

Bach, Stefan; Buslei, Hermann

**Working Paper**

The impact of losses on income tax revenue and implicit tax rates of different income sources: evidence from microsimulation using tax statistics for Germany

DIW Discussion Papers, No. 950

**Provided in Cooperation with:**

German Institute for Economic Research (DIW Berlin)

*Suggested Citation:* Bach, Stefan; Buslei, Hermann (2009) : The impact of losses on income tax revenue and implicit tax rates of different income sources: evidence from microsimulation using tax statistics for Germany, DIW Discussion Papers, No. 950, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin

This Version is available at:

<https://hdl.handle.net/10419/29808>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Discussion Papers

# 950

Stefan Bach • Hermann Buslei

**The Impact of Losses on  
Income Tax Revenue and Implicit  
Tax Rates of Different Income Sources**

Berlin, November 2009

Opinions expressed in this paper are those of the author and do not necessarily reflect views of the institute.

## IMPRESSUM

© DIW Berlin, 2009

DIW Berlin  
German Institute for Economic Research  
Mohrenstr. 58  
10117 Berlin  
Tel. +49 (30) 897 89-0  
Fax +49 (30) 897 89-200  
<http://www.diw.de>

ISSN print edition 1433-0210  
ISSN electronic edition 1619-4535

Available for free downloading from the DIW Berlin website.

Discussion Papers of DIW Berlin are indexed in RePEc and SSRN.  
Papers can be downloaded free of charge from the following websites:

[http://www.diw.de/english/products/publications/discussion\\_papers/27539.html](http://www.diw.de/english/products/publications/discussion_papers/27539.html)

<http://ideas.repec.org/s/diw/diwwpp.html>

[http://papers.ssrn.com/sol3/JELJOUR\\_Results.cfm?form\\_name=journalbrowse&journal\\_id=1079991](http://papers.ssrn.com/sol3/JELJOUR_Results.cfm?form_name=journalbrowse&journal_id=1079991)

# **The Impact of Losses on Income Tax Revenue and Implicit Tax Rates of Different Income Sources**

## **Evidence from Microsimulation Using Tax Statistics for Germany**

Stefan Bach, Hermann Buslei  
DIW Berlin

November 12, 2009

**Abstract:** In order to calculate the burden of a comprehensive and progressive income tax falling on a certain income source, an apportionment scheme for the entire tax burden has to be chosen. This raises the question of how to deal with losses, which is relevant for Germany in view of the heavy losses from renting. Using micro data from tax statistics we analyze the income tax shares of functional income sources for three apportionment schemes. The choice of the apportionment scheme markedly affects the tax shares of income sources and the implicit tax rates, in particular those of capital income.

**Keywords:** Income and business income taxation, implicit tax rates by income sources.

**JEL Classification:** H24, H25, D33.

This paper is part of a research project supported by the German Federal Ministry of Finance. Results and opinions expressed in this paper are those of the authors and do not necessarily reflect views of the Federal Ministry of Finance or DIW Berlin. The authors thank Hermann Quinke, Fraunhofer Institute for Applied Information Technology, FIT, Sankt Augustin, for the permission of using the FIT microsimulation model for simulations on the income tax liability for the years 2003 to 2007. Thanks also to Norbert Schwarz, Federal Statistical Office Germany, Florian Wöhlbier, European Commission, and Florian Walch, DIW Berlin, for helpful information and comments. The usual disclaimer applies.

# 1 Introduction

The effective tax burden on economic activities plays an important role for many issues of fiscal policy. Business and capital income taxation both affect investment, location decisions, financing, choices of legal form, and portfolio allocation. Taxes on wages have an impact on employment, both as part of the income tax or as payroll taxes financing social security. Due to the complexity of real-world taxation systems there is a need for summary measures on the tax burden of functional income sources and their share in total tax revenue (Sørensen, 2004: 1). Such summary measures are of particular interest for the description of tax burden over time or across countries.

Macroeconomic summary measures are constructed for income types by economic functions such as labor income, business and capital income, etc.). The European Commission (2009) estimates macroeconomic implicit tax rates in the tradition of Mendoza, Razin, and Tesar (1994) and enhancements of these methods (see OECD, 2001). The calculations are based on national accounts data and revenue statistics. They give an impression of the effective tax burden in a certain period in the past (“backward-looking”). Besides, the tax burden is modeled for “representative” companies, employees, or private households, in order to demonstrate potential impacts on different tax rules (“forward-looking”) (see, among others, Devereux et al., 2002, Spengel, 2003, OECD, 2007, Devereux et al., 2008; for the differences between the approaches see Becker and Fuest, 2006). In this paper, we only discuss a backward-looking approach which is based on micro data from tax statistics.

As a starting point for an empirical analysis on the effective tax burden of functional income sources one has to allocate total tax revenue across the income sources involved. For instance, business and capital income taxes should be assigned to business and capital income, payroll and social security taxes to labor income, unless incidence analysis suggests a different distributional impact. This is not straightforward, however, in the case of the personal income tax (PIT) which is the highest-yielding revenue source of direct taxation in most OECD countries. Actual PIT systems aggregate several income categories to a “comprehensive” tax base, allowing for loss-offset across income types within the assessment year and over time, deducting several personal allowances and taxing the residuum at progressive tax rates. The tax share falling on one income type hence depends on the amount of other taxable income types. Therefore, an apportionment scheme has to be chosen in order to calculate the tax burden of an income type. This raises the question of how far the estimated tax burden on one income

source depends on the choice of the apportionment system. Using representative micro data we precisely model different apportionment rules and analyze their impact on tax shares.

A simple apportionment scheme allocates the total PIT liability across the positive income sources according to their share in total positive income. Losses from particular income sources are neglected in this case. Many countries use this procedure for limiting tax credits against the PIT, e.g. tax credits for taxes from abroad, or for local and regional taxes.<sup>1</sup> The European Commission (2009) uses a second apportionment scheme. The individual tax liability is allocated according to the share of an income source in total income, both positive and negative. As long as the tax liability is positive, a negative income tax share is assigned to those income types that are running losses.

We suggest a third apportionment scheme which comprehensively accounts for loss offset. If some income sources run losses but others realize positive income we assign the fictitious tax liability to the positive income types that would have resulted in taxing them alone. The difference between the fictitious tax liability on positive incomes and the actual tax liability on total income is allocated to the losses as a negative revenue share. If there are losses but total income is still positive, due to tax progression the tax shares assigned to both positive and negative incomes are higher compared to the apportionment scheme used by the European Commission (2009). If the taxpayer's total income is negative, all the incomes are neglected by the second apportionment scheme since there is no tax to pay. In case of the third scheme these incomes are taken into account if there is at least one positive income source.

Thus, the third apportionment scheme puts more weight on losses compared to the second. This is a matter of particular interest if some income sources often run losses, which is the case for business income and especially for income from renting and leasing. In Germany, the latter income source was negative even in aggregate terms for decades. In order to analyze the third apportionment scheme we run a separate assessment for total positive income and assign the difference between the fictitious PIT liability for the positive incomes and the actual PIT liability to the loss income types as a negative revenue share. In analyzing the tax liability over time, we also take into account losses carried forward or carried back.

---

<sup>1</sup> In Germany, the local business tax, which plays an important role in business taxation, is credited against PIT liability in the case of non incorporated firms.

We analyze the impact of the alternative schemes on the tax share of functional income sources using representative micro data from tax statistics for all years available over the period from 1992 to 2003. Moreover, in order to point out the impact on macroeconomic implicit tax rates we calculate them following the approach of the European Commission (2009). The use of micro data from tax statistics instead of macro data from revenue statistics or national accounts allows for an apportionment of profit taxation to sole proprietors and partnerships. Therefore, for the first time for Germany we are able to allocate the overall tax burden on business income to private households (including the sole proprietors) and corporations (including partnerships) according to the concept of national accounts.

As a main result, we find that the choice of the apportionment scheme markedly affects the tax share attributed to the income sources. Income types without significant losses such as labor income or transfer incomes show higher tax shares and implicit tax rates if we account for losses. The opposite is true for capital income, in particular for income from renting and leasing, since losses from these incomes have been dominating during the last decades in Germany.

The following Section 2 portrays the three alternative apportionment schemes and illustrates their effects by an example close to reality. Section 3 further specifies the alternatives. Section 4 describes the empirical analysis based on micro data from tax statistics as well as national account data. Section 5 presents the results with respect to the income tax shares and implicit tax rates by functional income sources. Section 6 concludes.

## **2 Alternative Apportionment Schemes for the Personal Income Tax**

In order to allocate the tax revenue raised by a comprehensive and progressive personal income tax (PIT) including loss offset across the income sources involved, an apportionment scheme for the entire tax burden has to be chosen. The selected formula should be convenient for the analysis intended, and the assumptions should be made clear. This study scrutinizes the impact of different apportionment schemes on the income tax shares and implicit tax rates of functional income sources and points out the consequences of the underlying assumptions.

A simple approach is to allocate the total PIT liability across the positive income sources according to their share in total positive income. The German income tax law applies this pro-

cedure in crediting foreign taxes (Sec. 34c German Income Tax Code) or parts of the local business tax (Sec. 35 German Income Tax Code) against PIT.<sup>2</sup> Losses from particular income sources are neglected in this case although they reduce taxable income and thus the PIT liability. The latter is allocated to positive incomes only.

An alternative is splitting up PIT by both positive and negative income sources according to their share in total income, aggregated over all incomes and allowing for loss offset. The European Commission employs this apportionment scheme for the calculation of implicit tax rates for functional income sources (European Commission, 2009, De Laet and Wöhlbier, 2008).<sup>3</sup> From an economic point of view, taking into account losses in allocating PIT burden across income sources could be motivated by fundamental characteristics of income streams. Investment choices and many other economic decisions often have an impact over many years. Therefore the resulting income streams should be appraised for longer time periods. This is particular the case for business income, for which losses often have to be balanced by profits in later years. Another issue of German income taxation is that taxable income from renting and leasing is negative even in aggregate (see Table A-1 in the Appendix). Tax policy obviously aims to promote housing and real estate investments by hidden tax subsidies in the guise of income determination rules. An allocation rule that only refers to positive income sources raised in the particular assessment year neglects the dampening effect of loss offset allowances, both within the assessment year and over time. Thus, income tax shares of stronger loss-making income sources such as business and rental income are overestimated, the shares of labor or transfer income are underestimated respectively. The apportionment scheme based on yearly positive and negative income sources can not fully account for long-term impacts of taxation over the life-cycle, in particular with respect to individuals that are only running losses over a long time. However, accounting for current losses and also considering losses carried forward or carried back might capture the essential elements of intertemporal income allocation.

---

<sup>2</sup> In a similar way, the means testing of social transfers in Germany such as the housing allowance or public student loans only refers to positive income sources.

