How responsive are deductions to tax rate changes?*

Philipp Doerrenberg   Andreas Peichl

Sebastian Siegloch

PRELIMINARY WORK IN PROGRESS; COMMENTS WELCOME

May 26, 2014

Abstract

While the large literature on the elasticity of taxable income (ETI) suggests that taxpayers respond to tax rate changes, evidence on the adjustment channels along which these responses occur is relatively scarce. In this paper, we explore whether tax deductions are responsive to tax reforms and hence constitute one of these adjustment channels. We rely on rich German panel data from administrative tax records that include detail information on all income tax relevant parameters including all available tax deductions, and exploit several tax reforms that were implemented in Germany between 2001 and 2008. Our findings suggest an overall ETI of 0.15 for Germany and we provide evidence that this overall response is partly due to deduction adjustments. Our findings can help to design efficient tax systems that close the most responsive deduction possibilities and thus trigger less behavioral adjustments.

JEL Classification: H24, H31

Keywords: elasticity of taxable income, deductions, allowances, tax expenditures, administrative data, Germany

---

* **Doerrenberg**: ZEW Mannheim, CGS at University of Cologne and IZA (`doerrenberg@zew.de`); **Peichl** (corresponding author): ZEW Mannheim, University of Mannheim, IZA and CESifo. Postal Address: ZEW Mannheim, L7,1, 68161 Mannheim, Germany (`peichl@zew.de`). **Siegloch**: IZA Bonn, ZEW Mannheim. We are grateful to Michelle Hansch and Carina Woodage for very valuable research assistance. David Agrawal provided helpful comments and suggestions.

1 Introduction

The elasticity of taxable income (ETI) summarizes all channels of behavioral responses to income tax changes and therefore is the key parameter for evaluating the overall marginal efficiency costs of income taxation. Following the seminal contributions by Feldstein (1995, 1999), the ETI literature has developed and grown substantially, and the majority of studies find elasticities with respect to the net-of-tax rate in the range of about 0.1 to 0.8 (see Weber 2013 and Kleven and Schultz 2014 for recent examples, and Saez et al. 2012 for an overview). These results suggest that income tax payers are responsive to tax rate changes, but because the ETI captures all possible behavioral responses to taxation, the estimates do not inform about the channels along which behavioral adjustments occur. However, as pointed out by Slemrod (1996), Saez (2003) or Saez et al. (2012), detailed knowledge about the adjustment channels (i.e., the "anatomy" of tax systems) is desirable because the single components of taxable income are fully controlled for by the government. Hence, analyzing their responsiveness can help to design efficient tax systems.

Among all possible adjustment channels that are summarized in the ETI, the responsiveness of labor supply has so far received the most attention in the literature (see Blundell and MaCurdy 1999 and Bargain et al. 2014 for surveys). Results, though different in exact magnitudes, suggest that labor supply only weakly respond to tax rate changes, with elasticities in the range of 0 to 0.3. Other channels that have been found to contribute to the ETI are, e.g., inter- and intra-temporal income shifting (Auerbach and Slemrod 1997, Kreiner et al. 2013, Kreiner et al. 2014), or tax non-compliance (Kleven et al. 2011).

Adjusting tax deductions is a channel that has received relatively little attention in the literature. An exception is Matikka (2014) who studies tax reform effects on two particular tax deductions in Finland. He presents suggestive evidence that deduction behavior is responsive to income taxes.[1] The lack of evidence is somewhat surprising given that itemized deductions represent about 12% of the US taxable income, worth $80 billion in total (Saez 2004). In addition, Slemrod and Kopczuk (2002) and Kopczuk (2005) show that the ETI considerably varies with the availability of tax deductions: the ETI is larger in tax systems with more deduction possibilities. There is also evidence that broad gross income is less responsive to tax changes than taxable income, i.e. broad gross income minus deductions (Saez et al. 2012; Kleven and Schultz 2014). These results suggest that the adjustment of tax deductions might be relevant, but they do not provide direct evidence that

