would in principle be necessary to have COICOP 4-digit level data, however, these were only available for the year 1999. What we did, therefore, was to assume that the distribution of 4-digit categories within their parent 3-digit categories were constant across time, and we applied these shares to the available time series of 3-digit data. This means that φ varies across time for any given country following the broader evolution of the corresponding COICOP 3-digit categories, not the exact 4-digit categories.

In the general case, φ was taken as the sum of the shares of the consumption of tobacco, beer, wine, spirits, and fuels and lubricants for personal transport equipment, which are covered by excise taxation in almost all the countries. In some of the countries excise tax is also collected for the purchase of vehicles, personal effects (such as jewellery), electricity and other energy (such as gas). Those countries were identified using national data and the respective consumption shares were added to φ.

Travel income data (TRAVEL) were taken from Eurostat's Balance of Payments statistics.

Intermediate consumption of fuels (FuelINT) was obtained from Eurostat National Accounts Use Tables, with most recent data only from 2001, 2000 or 1999. The intermediate consumption of goods belonging to CPA (Classification of Products by Activity) category 23 ('Coke, refined petroleum products and nuclear fuels') was added up for all sectors except those involved in refining or energy production (such as NACE 23 itself).

Household construction outlays (HHCO) data are not commonly available. However, in the course of an earlier research project we were reliably informed by a former employee of the Office for National Statistics (ONS) at the OECD that this share, in the case of the UK, is around 30% of total output of the construction sector (which was readily available from

[10] Classification Of Individual Consumption by Purpose (1998 norm).

Eurostat for all countries and years). We decided to use this share for all countries and years, for lack of a better alternative.

The gross fixed capital formation and intermediate consumption data by sector (variables FGFCF, GGFCF, NGFCF, HGFCF, RGFCF, FINT, GINT, NINT, HINT, and RINT) were taken from the National Accounts statistics of Eurostat.

Tax revenue data for PEX and PVAT were taken from Eurostat National Accounts tax aggregates statistics. PEX was calculated by adding the data for excise duties on domestic and imported goods. The tax revenue data had to be corrected in some cases by using more reliable national data.

Calculating the average weighted excise tax rate (EX) proved to be one of the most difficult tasks, as most of the excise tax rates are given in currency values per physical unit for a given year instead of *ad valorem* values. Therefore it was not enough to gather the value rates from the Excise Duty Tables of DG Taxation and Customs Union but it was necessary to find corresponding price data in order to calculate *ad valorem* rates. The data on excise taxes for cigarettes, beer, wine and fuels relate to the first half of 2003. For spirits the data were taken from eurospirits.org and reflect 2004 values. In the case of the cigarette excise tax, the rate was also published as a percentage of TIRSP (tax inclusive retail selling price). For the other commodities average national prices had to be found. Average 2003 prices for beer, wine and spirits are published by the World Health Organization (WHO) for the respective European countries. The prices for the most common (in most cases unleaded) Super gasoline in December 2002 is published by GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit) for all the European countries. Using these data it was possible to translate excise rate *ad valorems* from gross to net rates for cigarettes, beer, wine, spirits and gasoline. An additional effort was made in order to calculate an *ad valorem* rate for those fuels which are used for industrial and commercial purposes in the intermediate consumption of FuelINT. Here we used the currency value rates for gas oil, liquid petroleum gas and methane, heavy fuel oil and kerosene. These rates were transformed by using fuel conversion rates in order to relate them to the unleaded petrol excise data that were already used for calculating the *ad valorem* rates for gasoline. Assuming that total fuel consumption for industrial and commercial purposes is split, with 50% for gasoline and 12.5% for each of gas oil, liquid petroleum gas and methane, heavy fuel oil and kerosene, a new *ad valorem* rate for industrial and commercial fuel consumption was constructed. The average weighted excise tax rate (EX) was then calculated by using the consumption shares of tobacco, beer, wine, spirits, and fuels and lubricants for personal transport equipment for HHFC and TRAVEL in DEG and the FuelINT share in DEG. The variable EX* is calculated in a similar way but using only the consumption shares in HHFC and disregarding FuelINT.