<sup>3</sup> For Germany, these calculations were realized using comprehensive microsimulation models commissioned by the Federal Ministry of Finance. Presumably, current losses of single income sources were taken into account for the apportionment (see European Commission, 2009: 371). It remains unclear, however, if, and in which way, intertemporal loss carry-forward or carry-back have also been taken into account.



The following example points out these impacts for a taxpayer over three assessment years, whereas the time value of money is ignored and a simple tax schedule is assumed. In every year the taxpayer earns wages of Euro 70,000. In the first and second year he is running losses from a real estate investment, in the third year he sells this investment with a considerable capital gain which is liable to PIT. To sum up, the total income over the three years amounts to Euro 210,000 from wages, and 20,000 from renting.

**Example**

**Income sources, taxable income and personal income tax liability over three years in Euro**

	Year			Total	Total in percent
	1	2	3		
<i>Assumptions tax base and tax rate</i>					
Income from					
wages and salaries	70 000	70 000	70 000	210 000	↑ 91.3 ↓ 8.7
renting and leasing	- 100 000	- 20 000	140 000	20 000	
Total income	- 30 000	50 000	210 000	230 000	100.0
Total positive income sources	70 000	70 000	210 000	350 000	↓ 152.2
Deduction of loss carry-forward	0	- 30 000	0	- 30 000	
Adjusted gross income	- 30 000	20 000	210 000	200 000	
Personal allowances	15 000	15 000	15 000	45 000	
Taxable income	0	5 000	195 000	200 000	
PIT liability, 25% flat rate	0	1 250	48 750	50 000	
<i>(1) Allocation of PIT liability across positive income sources</i>					
Income from					
wages and salaries	0	1 250	16 250	17 500	↑ 35.0 ↓ 65.0
renting and leasing	0	0	32 500	32 500	
Total	0	1 250	48 750	50 000	↓ 100.0
<i>(2) Allocation of PIT liability across all income sources including deducted losses</i>					
Income from					
wages and salaries	0	4 375	16 250	20 625	↑ 41.3 ↓ 58.8
renting and leasing	0	- 3 125	32 500	29 375	
Total	0	1 250	48 750	50 000	↓ 100.0
<i>(3) Allocation of PIT liability with separate assessment of positive and negative income sources</i>					
Income from					
wages and salaries	13 750	13 750	16 250	43 750	↑ 87.5 ↓ 12.5
renting and leasing	- 13 750	- 12 500	32 500	6 250	
Total	0	1 250	48 750	50 000	↓ 100.0
For information: Effective tax rate					
of income from					
wages and salaries	19.6	19.6	23.2	20.8	
renting and leasing	13.8	25.0	23.2	31.3	

In order to determine the tax liability we assume a simple tax law. There is a loss carry-forward rule, no loss carry-back, personal allowances of Euro 15,000 per year are deducted

from taxable income, there is a flat-rate tax of 25 percent, and there are no specific arrangements for family taxation or capital gains taxation. According to the example, no tax liability is due in the first year. Non-deducted losses could be carried forward to the following year. The total income tax liability over the period sums to Euro 50,000.

If we allocate the yearly income tax liability only across positive income types (alternative 1 in the example) we ignore the losses from renting set off against labor income in splitting up PIT. In contrast, the considerable capital gain from renting in the third year is fully included in the apportionment. Therefore, the first allocation rule results in a 35 percent tax share of renting income. In contrast, the share for income from renting in total income over the three years amounts to only 8.7 percent.

The example's second alternative allocates the PIT liability according to both positive and negative income sources, thereby allowing for loss offset. Since the losses carried forward from the first year result from renting, the corresponding loss deduction in the second year is assigned to this income source. Thus, the share of renting income in total PIT liability over the three years declines to 59 percent. Yet this share is still much too high since the second apportionment scheme does not account for the positive labor income in the first year which is completely offset against losses from renting.

We suggest a third apportionment scheme which fully accounts for loss offset, even in the case if there is no positive taxable income, like in the first year of our example. This alternative shows how much PIT revenue would have been raised if positive income sources were taxed alone without loss offset as well as the negative revenue impact of losses. For that purpose we run an additional assessment for each year that only accounts for positive income sources. The higher fictitious tax liability is allocated to positive income sources only. Afterwards, the difference between this fictitious tax liability on positive incomes and the actual tax liability on total income is allocated to the loss-making income sources as a negative revenue share. Over the three years, the tax share of the income sources nearly equals the income share. The remaining overestimation of the tax share falling on renting income results from the indirect tax progression that is caused by the personal allowances. These allowances are not included in the intertemporal loss offset. This impact would be enhanced by direct tax progression from increasing tax rates, which is still applied in most OECD countries.

### **3 Modeling the Apportionment Schemes**

The empirical assessment of the PIT apportionment across different income types requires an adequate data base. In principle, macro data, semi-aggregated data or micro data could be used. As the advantages of micro data the European Commission emphasizes a precise estimation of the share of each income type in total taxes and of the average tax rate (European Commission, 2009: 367, 375, see also Sørensen, 2004: 21, Clark, 2002).

In order to capture the impact of specific tax regulations for certain income types, the calculation of the PIT shares should be based on representative micro data from tax files. This allows a realistic allocation of taxes across income types for each taxpayer. In comparison, estimates based on statistics of cash revenue of the tax authorities do not necessarily provide a proper assignment of the income tax burden to the accrual period (BMF, 2004). Due to current interim payments, which are based on previous tax assessments, supplementary payments, or repayments for previous tax years, these estimates may differ substantially from the assessed tax liability in a certain year. Moreover, the reported aggregate tax revenue data may not be allocated properly by income sources since the underlying prepayment or repayment procedures encompass several income types. However, revenue statistics in Germany are available up to the present while micro data from income tax statistics are published with a considerable delay. At present, the latest complete wave is for the year 2004.

For couples which are assessed jointly in Germany or in case of further household members included in the assessment, the income sources should be treated separately by individuals, provided that the information is available. For the apportionment scheme proposed in this study (alternative 3), an additional tax assessment has to be made taking into account only positive incomes. This requires a microsimulation model which provides an estimate of the tax liability for each taxpayer close to reality. The PIT shares of the different income types on the individual level may then be added up in order to determine the respective shares on the aggregate level.

Naturally, the regulations of the German income tax system are more complex than the rules described in the example above. For instance, there are specific tax allowances and tax deductions for some income types. Moreover, as in many other countries, the tax rate is directly progressive which means that the marginal tax liability increases with taxable income.

The characteristics of the German income tax function *PIT* which are relevant for this study can be described for taxpayer *j* with income types *i* as follows (see also European Commission, 2009: 375, Clark, 2002):

$$PIT_j = t\left(\sum_i (Y_{i,j} - A_{i,j}) - L_j - A_j^p\right) - \sum_i C_{i,j} - C_j^p, \quad (1)$$

where the following notation applies:

$t(\cdot)$  denotes the tax rate function with taxable income as argument. This function is “linear-progressive” in Germany which means that the marginal tax rate increases with taxable income until the maximum income tax rate is reached (2009: 42 percent starting from a taxable income of Euro 52,552, and 45 percent from Euro 250,401 onwards).

$Y_i$  represents the single income type *i*, such as business income and its sub-categories (in Germany: agriculture and forestry, unincorporated business enterprise, and other self-employed activities), labor income, capital income (from capital investments and from renting and leasing), transfer income. Each type of income is included after the deduction of operating expenses or other income-related expenses.

$A_i$  measures income type specific allowances like the saver’s allowance for income from capital investments, or the allowance for income from agriculture and forestry.

$L$  denotes deducted losses that are carried forward from previous tax years or carried back from following tax years.

$A^p$  represents personal deductions and allowances like the tax allowance for elderly persons, the allowance for itemized special expenses and extraordinary expenses, or the child- or household allowances.

$C_i$  measures income type specific credits that are deducted from the tax liability as, for instance, the foreign tax credit, the credit for local business tax (since 2001) or the tax credit for domestic corporate income tax (until 2001).

$C^p$  denotes credits from the tax liability which are not related to specific income types, for example donations for political parties, or expenses for household-related services (among others: expenses for house-cleaning).

#### *Alternative 1*

In the first PIT apportionment scheme considered, the total PIT liability is distributed by the share of positive income for each income type in total positive income. The income tax burden of person *j* assigned to income type *i* is formally defined as

$$PIT_{i,j} = \frac{\max(Y_{i,j} - A_{i,j}, 0)}{\sum_i \max(Y_{i,j} - A_{i,j}, 0)} \left( PIT_j + \sum_i C_{i,j} \right) - C_{i,j}. \quad (2)$$

Thus, the PIT liability is allocated according to the level of the positive incomes for each income source, as far as the earnings exceed the income-specific tax deductions. First, all in-

come-specific tax credits are added on top of the tax liability that should be allocated among the income types. In a second step, the PIT share attributed to an income type will be reduced by the tax credits granted for this specific income type. Tax credits from the tax liability that do not refer to specific income types ( $C^p$ ) will not be considered in the apportionment. Thus, they reduce the tax burden of all income types proportionally to their share in total positive income.

### *Alternative 2*

The second alternative of an apportionment scheme takes into account both positive and negative income types. For that purpose, one should not only consider current positive and negative income sources but also deducted losses in the tax year ( $L$ ), which are carried forward from previous tax years or carried back from following tax years. If adequate panel data were available, one could assign the impact of the losses from other periods to each income type, as it is the case for income from renting in the example above (section 2). However, the only data available for Germany for the past are the cross-section surveys of the income tax statistic which were drawn every three years. The waves are not connected and do not provide panel information. Panel information might be available in the future and will be based on the yearly survey of the assessment data that starts with the year 2001. At present, the available cross-section data only allow to take into account the aggregate of losses deducted. We define an additional negative income type  $L$  which comprises deducted losses from other periods and will be considered in the allocation of the income tax across income types.

Thus, the income tax liability on income type  $i$  for person  $j$  ( $PIT_{i,j}$ ) is formally defined as:

$$PIT_{i,j} = \frac{Y_{i,j} - A_{i,j}}{\sum_i (Y_{i,j} - A_{i,j}) - L_j} \left( PIT_j + \sum_i C_{i,j} \right) - C_{i,j}. \quad (3a)$$

The negative income tax liability  $PIT_{L,j}$  falling on deducted losses ( $L_j$ ) is defined as:

$$PIT_{L,j} = \frac{-L_j}{\sum_i (Y_{i,j} - A_{i,j}) - L_j} \left( PIT_j + \sum_i C_{i,j} \right). \quad (3b)$$

While the information from the cross-section micro data of the income tax statistic does not allow a precise allocation of deducted losses across income types, it can be used as a basis for a rough estimate. For the past the cross section data show the amount of current unclaimed losses, i.e. losses which cannot be set off against current positive income in the tax year. The

latest available wave of the income tax statistics 2004 reports a share of unclaimed losses in total losses for income from renting of 24 percent and a share for business income of 64 percent, the other income types are not important. Note, however, that the share of unclaimed losses for income from renting was somewhat higher in the years before 2004, and it was considerably higher in the nineties (1995: 39 %, 1998: 37 %). We use rough estimates based on this information in the calculations presented below in order to allocate the tax share of unclaimed losses  $PIT_L$  across the income types  $i$  for the calculation of implicit tax rates (section 5.2).

### Alternative 3

Alternative 3 differs from alternative 2 if a person has positive income for some income types and losses for at least one other income type. For persons with positive income types only, the share of each income type is identical to the result in alternative 2. Thus, differences emerge only for persons with positive *and* negative income types. As demonstrated in the example in section 2, an additional tax assessment of positive incomes only and assigning the negative PIT share to losses might lead to results for the PIT shares which are close to those based on a proper analysis over time.

At fist, the additional tax assessment takes into account only positive income types. The fictitious tax liability on positive income types of person  $j$ ,  $PIT_j^+$  is formally defined as:

$$PIT_j^+ = t \left( \sum_i \max(Y_{i,j} - A_{i,j}, 0) - A_j^p \right) - \sum_i C_{i,j} - C_j^p. \quad (4)$$

This higher tax liability is distributed among the positive income types as:

$$PIT_{i,j}^+ = \frac{\max(Y_{i,j} - A_{i,j}, 0)}{\sum_i \max(Y_{i,j} - A_{i,j}, 0)} \left( PIT_j^+ + \sum_i C_{i,j} \right) - C_{i,j}. \quad (5)$$

Then, the difference between the actual income tax  $PIT_j$  and the fictitious higher tax on positive income  $PIT_j^+$  is distributed among the negative income types. The tax burden for a negative income type  $i$  is then given as:

$$PIT_{i,j}^- = \frac{\min(Y_{i,j} - A_{i,j}, 0)}{\sum_i \min(Y_{i,j} - A_{i,j}, 0) - L} \left( PIT_j - PIT_j^+ + \sum_i C_{i,j} \right) - C_{i,j}. \quad (6a)$$

Analogous to equation 3b, the negative income tax burden  $PIT_{L,j}^-$  which falls on loss carry-forward or loss carry-backward ( $L_j$ ) is given by:

$$PIT_{L,j}^- = \frac{-L_j}{\sum_i \min(Y_{i,j} - A_{i,j}, 0) - L_j} \left( PIT_j^- - PIT_j^+ + \sum_i C_{i,j} \right). \quad (6b)$$

If the tax credits  $C_i$  and  $C^p$  themselves depend on the level of taxable income or on the level of the income tax liability, the effects of these dependencies could in principle be captured in the equations (5), (6a), and (6b). For example, the old-age allowance depends on the level of labor income and other incomes except specific old-age incomes (pensions or annuities). The credit of foreign taxes or of the local business tax depends on the share of these income types in total taxable income and on the level of the PIT liability.

In case of a progressive tax, there are two main differences between alternative 2 and alternative 3 (see the example in the appendix). First, the distributed tax liability is equal to zero both for positive and negative income types under alternative 2 if total income (adjusted gross income) is below zero and, thus, no taxes are paid in the current tax year. This differs from alternative 3 and this difference can be most easily described for the simple case of one positive and one negative income type. In this case, under alternative 3 the positive income type is assigned a tax amount which depends on the level of the positive income type alone. If the sum of both incomes is below zero, the negative income type is assigned the level of the (fictitious) tax on the positive income type, with the opposite sign.

The second difference occurs if total income is positive and a PIT liability exists but at least one income type is negative. In alternative 2, the amount of losses is valued with the average tax rate and this rate is taken at the level of total income (adjusted gross income). Under alternative 3, taxes assigned to the loss income type are equal to the difference between the tax liability considering only the positive income types and the tax which falls on total income (adjusted gross income). Approximately, this is equal to a valuation of the losses with the marginal tax rate (for the interval between total income and total positive income). As for a progressive tax scheme the marginal tax rate is higher than the average tax rate, losses are valued higher under alternative 3.

It can be shown that alternative 2 and 3 lead to equal results for a pure flat tax with tax rate  $\alpha$  if no allowances are granted and taxes are refunded in case of negative taxable income:

$$PIT_j^{flat} = \alpha \sum_i (Y_{i,j} - A_{i,j}). \quad (7)$$

This is, for instance, the case with the European value-added tax (VAT). However, income tax systems in Germany and other OECD countries are far from fulfilling these conditions. The income tax is assessed on an annual basis. Unclaimed losses may only be carried back or carried forward in other tax years and offset against positive income, without any consideration of personal allowances. Approaches aiming to equalize the average tax rate over a longer time-period (Vickrey, 1939, Hackmann, 1979) cannot be found in real tax rules. This disadvantages persons with highly volatile income compared to those with a steady income stream. Thus, alternative 3, or the differences in the results of alternatives 2 and 3 respectively, provide important additional information on the income tax share and implicit tax rates of income sources when losses play an important role for some income types. This was the case in Germany in the eighties and the nineties of the last century, especially for rental income (see Table A-1 in the appendix). The share of the income tax burden as well as the implicit tax rate for these income types are considerably lower under alternative 3 while the opposite applies for the other income types (see the results presented in section 5).

## **4 Empirical Strategy for Germany**

### **4.1 Apportionment Schemes for the Personal Income Tax**

The effects of alternatives 1 and 2 can be analyzed empirically by using representative micro data of the German income tax statistics. Until 2001, the income tax statistics were collected in triennial intervals, including additional data from the wage withholding taxation. Since 2001, a yearly survey of the assessment data is also available. Our analysis is based on highly representative 10 percent stratified random samples from the personal income tax statistics of the particular years.<sup>4</sup> The data sets include nearly all items of the tax return forms which are stored electronically by the fiscal authorities. Due to the long-lasting assessment procedures, the latest available wave of the income tax statistics is for the year 2004. Based on this detailed information we consider all income-specific allowances and tax credits in allocating the PIT liability across income types. The analysis of alternative 3, however, requires an addi-

---

<sup>4</sup> A higher sampling fraction is provided for taxpayers with higher income and other tax-relevant characteristics in order to minimize the standard error with respect to taxable income.



tional PIT assessment that only accounts for positive income sources. We are using comprehensive microsimulation models to determine the higher fictitious PIT liability.

As income-specific allowances ( $A_i$ ) we take into account the allowance for income from agriculture and forestry (Sec. 13 sub. 3 German Income Tax Code) and the saver's allowance (Sec. 20 sub. 4 German Income Tax Code). As income-specific tax credits ( $C_i$ ) we consider the former top tax rate limitation for income from unincorporated business enterprise (Sec. 32c, until 2000), the credit for local business tax (Sec. 35, since 2001), and the credit for income from agriculture and forestry (Sec. 34e, until 2000). For income from capital investment, we account for the domestic corporate income tax that could be credited against PIT under the full imputation system in Germany until 2001. Due to lack of information and their minor quantitative importance, we neglect foreign tax credits in the apportionment analysis.<sup>5</sup>

We also neglect the reduced tax rates for capital gains from sale of an enterprise, or parts of an enterprise (which apply if the entrepreneur retires or becomes disabled, Sec. 34 sub. 3 German Income Tax Code), that could be regarded as a type of tax credit. One should assign this tax reduction to business income. However, this would require extensive calculations in order to isolate the dampening impact on the tax liability. With respect to the minor impact on PIT revenue we neglect this provision for the split-up across income types.

For the PIT apportionment, the taxation with progression procedure ("Progressionsvorbehalt") could be treated in different ways. According to this peculiar tradition of the German income taxation system, certain tax-exempted incomes (in particular exempted foreign income and wage replacement benefits from social security) are taken into account in calculating the average tax rate, which is then applied to taxable income only. We simply allocate this tax-enhancing effect to the sources of taxable income according the respective apportionment scheme under consideration. Alternatively, one could regard this tax increase as a burden on the exempted income sources.

For joint-filing married couples we implement the PIT apportionment using the income information for each spouse which is separately reported in the data set. If, for instance, the

---

<sup>5</sup> The income tax files include only summarized information on foreign taxes that are allowed to credit against German PIT liability. There is no information available from which particular income types the foreign tax credit stems. Presumably, capital investments dominate the underlying incomes, and these incomes are usually taxed in the investor's country of residence including foreign tax credit according to the double taxation

husband is running losses from renting of Euro 20,000, and his wife earns Euro 10,000 from renting, the wife's positive income would account for the split-up according to alternative 1. If we regarded the couple as a single taxpayer, however, there would be losses from renting of Euro 10,000. In the case of alternative 3, the wife's positive income from renting were considered in allocating the higher fictitious tax liability allocated to positive income sources only, and the husband's losses were included in the apportionment of the negative revenue shares of loss income sources.

In addition to the analysis based on the tax return data from the income tax statistics of the respective years, we have to estimate the missing revenue from the numerous non-filing taxpayers only paying wage tax at the source. Until 2004, these tax returns are only partially included in the German income tax statistics since there was no reliable system to collect the wage tax cards that are not returned to the fiscal authorities. Results for 2004, the first year in which the electronic data transfer of the employers' wage-tax returns has been utilized by the tax statistics, reveal about 6 million non-filing wage taxpayers and an extra wage tax revenue of Euro 14.5 billion including solidarity surcharge tax. For the previous years, we estimate this missing revenue in comparing the entire wage tax revenue from the current revenue statistics with the aggregated wage tax of the filing taxpayers credited against income tax liability and thus reported in the income tax statistics. We assign the missing wage tax revenue to labor income.

The empirical analysis of alternative 3 is more intricate compared to the other apportionment alternatives. For an additional PIT assessment of the positive income sources we use comprehensive microsimulation models that fully account for nearly all of the relevant items of applicable tax law in the respective years. For the years 1995 and 1998 we use our own microsimulation model (Bach et al., 2004). For the years 2002 onwards we use the personal income tax microsimulation model of the Fraunhofer Institute for Applied Information Technology FIT, Sankt Augustin, which is operated on behalf of the German Federal Ministry of Finance in order to evaluate the fiscal and distributional impact of tax reforms.

The models are based on income tax samples for the corresponding years. The FIT personal income tax model is based on the 2003 wave of the assessed income tax statistics. Taxpayers,

---

provisions. In some cases business or labor income might also be affected, but usually these foreign incomes are exempted from domestic PIT in Germany.

taxable and non-taxable income sources, and the other tax-relevant items are extrapolated to 2007 (for a description of the methods used see Quinke, 2001, Bach et al., 2004). Changes in tax law including the recent reforms are captured in the simulation code. Based on this model we are running simulations on the PIT liability for 2007.