Calculating the average weighted VAT tax rate (the variable we label as VAT in our equations) was done with the help of tax law data from the IBFD European Tax Handbooks. This source provides information on VAT taxable transactions, exemptions and rates. In some of the EU-29 countries, apart from the standard VAT rate and the zero rate, up to three reduced rates are in force. Thus the reduced rates and the zero rate are weighted with the respective shares of goods consumed in HHFC. For the remaining part of DEG the standard VAT rate is applied. Unfortunately, the information on the VAT law with respect to the exemptions is not always very precise. It was difficult to assess, e.g., what exactly might be included in 'basic food' or 'food'. In these cases we used for 'basic food' half of the sum of bread and cereals, milk, cheese and eggs, fruit and vegetables, and for 'food' half of the total share of food consumed by the households. In the case of the consumption of services in banking, insurance, post, lottery, health and rent we applied the zero VAT rate for all countries. The average weighted VAT rate for excised goods (VAT*) is calculated in a similar manner by weighting the single VAT rates (the standard and the reduced rates) with the respective consumption shares of φ.

At the moment of data collection, most of the Eurostat data were available up to 2003 only. The prices and tax data for the average weighted excise tax rates reflect the situation of about end 2002 / beginning 2003. The Household Budget Survey data employed are only from 1999 and Eurostat National Accounts Use Tables provides most recent data only for 2001 or 2000. In light of these restrictions, we decided to restrict the data set to the 2000-2003 period. This chosen time period reflects the necessary trade-off between quality and quantity for our data set.

Finally we should indicate how we dealt with missing data. Whenever we were faced with missing values for single countries or years, we tried to find the data from national sources. If this was not possible and only some years were missing for a specific country, we either used the data from preceding or subsequent years or we took averages of shares of other years. In those cases where variables for a whole country were missing, we used data from similar countries in relative terms to fill the gaps. In the case of consumption data (HHFC and its components) we assumed that countries of similar cultural stock may have similar consumption patterns, e.g. Ireland and the UK or Greece and Cyprus.

For estimating tax evasion in income (complement to 1.3.2)

The data used for the computation of Net Total Household Income (*NTHI*) and the corresponding Net Equivalent of the Tax Base (*NETB*) were taken from Eurostat and the OECD. The required data could be found in the Eurostat National Accounts data for household final consumption and for construction output, which were used for estimating household construction outlays. Household savings were estimated using published net household savings rates, some of which were available from Eurostat (by taking the ratio of

net household savings to net household disposable income), others from the OECD (different countries are covered in each data set). In the specific case of the UK it was necessary to compute the net household savings rate by hand, using Eurostat, OECD and ONS data. Data on social benefits paid to households were taken from Eurostat. Certain separate household incomes (which are taxed separately at flat rates in certain countries, such as property income) were also taken from Eurostat.

Demographic data, in particular the age structure of the population of the various countries used to calculate the appropriate weights for the income distribution, were taken from Eurostat.

The 200-point income distributions were extracted by authorized remote access to the LIS database (Luxembourg Income Study project).

The legislation on income tax and social security, in particular the necessary quantitative information such as income bands, rates, levels of exemptions, deductions and credits, SSC rates and ceilings, were taken from the European Tax Handbook, years 1996-2003, published by the International Bureau of Fiscal Documentation (IBFD). It is worth mentioning here that these handbooks are, to our knowledge, the only reasonably detailed and systematic source of information on tax systems of individual European countries that follow a unified format and that cover almost all European countries year after year in English. In short, it is the best available source. On the other hand, we must point out that the handbooks are not very easy to use and, crucially, that they sometimes side-step vital information, for example in the cases of Germany, Italy and Austria, where we were forced to consult national sources ourselves due to missing key elements of the PIT and/or SSC systems. Another important aspect which is often not very clearly explained in the handbooks (regardless of the country) is the taxation of social benefits (exactly which ones are exempt, and which are not). Since social benefits are quite a large share of household income in many European countries, this is in fact a very important issue. In effect there is not a single easy-to-use source which provides a comprehensive description of the personal income tax and social security systems in Europe. On the other hand, it should also be said that for many countries the handbooks provided more information than we could reasonably handle in this project, as some exemptions, deductions, credits or separate taxation schemes relate to elements for which it was not easy to get data, e.g. deductions related to mortgage interest payments, to sales of property, or differentiated rates of separate flat-rate taxation for special incomes such as royalties. All in all, we decided to stick to simplified calculations of the liabilities based on the most important elements, namely employment income, pensions and average separate tax rates for property income where applicable, though we also took account of the most important deductions, personal allowances and tax credits every time.

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