The simulation models allow us realistic assessments of the additional PIT liability for the positive income sources according to alternative 3. For the calculation of total income and the subsequent determination of the PIT liability we nullify all of the negative income sources as well as the deduction of losses carried forward and back. In the case of joint-filing married couples, the apportionment scheme is performed with the detailed income information for each spouse, including the allocation of positive and negative PIT revenue shares according to alternative 3. Behavioral responses of the taxpayers to the higher tax burden are not considered.

## **4.2 Data Demands for the Calculation of Implicit Tax Rates**

In order to highlight the impact of the different apportionment schemes on macroeconomic implicit tax rates we calculate these figures following the approach of the European Commission (2009). Implicit tax rates are defined as the ratio of the tax burden assigned to the respective income types and the corresponding income aggregates that are derived from the national accounts statistics. The implicit tax rates are calculated for labor income and for capital and business income, the latter differentiated by corporations and households including the self-employed. The European Commission (2009) reports such implicit tax rates for every year since 1995.<sup>6</sup>

In line with the concept of the European Commission (2009), we adopt the “usual” assumptions regarding tax incidence, in particular, that the employers’ share of social contributions is borne by labor income, and that the corporate income tax and other business taxes fall on

---

<sup>6</sup> The yearly calculation of macroeconomic implicit tax rates according to the approach of the European Commission (2009) raises a problem with respect to the timely accounting of losses carried forward or back (Clark, 2002: 15, see also Jacob et al., 2008: 11, 19). Current unclaimed losses actually reduce the income aggregate of the year when they arise. In contrast, the tax liability is reduced in the following or previous tax years when the losses are deducted from the tax base. In single years, this timing problem might have a significant impact on the implicit tax rates, in particular if there is a trend in losses, or gains and losses systematically vary over the business cycle. This problem might be of some importance for Germany because unclaimed losses carried forward strongly increased over the last decades (Dwenger, 2008). We abstain from

business and capital income. This means that these taxes are not shifted forward to consumers or backwards to employees or suppliers.<sup>7</sup> The main task of studies such as European Commission (2009) and our contribution presented here is to provide empirical information on tax revenue and macroeconomic tax bases. Based on this approach, different incidence assumptions across income sources could also be analyzed.

For calculating the implicit tax rate on labor income the European Commission includes the social contributions levied on labor income (European Commission, 2009: 354), in addition to the wage share in PIT liability. The revenue of social contributions is taken from the national accounts statistics (compulsory actual social contributions paid by employers and employees on employed labor income). The total tax burden on labor is put in relation to the compensation of employees according to national accounts. This is the broadest macroeconomic labor income aggregate, comprising all salaries and wages from dependent employment, including the remuneration of civil servants, wages from short-time employment taxed in a lump sum (the so called “minijobs” in Germany), other compensations from dependent employment exempted from PIT or social contributions, and the employers’ social contributions.

Our calculations on the implicit tax rates on capital and business income differ in some respects from the approach of the European Commission (2009). For the yearly tax burden of the local business tax and the corporate income tax, the Commission uses data from the current revenue statistics. In contrast, we are using the actual annual tax liability for these taxes, as it is reported in the corresponding tax statistics (see also Bach und Dwenger, 2007). This gives a more reliable picture of the yearly implicit tax rate, since the cash revenue disclosed in the revenue statistics for a given year might considerably differ from the actual tax liability for that year. These business taxes heavily rely on business profits, which is also true for the local business tax. Thus, current interim payments which are based on previous tax assessments as well as supplementary payments or repayments after the assessment for previous tax years might considerably abandon the year’s actual tax liability according to the tax assess-

---

adjusting for these unclaimed losses, and thus remain in line with the modelling of the European Commission (2009).

<sup>7</sup> These assumptions have been questioned for several decades. With respect to the first, this might not be true in the short run since the employer has to pay the contribution from his payroll in accordance with the applicable tax law. Adjustments in wage setting etc. take some time. In the case of the latter, recent studies indicate that labor might bear a substantial burden from the corporate income tax (Gentry, 2007). This seems plausible against the background of globalization, market income polarization, as well as the European tax reduction competition.

ment, and these timing differences might heavily fluctuate with the business cycle or after major tax reforms.

As measure of the corporate income tax burden we use the assessed tax liability including solidarity surcharge and after deduction of domestic corporate income tax (until 2001 Germany applied the full imputation system to avoid double taxation of distributed profits). For 2007, we use the estimates of our microsimulation model on business taxation *BizTax* for Germany (Bach et al., 2008). This model is based on representative micro data from the last available waves of the German business tax statistics, the model data set is updated to the present using the pertinent macro data and forecasts. Recent tax reforms are implemented in the tax assessment program code. Moreover, we estimate the withholding taxes on capital investments which are not credited against domestic personal or corporate income tax, thus paid by foreigners or tax exempted residents. For that purpose, we compare the cash revenue from these taxes with the credits for these taxes reported in the personal and corporate income tax statistics for the particular years.

The European Commission assigns the social contributions levied on the income of the self-employed to capital and business income. In Germany, some self-employed members of professional guilds such as craftsmen, farmers, artists, or writers are compulsorily insured in the public pension system. Moreover, other self-employed persons are voluntarily insured in the public pension system or in the public health insurance. We take these figures from the national accounts, according to the method of the European Commission (2009: 348).

The European Commission proposes a specific income concept for the denominator of the implicit tax rate on capital and business income (European Commission, 2009: 360) that is derived from the income accounts of the national accounts statistics. The idea is to approximate the actual tax base as close as possible. We modify this approach with respect to three items. First, we take into account the specific treatment of the local business tax revenue in the German national accounts. Although the German local business tax nowadays is largely levied on business profits, its revenue is not booked into the category “taxes on income” of the secondary distribution of income account (ESA 95 Code: d51). Instead, it is factored into the position “other taxes on production” in the generation of income account (ESA 95 Code: d29). This comes from the historical tradition of the local business tax which was formerly levied on a broader base of the firm’s value added and equity. German statistical authorities are currently reconsidering this assignment. The revenue of “other taxes on production” is deducted in calculating primary incomes in national accounts. Since local business tax reve-

nue should be included in the numerator of the implicit tax rate, it should not reduce the denominator, as it is the case in the Commission's calculations. Therefore, we increase the denominator as defined by the European Commission by the local business tax revenue. Second, we reduce capital and business income by the non-taxable subsidies which are roughly estimated by 20 percent of the category "production subsidies other than on products" (ESA 95 Code: d39rec) (see Bach und Dwenger, 2007: 62), and the profit income of the central reserve bank. The Tables 3 to 5 in the following section 5 both include the capital and business income aggregates according to our concept and of the European Commission.

The comprehensive utilization of tax statistics data allows us, for the first time for Germany, to differentiate the implicit tax rate on capital and business income in those of corporations and households including the self-employed according to the concept of the European Commission. The reports of the European Commission (2009) do not provide these figures for Germany since the revenue statistics used in that study do not allow an apportionment to these subgroups of taxpayers. The problem is to isolate the share of non-incorporated partnerships in tax revenue. Partnerships play an important role in Germany as many medium-sized businesses and even some bigger firms use this legal form. The income of partnerships is taxed "transparently" which means that the entire business income is passed to the shareholders who have to enter it into their PIT return. In national accounts, however, partnerships are assigned to the corporate sector, and German national accounts statistics follow this approach according to European and international standards. The revenue statistics do not distinguish between those company sectors, but the tax statistics do. The local business tax statistics include the legal form of the firms, which we use. The income tax statistics differentiate business income (from agriculture and forestry, from business enterprise, and from professional services) into income from sole proprietorship and from partnerships. Based on this information, we further allocate the PIT share on business income across sole proprietors and partnerships using the alternative 2 as apportionment scheme. The share of sole proprietors is assigned to the household sector, the share of partnerships is assigned to corporations. The social contributions of the self-employed are allocated to the household sector.

For the denominator of the implicit tax rate we calculate the two sectors' macroeconomic income aggregates according to the concept of the European Commission (2009: 362), using

the sectoral income accounts of the national accounts data.<sup>8</sup> The addition of the local business tax revenue as well as the deductions for non-taxable subsidies and profit income of the central reserve bank (see above) follow the respective information of the sectoral accounts.

## 5 Results

### 5.1 Personal Income Tax Shares

The results of the three PIT apportionment alternatives considered in this study are presented in Table 1 for the years 1992, 1995, 1998, 2003, and 2007. For 1992, the alternative 3 of the PIT split-up has not been analyzed because we do not have a microsimulation model for this year. The starting point of the apportionment procedure is the entire PIT liability per year including the non-assessed wage tax revenue and the solidarity surcharge. Until 2001, we deduct the domestic corporate income tax credited against PIT, according to the full imputation system applied until then in Germany. The PIT is the tax with the highest revenue in Germany. For instance, in 2003 the entire revenue of PIT including non-assessed wage tax and solidarity surcharge amounts to Euro 198 billion, or 9.2 percent of the gross domestic product (GDP). This revenue rises to 9.4 percent of GDP in 2007 according to our estimations based FIT personal income tax model. The model's data base for 2007 is aligned to the performance of the macroeconomic income aggregates and the cash revenue of the PIT components.

The categories of the income types considered in Table 1 follow the concept of the European Commission (2009). While most of the definitions of income types are obvious, some deserve a comment. Labor income only includes compensations for active dependent employment. Pensions and related benefits from former employment, in particular the remuneration of retired civil servants, are assigned to transfer income. Self-employed income comprises the income from all unincorporated business, inclusive agriculture and forestry and from professional services. These income sources comprehend the entire profit from business enterprise.

---

<sup>8</sup> According to the concept of the European Commission (2009: 363) the capital and business income aggregates assigned to the two sectors do not sum up to the overall aggregate. Due to the double taxation of dividends at the company level and at the shareholder level, the Commission includes the dividend income received by private households (ESA 95 Code: d42\_S14-15rec) in both the corporations' and the households' denominator.

There is no fictitious allocation across imputed entrepreneurial wage, return on business capital, and extra profits. Income from renting and leasing, from capital investment, and capital gains are consolidated to capital income. The remaining income types liable to PIT such as the taxable share of public pensions or alimonies between separated or divorced spouses are assigned to transfer income. For the apportionment alternatives 2 and 3 we consider deducted losses that were carried forward or carried back from previous or following tax years as a specific negative income type, as described above (see above, section 4.2). Further analysis of the available waves of the income tax statistics shows that more than two thirds of the unclaimed losses generated in 2002 to 2004 stem from self-employed income, the rest refers to losses from renting. In the nineties, the share of renting income was somewhat higher. For the calculation of implicit tax rates (see the following section 5.2) we assign the negative revenue impact of deducted losses from previous or following tax years to capital and business income, since labor income or other income types have practically no impact on unclaimed losses carried forward or back.

As expected, the PIT apportionment according to positive income types only (alternative 1) yields relatively low shares for income types that do not have significant losses such as labor income or transfer income (Table 1). Their share in the PIT is higher in alternatives 2 and 3. Taxable income from renting and leasing was heavily generating losses during the nineties. This causes lower PIT shares of capital income and especially of renting income for alternatives 2 and 3 compared to alternative 1.

We find some variation over time for all income types. The share of self-employed income decreases from 1992 to 1995 as well as from 1998 to 2003. Besides business cycle fluctuations, the introduction of the top tax rate limitation for income from business enterprise in 1993 and the credit for local business tax as of 2001 might have had an impact on this development. According to the estimation for 2007 the self-employed income's share rises markedly. This reflects the profit boost in the years before, which is taken into account for the projection of the model's data base. Correspondingly, labor's share in PIT revenue varies in the opposite direction.



Table 1

**Allocation of PIT revenue by income sources according to different apportionment schemes, 1992–2007**

	1992	1995	1998	2003	2007 <sup>1)</sup>
	Annual revenue, mill. Euro				
Personal income tax, wage tax <sup>2)</sup>	147 927	154 177	180 688	189 144	216 154
Solidarity surcharge	5 659	10 675	8 974	9 064	10 506
Total	153 586	164 852	189 661	198 208	226 660
	as % of GDP				
Total	9.3	8.9	9.7	9.2	9.4
	Structure in % by income types				
Alternative 1					
Allocation across positive income sources <sup>3)</sup> from					
Labor income <sup>4)</sup>	72.9	76.6	73.6	76.2	69.2
Self-employed income	20.7	17.6	21.0	16.7	23.5
Sole proprietors	13.5	10.5	11.9	10.8	15.3
Partnerships	7.2	7.1	9.1	5.9	8.2
Capital income	3.7	2.7	2.7	4.1	4.0
Capital investment <sup>5)</sup>	1.9	0.7	0.8	2.0	2.1
Renting and leasing	1.8	2.0	1.9	2.1	1.9
Transfer income <sup>6)</sup>	2.7	3.1	2.7	3.0	3.3
Deducted losses from other tax years	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0
Alternative 2					
Allocation across all income sources including deducted losses from					
Labor income <sup>4)</sup>	74.5	78.8	75.7	77.9	70.3
Self-employed income	21.4	18.7	21.9	16.9	24.2
Sole proprietors	14.0	11.2	12.4	10.8	15.5
Partnerships	7.4	7.6	9.5	6.1	8.7
Capital income	1.5	-0.4	-0.1	2.4	2.7
Capital investment <sup>5)</sup>	2.2	1.1	1.2	2.2	2.2
Renting and leasing	-0.7	-1.4	-1.2	0.2	0.5
Transfer income <sup>6)</sup>	2.8	3.1	2.7	3.0	3.4
Deducted losses from other tax years	-0.2	-0.3	-0.2	-0.3	-0.6
Total	100.0	100.0	100.0	100.0	100.0
Alternative 3					
Allocation with separate assessment of positive and negative income sources <sup>3)</sup> from					
Labor income <sup>4)</sup>		81.6	78.4	79.8	71.5
Self-employed income		20.1	22.9	17.0	24.3
Sole proprietors		12.0	13.0	10.9	15.5
Partnerships		8.1	9.9	6.1	8.7
Capital income		-3.7	-3.1	1.2	1.9
Capital investment <sup>5)</sup>		1.7	1.7	2.4	2.3
Renting and leasing		-5.4	-4.8	-1.2	-0.5
Transfer income <sup>6)</sup>		3.4	3.0	3.3	3.5
Deducted losses from other tax years		-1.3	-1.2	-1.3	-1.1
Total		100.0	100.0	100.0	100.0

1) Estimation.- 2) Assessed personal income tax, non-assessed wage tax, less credited domestic corporate income tax.- 3) For joint-filing married couples the income sources of each spouse are counted separately.- 4) Compensations for active dependent employment, excluding pensions and related benefits from former employment.- 5) Including capital gains.- 6) Other income liable to PIT less capital gains, including pensions and related benefits from former employment.

Sources: Personal income tax statistics, 10 % or 1 % stratified random samples of the respective years; PIT microsimulation models of DIW Berlin and FIT Sankt Augustin; Federal Statistical Office Germany (Destatis).

If we compare the results for alternative 2 which is used by the European Commission with those for alternative 3 suggested by us, we find that the labor income share in PIT for alternative 3 is higher by various percentage points. In 1995 the difference is 2.8 percentage points, it declines to 1.2 percentage points by 2007. For transfer income the revenue share increases by 0.3 percentage points. In contrast, the revenue shares of both capital income and loss deduction decrease considerably from alternative 2 to alternative 3. For capital income this effect is dominated by the heavy losses from renting and leasing during the last decades. Even for alternative 2 the PIT shares of total capital income are negative in the years 1995 and 1998. The decline of losses from renting and leasing leads to a positive share of this income type in the following years under alternative 2 but remains slightly negative under alternative 3. The PIT share of total capital income is positive in 2003 and 2007 for both alternatives 2 and 3.

## **5.2 Implicit Tax Rates**

Our Tables 2 to 5 highlight the impact of the PIT apportionment scheme for the macroeconomic implicit tax rates on income sources, which are regarded as summary measures for the income tax burdens by economic functions. We adopt the approach developed by the European Commission (2009), as outlined above (section 4.2). For that purpose, the tax revenue assigned to the respective income types is divided by the corresponding income aggregates, derived from the national accounts statistics. According to the approach of the European Commission, implicit tax rates are calculated for labor income (Table 2), and for capital and business income (Table 3), the latter differentiated by corporations (Table 4) and households including self-employed (Table 5).

The upper panel of the Tables 2 to 5 shows the results for the implicit income tax rates by the three apportionment schemes. The next panel displays the entire implicit tax rates where other relevant taxes such as social contributions or other taxes on business income are also taken into account. These results could be best compared with the Commission's results on implicit tax rates for Germany. Deviations from our results stem from the differing data bases (assessment data from the tax statistics versus revenue statistics) and from some adjustments in the denominator of the implicit tax rate on capital and business income (see section 4.2). The underlying aggregates on income sources and tax burden are reported in the lower panel of the Tables 2 to 5.

### *Implicit tax rates on labor income*

In calculating the implicit tax rate on labor income, the European Commission puts the tax revenue in relation to the compensation of resident employees according to national accounts (for the precise definition see above, section 4.2). The tax revenue from labor income includes both the wage share in PIT liability and the actual social contributions on labor income. According to our results the implicit tax rate rises until 1998 and declines afterwards (Table 2). The latter should reflect the reform agenda of the first red-green federal government after 1998, which markedly reduced social contribution rates. These reliefs were financed by spending cuts in social security and indirect tax hikes (VAT, eco taxes). In the following years the step-by-step income tax reform reduced income tax rates until the year 2005. Our results with respect to level and trend of the implicit tax rates on labor income are very close to those obtained by the European Commission (2009: 325) in most years, the remaining differences are due to the fact that the Commission's calculations are based on cash revenue of PIT.

What is interesting here is the share of PIT including solidarity surcharge that is affected by the apportionment scheme. Compared with alternative 1 which allocates the income tax only by positive income sources, alternative 2 yields an increase in implicit tax rates by 0.4 percentage points in 1995. Alternative 3 involves a rise of 0.8 percentage points in that year. The downturn of losses from renting and leasing lowers these differences until 2007 to 0.2 percentage points for alternative 2, and 0.4 percentage points for alternative 3 respectively. These differences seem not to be too substantial at first glance. In view of the huge aggregate of labor income amounting to Euro 1,200 billion, however, these differences deal with a tax revenue of Euro 3 to 5 billion in 2007. This equates to the revenue of the German inheritance and gift tax, which has been under heavy discussion for many years.

Table 2

**Implicit tax rates on labor income according to different apportionment schemes for PIT revenue, 1992–2007**

	1992	1995	1998	2003	2007 <sup>1)</sup>
Implicit tax rates on labor income <sup>2)</sup>	%				
Personal income tax and solidarity surcharge on labor income, allocated by					
Alternative 1: Allocation across positive income sources	12.2	12.7	13.5	13.3	13.2
Alternative 2: Allocation across all income sources	12.5	13.0	13.9	13.6	13.5
Alternative 3: Allocation with separate assessment		13.5	14.4	14.0	13.7
Actual social contributions on labor income <sup>3)</sup>	24.8	26.4	27.6	26.9	26.0
Total, allocated by					
Alternative 1: Allocation across positive income sources	37.1	39.1	41.1	40.2	39.2
Alternative 2: Allocation across all income sources	37.3	39.4	41.5	40.5	39.5
Alternative 3: Allocation with separate assessment		39.9	42.0	40.8	39.7
For information:					
Tax revenue and income aggregates	bill. Euro				
Personal income tax and solidarity surcharge on labor income, allocated by					
Alternative 1: Allocation across positive income sources	112.0	126.3	139.5	151.0	156.8
Alternative 2: Allocation across all income sources	114.4	129.9	143.6	154.5	159.4
Alternative 3: Allocation with separate assessment		134.4	148.7	158.2	162.1
Actual social contributions on labor income <sup>3)</sup>	227.9	263.1	284.8	304.0	307.7
Compensation of employees (resident), national accounts	917.2	997.0	1032.3	1132.1	1183.6
1) Estimation.- 2) Based on the compensation of employees (resident), national accounts. This includes the employers' social contributions.- 3) Paid by employers and employees. Sources: Personal income tax statistics, 10 % or 1 % stratified random samples of the respective years; microsimulation models of DIW Berlin and FIT Sankt Augustin; Federal Statistical Office Germany (Destatis).					

*Implicit tax rates on capital and business income*

Moreover, the European Commission calculates implicit tax rates on capital and business income. Table 3 assembles all taxes on business and capital income which are divided by the corresponding income aggregates. For the denominator we basically rely on the income concept of the Commission based on national accounts, but adjust for the local business tax which is deducted from business income and correct for tax-exempted subsidies and central reserve bank profit (see above, section 4.2). For the numerator we include the PIT share and the other taxes on business and capital income, such as the local business tax, the corporate income tax, the capital returns tax non-credited to domestic personal or corporate income tax, and the social contributions levied on the income of the self-employed.

Table 3

**Implicit tax rates on capital and business income  
according to different apportionment schemes for PIT revenue, 1992–2007**

	1992	1995	1998	2003	2007 <sup>1)</sup>
Implicit tax rates on capital and business income <sup>2)</sup>	%				
Personal income tax and solidarity surcharge on capital and business income, allocated by					
Alternative 1: Allocation across positive income sources	9.1	7.1	8.7	7.4	8.3
Alternative 2: Allocation across all income sources	8.5	6.3	7.9	6.7	7.9
Alternative 3: Allocation with separate assessment		5.3	6.8	6.0	7.5
Social contributions of the self-employed, local business tax, corporate income tax, non-credited capital returns tax, solidarity surcharge <sup>3)</sup>	12.8	11.6	13.1	11.4	11.6
Total, allocated by					
Alternative 1: Allocation across positive income sources	21.9	18.7	21.8	18.7	19.8
Alternative 2: Allocation across all income sources	21.3	17.9	21.0	18.1	19.5
Alternative 3: Allocation with separate assessment		16.8	19.9	17.3	19.1
For information:					
Tax revenue and income aggregates	bill. Euro				
Personal income tax and solidarity surcharge on capital and business income, allocated by					
Alternative 1: Allocation across positive income sources	37.4	33.4	45.1	41.3	62.3
Alternative 2: Allocation across all income sources	34.9	29.8	40.9	37.7	59.6
Alternative 3: Allocation with separate assessment		24.8	35.3	33.4	56.7
Other taxes on capital and business income, and social contributions of the self-employed <sup>3)</sup>					
Local business tax	22.5	20.7	24.5	24.5	40.7
Corporate income tax <sup>4)</sup>	18.3	17.9	26.4	23.3	28.3
Non-credited capital returns tax <sup>5)</sup>	1.8	3.8	4.0	4.3	6.4
Solidarity surcharge	0.8	1.6	1.7	1.5	1.9
Social contributions of the self-employed	8.9	10.5	10.9	10.2	9.8
Total	52.3	54.5	67.6	63.8	87.1
Capital and business income, national accounts concept of the European Commission	398.9	460.5	503.3	545.5	721.6
own concept <sup>6)</sup>	409.4	470.7	517.6	560.4	753.0
<p>1) Estimation.- 2) Based on business and capital income derived from national accounts, own concept.- 3) Data from tax statistics, estimations for 2003 and 2007; social contributions according to national accounts.- 4) Assessed corporate income tax less credited corporate income tax (full imputation scheme until 2001).- 5) Estimation.- 6) Business and capital income derived from national accounts according to the concept of the European Commission, plus deducted local business tax, less profit of the central reserve bank, less 20 percent of received subsidies. Sources: Personal income tax statistics, 10 % or 1 % stratified random samples of the respective years; corporate income tax statistics; local business tax statistics; microsimulation models of DIW Berlin and FIT Sankt Augustin; Federal Statistical Office Germany (Destatis).</p>					

For the PIT share on business and capital income we sum up the shares falling on the self-employed income, on income from capital investment, on renting and leasing, and on deducted losses from other tax years (see the respective items in Table 1). The last are almost completely caused by unclaimed losses from to self-employed and capital income, since losses do not play any significant role in labor and transfer income (see the discussion in sec-

tion 4.2). Table 4 and Table 5 present the breakdown of the implicit tax rate on capital and business income to corporations and house-holds including self-employed.

Generally, the results presented here show relatively low implicit tax rates on capital and business income, compared to statutory tax rates or even effective tax rates estimated from „forward-looking“ simulation models for Germany (see Spengel, 2003, Becker and Fuest, 2006, Devereux et al., 2008). This reflects the remarkable shortfall of taxable business income reported in the tax statistics, compared to the corresponding income aggregates of national accounts (see Bach and Dwenger, 2007, Heckemeyer and Spengel, 2008). The same is true for capital income of households, which is also caused by the saver’s allowance for income from capital investments, and, presumably, considerable tax evasion.<sup>9</sup>

The implicit tax rates on capital and business income markedly declined since 1992. In 1995, the massive investment incentives for Eastern Germany provided by generous tax allowances might have impaired the tax burden, besides small tax cuts in the previous years. In 1998, the implicit tax rate turns out somewhat higher which might be explained by the upturn of the business cycle. By 2003, the tax cuts from the preceding business tax reform came into effect. The years until 2007 show considerably rising implicit tax rates due to the boost in business income.

Because of the much smaller share of capital and business income in comparison with labor income, the impact of the PIT apportionment scheme on the implicit tax rates is significantly stronger than for labor income. The 1995 implicit tax rate using alternative 2 decreases by 0.8 percentage points compared to alternative 1, for alternative 3 the impact of the PIT allocation makes up 1.8 percentage points. Until 2007, these differences fall to 0.4 percentage points for alternative 2, and to 0.7 percentage points for alternative 3 respectively.

The comprehensive utilization of tax statistics data allows us, for the first time for Germany, to differentiate the implicit tax rate on capital and business income into those of corporations and households including the self-employed according to national accounts sectors. The report of the European Commission (2009) does not provide these figures for Germany since

---

<sup>9</sup> In order to illustrate the possible effect of an overestimation of capital and business income in national accounts on our results for the respective implicit tax rate, we calculated the implicit tax rates for alternative 2 assuming a capital and business income aggregate decreased by an amount equal to 1 percent of GDP. In this case, the level of the implicit tax rate shown in Table 3 for alternative 2 increases by less than 1 percentage point in all years observed.

the revenue statistics used in that study do not allow an apportionment to these subgroups of taxpayers with respect to non-incorporated partnerships (see above, section 4.2).<sup>10</sup>

Table 4 presents the results for the implicit tax rates for corporate business income, including the business and income tax share of partnerships. There is a considerable decrease in implicit tax rates over the period observed, in particular since the business tax reform 2001. Until 2007, the implicit tax rates might have decreased further according to our estimated tax revenue. Although the tax revenue of both PIT and the other business income taxes rises considerably again, the macroeconomic tax base increases even stronger. In 1995, the implicit tax rate for alternative 2 increases by 0.4 percentage points compared to alternative 1, for alternative 3 by 0.7 percentage points. These differences reduce to 0.2 percentage points both for alternative 2 and 3 until 2007.

The implicit tax rates on capital and business income for the household sector including the self-employed are dominated by the PIT burden (Table 5) since the social contributions of the self-employed and the other taxes on business and capital income are low. The apportionment schemes have a strong impact on implicit tax rates, in particular when losses from renting and leasing peaked around the years 1995 and 1998. For these years the results report a reduction of the implicit tax rate for alternative 2 by 1.1 percentage points in comparison to alternative 1, and by 2.5 percentage points for alternative 3 (2.6 percentage points in 1998). In particular due to the decline of losses from renting and leasing the implicit tax rates almost recapture the 1992 level by 2007. The differences in the implicit tax rates decrease to 0.7 percentage points (alternatives 2 versus 1) and 1.2 percentage points (alternatives 3 versus 1).

---

<sup>10</sup> It should be noted that the capital and business income aggregates assigned to the two sectors do not sum up to the overall aggregate, as explained in footnote 8. Thus, the overall implicit tax rate on capital and business income is not equal to the weighted average of the sectors' implicit tax rates.

Table 4

**Implicit tax rates on capital and business income of corporations including partnerships according to different apportionment schemes for PIT revenue, 1992–2007**

	1992	1995	1998	2003	2007 <sup>1)</sup>
Implicit tax rates on capital and business income <sup>2)</sup>	%				
Personal income tax and solidarity surcharge on capital and business income, allocated by					
Alternative 1: Allocation across positive income sources	6.1	5.3	6.4	3.8	3.9
Alternative 2: Allocation across all income sources	6.3	5.7	6.7	3.9	4.2
Alternative 3: Allocation with separate assessment		6.0	7.0	3.9	4.2
Local business tax, corporate income tax, non-credited capital returns tax, solidarity surcharge <sup>3)</sup>	21.4	17.6	18.9	15.2	14.5
Total, allocated by					
Alternative 1: Allocation across positive income sources	27.5	22.9	25.3	18.9	18.4
Alternative 2: Allocation across all income sources	27.7	23.2	25.6	19.0	18.7
Alternative 3: Allocation with separate assessment		23.6	25.8	19.0	18.7
For information:					
Tax revenue and income aggregates	bill. Euro				
Personal income tax and solidarity surcharge on capital and business income, allocated by					
Alternative 1: Allocation across positive income sources	11.0	11.7	17.4	11.7	18.6
Alternative 2: Allocation across all income sources	11.4	12.5	18.0	12.0	19.7
Alternative 3: Allocation with separate assessment		13.3	18.8	12.0	19.8
Other taxes on capital and business income <sup>3)</sup>					
Local business tax	19.1	18.6	22.4	21.7	37.2
Corporate income tax <sup>4)</sup>	18.3	17.9	26.4	23.3	28.3
Non-credited capital returns tax <sup>5)</sup>	0.4	0.8	0.8	0.9	1.3
Solidarity surcharge	0.7	1.4	1.5	1.3	1.6
Total	38.5	38.6	51.1	47.1	68.5
Capital and business income, national accounts					
concept of the European Commission	170.0	210.2	256.7	296.7	443.2
own concept <sup>6)</sup>	180.3	220.2	270.4	310.8	472.9
<p>1) Estimation.- 2) Based on business and capital income derived from national accounts, own concept.- 3) Data from tax statistics, estimations for 2003 and 2007.- 4) Assessed corporate income tax less credited corporate income tax (full imputation scheme until 2001).- 5) Estimation.- 6) Business and capital income of corporations derived from national accounts according to the concept of the European Commission, plus deducted local business tax, less profit of the central reserve bank, less 20 percent of received subsidies.</p> <p>Sources: Personal income tax statistics, 10 % or 1 % stratified random samples of the respective years; corporate income tax statistics; local business tax statistics; microsimulation models of DIW Berlin and FIT Sankt Augustin; Federal Statistical Office Germany (Destatis).</p>					



Table 5

**Implicit tax rates on capital and business income of households and self-employed according to different apportionment schemes for PIT revenue, 1992–2007**

	1992	1995	1998	2003	2007 <sup>1)</sup>
Implicit tax rates on capital and business income <sup>2)</sup>	%				
Personal income tax and solidarity surcharge on capital and business income, allocated by					
Alternative 1: Allocation across positive income sources	7.5	5.4	6.4	6.1	7.5
Alternative 2: Allocation across all income sources	6.6	4.3	5.3	5.3	6.9
Alternative 3: Allocation with separate assessment		2.8	3.8	4.4	6.4
Social contributions of the self-employed, local business tax, non-credited capital returns tax, solidarity surcharge <sup>3)</sup>	3.9	3.9	3.8	3.4	3.2
Total, allocated by					
Alternative 1: Allocation across positive income sources	11.4	9.3	10.2	9.6	10.8
Alternative 2: Allocation across all income sources	10.6	8.2	9.0	8.7	10.1
Alternative 3: Allocation with separate assessment		6.7	7.6	7.9	9.6
For information:					
Tax revenue and income aggregates	bill. Euro				
Personal income tax and solidarity surcharge on capital and business income, allocated by					
Alternative 1: Allocation across positive income sources	26.4	21.8	27.7	29.6	43.7
Alternative 2: Allocation across all income sources	23.5	17.3	22.9	25.7	39.8
Alternative 3: Allocation with separate assessment		11.5	16.5	21.4	36.9
Other taxes on capital and business income, and social contributions of the self-employed <sup>3)</sup>					
Local business tax	3.4	2.1	2.2	2.8	3.4
Non-credited capital returns tax <sup>4)</sup>	1.5	3.1	3.2	3.5	5.2
Solidarity surcharge	0.1	0.2	0.2	0.2	0.3
Social contributions of the self-employed	8.9	10.5	10.9	10.2	9.8
Total	13.8	15.9	16.5	16.6	18.7
Capital and business income, national accounts concept of the European Commission	353.1	405.2	434.3	482.9	577.7
own concept <sup>5)</sup>	353.3	405.4	434.9	483.7	579.3
<p>1) Estimation.- 2) Based on business and capital income derived from national accounts, own concept.- 3) Data from tax statistics, estimations for 2003 and 2007; social contributions according to national accounts.- 4) Estimation.- 5) Business and capital income of households and self-employed derived from national accounts according to the concept of the European Commission, plus deducted local business tax, less 20 percent of received subsidies. Sources: Personal income tax statistics, 10 % or 1 % stratified random samples of the respective years; local business tax statistics; microsimulation models of DIW Berlin and FIT Sankt Augustin; Federal Statistical Office Germany (Destatis).</p>					

## 6 Conclusions

Summary measures on the tax burden by economic functions have a considerable influence on tax policy debates. They comprehend essential characteristics of the tax system and allow for comparisons over time or across countries. However, summarizing the vast complexity of the tax system to one or a few parameters always implies a loss of information. The effectiveness and significance of such parameters depends on their construction, and on the data base from which they are derived.

Macroeconomic implicit tax rates are important parameters for the description and evaluation of the tax burden by economic functions. This is particular true for the taxation of main income sources such as labor income, capital and business income, or transfer income. For that purpose, the tax revenue assigned to these income types is divided by the corresponding income aggregates, usually derived from the national accounts statistics (European Commission, 2009). This calculation is not straightforward, however, in the case of a “comprehensive” personal income tax (PIT). Real-world PIT systems aggregate several income categories, allow for loss-offset across income types, grant deductions of several personal allowances, and tax the residuum at progressive tax rates. Therefore, one has to implement an apportionment scheme for PIT which depends on the aim of the analysis. This raises the question of how far the estimated tax burden of one income source depends on the choice of the apportionment system. In particular, losses that are allowed to set off against positive income in a tax year or over time may have a marked impact on the tax share of income sources as well as on implicit tax rates.

In this study, we examine three alternative apportionment schemes for allocating the personal income tax by income sources. The analysis demonstrates the impact of the alternatives on the tax shares and the implicit tax rate of income sources. The first apportionment scheme allocates total PIT liability across the positive income sources according to their share in total positive income. Losses from particular income sources are neglected in this case. A second apportionment scheme, which is used by the European Commission (2009), distributes the tax burden according to an income source’s share in total income, both positive and negative. Hence, the PIT share equals the income amount times the average tax rate. This apportionment scheme accounts for negative income shares of losses which are set off against current positive income. However, this only applies if total income is positive and thus a tax liability comes due. We propose a third apportionment alternative which comprehensively accounts for loss offset. In addition to the apportionment alternative 2 we account for losses even if the taxpayer’s total income is negative but at least one income source is positive. For that purpose, we run a separate assessment for total positive income and assign the difference between the fictitious PIT liability for the positive incomes and the actual PIT liability to the loss income types as a negative revenue share. With a direct progressive tax rate function, as it applies in Germany and most of the OECD countries, the negative revenue share of losses turns out to be higher than for alternative 2. This is also the case for losses which are completely offset against current positive income. Approximately, losses are valued with the aver-

age tax under alternative 2, and with the marginal tax rate under alternative 3. Losses carried forward and carried back are also taken into account applying the alternatives 2 and 3.

We analyze the impact of the alternative schemes using representative micro data from the available years of the tax statistics over the period of 1992 to 2003. Moreover, we point out the impact on macroeconomic implicit tax rates which we calculate following the approach of the European Commission (2009). Besides the personal income tax we include social contributions and the other taxes on business income (local business tax, corporate income tax). The use of micro data from tax statistics instead of macro data from revenue statistics or national accounts allows us, for the first time for Germany, to allocate the overall tax burden on business income to private households (including the sole proprietors) and corporations (including partnerships) according to the concept of national accounts.

We find that the choice of the apportionment scheme markedly affects the tax share of the income sources. Alternative 1 involves higher income tax shares and implicit tax rates for income types that are running losses. Only tax liabilities on positive income count for the tax share although the tax base for calculating implicit tax rates is reduced by losses. Therefore, this apportionment scheme is not well suited for the calculation of implicit tax rates. Our calculations show noticeable differences in the results of alternatives 1 and 2 for capital income, in particular for income from renting and leasing, since losses from these incomes have been dominating during the last decades in Germany. Interpreting the macroeconomic implicit tax rate as tax burden of the “average individual”, one might better rely on alternative 2 which is also used by the European Commission (2009).

Alternative 3 puts more weight on losses, compared to alternative 2. This results in lower shares of capital and business income in total income tax burden, in particular due to the high losses from renting and leasing. This impact accounts for more than one percentage point during the nineties. For capital and business income of households including the self-employed this difference makes up 1.5 percent at that time, since losses from renting are concentrated at the household sector. Due to the decline of losses from renting these differences decrease considerably until the last years. Correspondingly, income sources without significant losses such as labor income or transfer incomes move in the opposite direction. They show higher tax shares and implicit tax rates. Thus, the apportionment alternative 3 provides significant information if single income sources run losses to a larger extend and over longer periods, as it was the case for income from renting in Germany over the last decades.

## Appendix

Table A-1

### Business and capital income in the personal income tax statistics, 1983–2004

Income source	1983	1986	1989	1992	1995	1998	2001	2002	2003	2004
Income from	in billion Euro									
agriculture and forestry	4.3	4.6	5.8	6.1	6.4	7.7	7.4	7.0	6.8	7.2
positive income	4.5	4.8	6.1	6.7	6.9	8.2	7.9	7.6	7.4	7.7
negative income	- 0.1	- 0.2	- 0.3	- 0.5	- 0.5	- 0.5	- 0.5	- 0.6	- 0.6	- 0.5
business enterprise	44.6	50.6	67.2	67.3	62.0	86.7	70.7	71.6	71.8	78.4
positive income	46.1	52.4	73.2	78.4	77.2	103.8	88.9	87.7	85.1	90.8
negative income	- 1.5	- 1.8	- 6.0	- 11.1	- 15.2	- 17.1	- 18.2	- 16.0	- 13.3	- 12.4
self-employed activities	18.3	20.7	24.9	35.3	40.0	48.6	51.8	53.4	52.4	55.5
positive income	18.4	20.9	25.4	36.1	40.9	49.7	52.9	54.6	53.6	56.6
negative income	- 0.2	- 0.2	- 0.5	- 0.7	- 1.0	- 1.1	- 1.1	- 1.1	- 1.2	- 1.1
capital investment	9.9	12.8	16.1	28.6	18.3	22.7	32.3	19.7	17.0	16.7
positive income	9.9	12.9	16.4	28.8	18.6	23.0	32.8	20.2	17.4	17.0
negative income	- 0.1	- 0.1	- 0.2	- 0.3	- 0.3	- 0.3	- 0.5	- 0.4	- 0.4	- 0.4
renting and leasing <sup>1)</sup>	- 9.8	- 10.5	- 5.0	- 9.3	- 18.6	- 16.5	- 3.4	- 1.4	0.9	5.2
positive income	7.1	8.4	10.0	12.9	15.7	19.3	20.6	21.6	21.9	23.0
negative income	- 16.9	- 18.9	- 15.1	- 22.2	- 34.3	- 35.8	- 24.0	- 23.0	- 21.0	- 17.8
Total income	67.2	78.3	108.9	128.0	108.1	149.2	158.7	150.4	148.9	163.0
positive income	86.0	99.5	131.1	162.9	159.4	204.0	203.1	191.6	185.4	195.2
negative income	- 18.8	- 21.2	- 22.1	- 34.8	- 51.3	- 54.8	- 44.4	- 41.2	- 36.6	- 32.2
For information:	as percent of GDP									
Total income	7.7	7.8	9.3	7.8	5.8	7.6	7.5	7.0	6.9	7.4
positive income	9.9	9.8	11.2	9.9	8.6	10.4	9.6	8.9	8.6	8.8
negative income	- 2.2	- 2.1	- 1.9	- 2.1	- 2.8	- 2.8	- 2.1	- 1.9	- 1.7	- 1.5
1) 1983 and 1986: less imputed rental value from owner-occupied dwellings (estimated). Sources: Federal Statistical Office Germany (Destatis).; own calculations.										

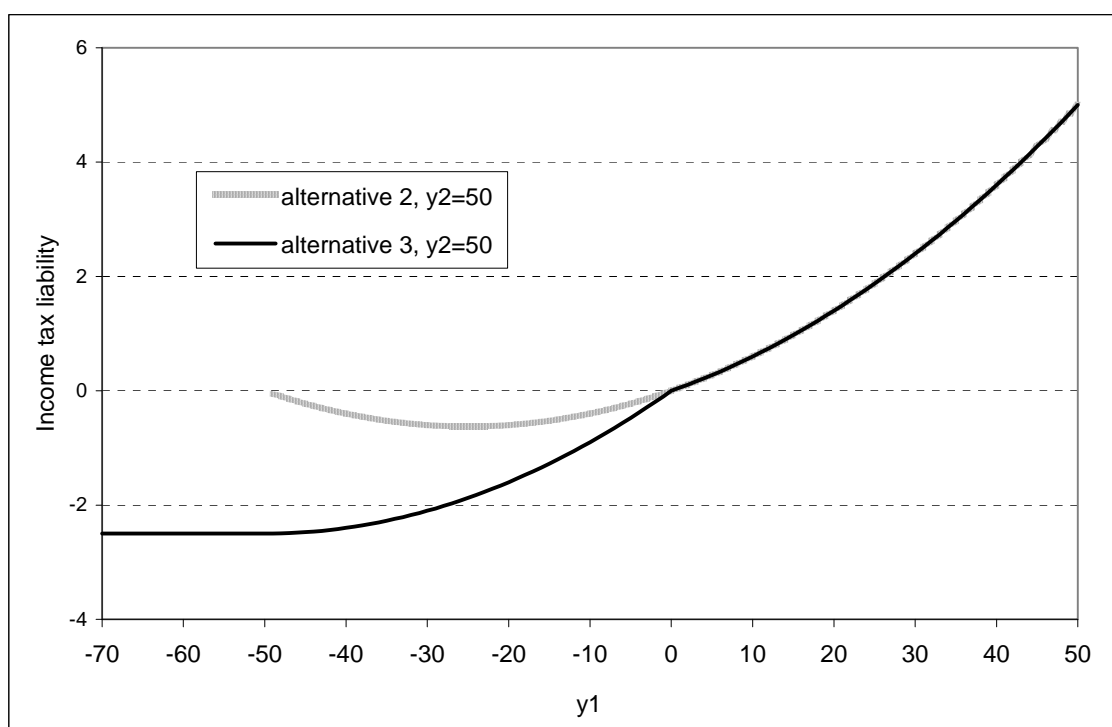
### *Illustration of the apportionment alternatives 2 and 3 for the personal income tax*

In a simple example, we consider two types of income ( $y_1$ ,  $y_2$ ). The progressive tax function ( $T$ ) is assumed to be given by:  $T = 0.001 * (y_1 + y_2)^2$ .

For a constant level of income type 2 (equal to 50), Figure 1 shows the share (in absolute terms) of the income tax which falls on income type 1, depending on the level of  $y_1$  in a range between -70 und +50. First, it can be easily seen, that the share of the income tax falling on income type 1 is the same in both alternatives if the value of  $y_1$  is positive (and therefore, the values of both types of income in the example are positive).

Figure A-1

**Tax liability assigned to income type 1 according to the apportionment alternatives 2 and 3**



If the values for income type 1 start to be negative, both alternatives assign a strictly negative tax share to income type 1 at first. The value of this share is higher in alternative 3 compared to alternative 2. In alternative 2, the amount is equal to average tax rate calculated at  $(-y_1 + y_2)$  times  $y_1$ . In the case of a loss of just one unit for  $y_1$ , the tax share assigned to income type 1 in alternative 2 is equal to the average tax rate (calculated at  $(-y_1 + y_2)$ ). In alternative 3, the tax share assigned to income type 1 for negative values of  $y_1$  is defined as the difference of the tax calculated at  $y_2$  and the tax calculated at  $(-y_1 + y_2)$ . For (negative) values of  $y_1$  which are close to zero, the tax amount assigned to income type 1 is nearly equal to the marginal tax rate calculated at  $y_2 = 50$ , with a negative sign. For the progressive tax function assumed, this

marginal tax rate is obviously higher than the respective average tax rate applied in alternative 2.<sup>11</sup>

In case that the loss for income type 1 exceeds the positive income of type 2, the tax assigned to income type 1 remains negative in alternative 3. The amount is equal to the tax due to the positive income of income type 2 ( $y_2=50$ ), however, with the opposite sign.

---

<sup>11</sup> For a linear tax function, for example  $T=0.1 (y_1+y_2)$ , the results of alternatives 2 and 3 would be equal also for negative values of  $y_1$  as long as the sum of both values remains positive. Consider, for example, the values  $y_1=-1$ ,  $y_2=50$ ,  $y_1+y_2=49$ . For these, the tax assigned to income type 1 according to alternative 2 is equal to  $-1/49*(0,1*49)=-0,1$ . According to alternative 3, the tax amount assigned to income type 1 is equal to  $-(0,1*50-0,1*49)=-0,1$ .

## References

- Bach, Stefan, Hermann Buslei, Hans-Joachim Rudolph, Erika Schulz, Dagmar Svindland (2004): Aufkommens- und Belastungswirkungen der Lohn- und Einkommensteuer 2003 bis 2005. Simulationsrechnungen auf Grundlage von fortgeschriebenen Einzeldaten der Einkommensteuerstatistik mit dem Lohn- und Einkommensteuersimulationsmodell des DIW Berlin. Projektbericht 3 zur Forschungskooperation „Mikrosimulation“ mit dem Bundesministerium der Finanzen. Materialien des DIW Berlin Nr. 38.  
[http://www.diw.de/documents/publikationen/73/41633/diw\\_rm04-04-38.pdf](http://www.diw.de/documents/publikationen/73/41633/diw_rm04-04-38.pdf)
- Bach, Stefan, Nadja Dwenger (2007): Unternehmensbesteuerung: Trotz hoher Steuersätze mäßiges Aufkommen. Wochenbericht des DIW Berlin Nr. 5/2007.  
<http://www.diw.de/documents/publikationen/73/55734/07-5-1.pdf>
- Bach, Stefan, Hermann Buslei, Nadja Dwenger, Frank Fossen (2008): Dokumentation des Mikrosimulationsmodells BizTax zur Unternehmensbesteuerung in Deutschland. DIW Berlin Data Documentation 29.  
[http://www.diw.de/documents/publikationen/73/79803/diw\\_datadoc\\_2008-029.pdf](http://www.diw.de/documents/publikationen/73/79803/diw_datadoc_2008-029.pdf)
- Becker, Johannes, Clemens Fuest (2006): Ist Deutschland Hoch- oder Niedrigsteuerland? Der Versuch einer Synthese. Perspektiven der Wirtschaftspolitik 7, 35-42.
- BMF – Bundesministerium der Finanzen (2004): Zur Eignung der Steuereinnahmen von Lohnsteuer und veranlagter Einkommensteuer für Analysen der Steuerlastverteilung. Monatsbericht des BMF, Oktober 2004.  
[http://www.bundesfinanzministerium.de/nr\\_324/DE/BMF\\_Startseite/Service/Downloads/Abt\\_I/27137\\_0.templateId=raw.property=publicationFile.pdf](http://www.bundesfinanzministerium.de/nr_324/DE/BMF_Startseite/Service/Downloads/Abt_I/27137_0.templateId=raw.property=publicationFile.pdf)
- Clark, W. Steven (2002): Using micro-data to assess average effective tax rates. CESifo Venice Summer Institute 2002. Workshop on "Measuring the Tax Burden on Capital and Labour". [http://www.cesifo-group.de/DocCIDL/cesifo\\_wp966.pdf](http://www.cesifo-group.de/DocCIDL/cesifo_wp966.pdf)
- De Laet, Jean-Pierre, Florian Wöhlbier (2008): Tax burden by economic function. A comparison for the EU Member States. MPRA Munich Personal RePEc Archive.  
[http://mpra.ub.uni-muenchen.de/14761/1/MPRA\\_paper\\_14761.pdf](http://mpra.ub.uni-muenchen.de/14761/1/MPRA_paper_14761.pdf)
- Devereux, Michael P., Rachel Griffith, Alexander Klemm (2002): Corporate Income Tax Reforms and International Tax Competition. Economic Policy 17, 451-495.
- Devereux, Michael P., Christina Elschner, Dieter Endres, Jost H. Heckemeyer, Michael Overesch, Ulrich Schreiber, Christoph Spengel (2008): Effective levels of company taxation within an enlarged EU. Report prepared for the European Commission, TAXUD/2005/DE/3 10.  
[http://ec.europa.eu/taxation\\_customs/resources/documents/taxation/gen\\_info/economic\\_analysis/economic\\_studies/effective\\_levels\\_report.pdf](http://ec.europa.eu/taxation_customs/resources/documents/taxation/gen_info/economic_analysis/economic_studies/effective_levels_report.pdf)
- Dwenger, Nadja (2008): Tax Loss Offset Restrictions - Last Resort for the Treasury? An Empirical Evaluation of Tax Loss Offset Restrictions Based on Micro Data. DIW Berlin Discussion Papers 764. <http://www.diw.de/documents/publikationen/73/79199/dp764.pdf>
- European Commission (2009): Taxation trends in the European Union. Data for the EU Member States and Norway. 2009 edition. Luxembourg.  
[http://ec.europa.eu/taxation\\_customs/resources/documents/taxation/gen\\_info/economic\\_analysis/tax\\_structures/2009/2009\\_full\\_text\\_en.pdf](http://ec.europa.eu/taxation_customs/resources/documents/taxation/gen_info/economic_analysis/tax_structures/2009/2009_full_text_en.pdf)
- Gentry, William M. (2007): A Review of the Evidence on the Incidence of the Corporate Income Tax. Office of Tax Analysis, US Department of the Treasury. OTA Paper 101.  
<http://www.ustreas.gov/offices/tax-policy/library/ota101.pdf>

- Hackmann, Johannes (1979): Die Besteuerung des Lebenseinkommens. Ein Vergleich von Besteuerungsverfahren, Tübingen: Mohr (Siebeck).
- Heckemeyer, Jost H., Christoph Spengel (2008): Ausmaß der Gewinnverlagerung multinationaler Unternehmen – empirische Evidenz und Implikationen für die deutsche Steuerpolitik. Perspektiven der Wirtschaftspolitik 9, 37-61.
- Jacob, Martin, Rainer Niemann, Martin Weiss (2008): The Rich Demystified: A Reply to Bach, Corneo, and Steiner (2008). CESifo Working Paper No. 2478. [http://www.cesifo-group.de/~DocCIDL/cesifo1\\_wp2478.pdf](http://www.cesifo-group.de/~DocCIDL/cesifo1_wp2478.pdf)
- Mendoza, Enrique G., Assaf Razin, Linda L. Tesar (1994): Effective Tax Rates in Macroeconomics. Cross-country Estimates of Tax Rates on Factor Incomes and Consumption. Journal of Monetary Economics 34, 297-323.
- OECD (2001): Tax Ratios – A Critical Survey. Paris.
- OECD (2007): Taxing Wages 2005/2006: 2006 Edition. Paris. [http://www.oecd.org/document/17/0,3343,en\\_2649\\_34533\\_38148433\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/17/0,3343,en_2649_34533_38148433_1_1_1_1,00.html)
- Quinke, Hermann (2001): Erneuerung der Stichprobe des ESt-Modells des Bundesministeriums der Finanzen auf Basis der Lohn- und Einkommensteuerstatistik 1995. Fraunhofer-Institut für Angewandte Informationstechnik FIT, Sankt Augustin. Unveröffentlichter Projektbericht April 2001.
- Sørensen, Peter Birch (2004): Measuring Taxes on Capital and Labor: An Overview of Methods and Issues. In: Peter Birch Sørensen: Measuring the tax burden on capital and labor. Cambridge, Ma., London, 1-33.
- Spengel, Christoph. (2003): Internationale Unternehmensbesteuerung in der Europäischen Union. Steuerwirkungsanalyse, Empirische Befunde, Reformüberlegungen. Düsseldorf.
- Vickrey, William (1939): Averaging of Income for Income-Tax Purposes. Journal of Political Economy 43, 379-397.