[1] In addition, another strand of literature shows that charitable giving is responsive to income tax changes (see, e.g., Joulfaian 2000, Yörük 2013 and Andreoni 2006 for a survey).

deduction behavior is responsive to tax rate changes since a smaller elasticity for broad than taxable income does not necessarily imply that deductions respond to tax rate changes.[2] Theoretically, tax deductions should respond to tax rate changes given that a higher (lower) tax rate makes the claiming of tax deductions more (less) profitable.[3]

This paper contributes to the literature on behavioral responses to taxation by providing a thorough and comprehensive empirical analysis of the tax effects on various tax deductions. We use rich German panel data from administrative tax records that include detailed information on all income tax relevant parameters including all available tax deductions. The data are administrated by the German federal statistics office and include the universe of all income tax filers in Germany. The source of variation we exploit stems from various income tax reforms that were implemented in Germany in the early 2000s. These reforms affected different types of taxpayers differently. For instance, over this period, the top marginal tax rate decreased from 53% to 42% in several steps, and the lowest marginal tax rate from 24% to 15%, while tax rates in the middle of the distribution where less affected. In addition, the reforms changed rules for some deductions (increasing or decreasing the amount), while leaving other rules unchanged. These differential reform intensities allow identification of the tax rate effect on deduction behavior.

Studying the case of Germany is of particular interest in this context since the German tax system allows for a large set of deductions: on average, taxable income is 20% lower than broad income with variation over the income distribution and by income source.[4] Moreover, given the multitude of different tax expenditures, we expect heterogeneous responses to tax rates for different types of deductions. In addition, the comprehensive German personal income tax applies different rules, exemptions and deductions to different sources of income (e.g. income from employment vs. self-employment or business vs. income from interest or dividends / corporate income vs. capital gains vs. income from renting & leasing). At this stage of the project, we study an aggregate measures of deductions and work-related expenses that summarize all single components of deductions and expenses.

Our empirical strategy is based on the frequently used instrumental variable

[2]A positive response of broad gross income combined with constant deduction claiming also yields an ETI that is larger than the elasticity of broad income. See Section 2.2 for more details regarding the relationship between ETI and the elasticity of broad gross income.

[3]This leads to the hypothesis that the net-of-rate has a negative effect on claiming tax deductions.

[4]Bach et al. (2013) analyze the ratio of taxable income in broad income over time. Their findings are broadly in line with our numbers although they employ a different concept of broad income and use a different data source.

(IV) methodology following Gruber and Saez (2002).[5] We start our empirical analysis with tax elasticity estimates for different income concepts (e.g., broad gross vs. adjusted gross vs. taxable income)[6] and continue with a close examination of tax deductions. The empirical identification of tax changes on tax deductions generally faces the same challenges as the identification of the ETI: there exists a mechanical relationship between tax deductions and tax rates in progressive tax systems and mean reversion as well as heterogeneous tax-unrelated income trends also matter for estimating deduction responses to tax rate changes. This motivates us to employ similar empirical models for the ETI and deduction elasticity estimations.

Our preliminary findings suggest an elasticity of taxable income of around 0.15, which is rather moderate but statistically significant from zero. The elasticity of broad income is estimated to be around 0.2 and therefore larger than the ETI. While this is in contrast to most studies in the literature, it is consistent with our finding that the elasticity of deductions is positive (see section 2.2). Our aggregated deduction measure that summarizes all itemized deductions responds with a 0.7% increase to a 1% increase in the marginal net-of-tax rate.[7]

The results in this paper suggest that behavioral adjustments to changing income taxes occur along various margins and that deductions are indeed responsive. These findings can help to design efficient tax systems that, in the spirit of Ramsey (1927), close the most responsive deduction possibilities and thus trigger less behavioral adjustments. Our findings also support the general notion that the complexity of the entire tax system, rather than just tax rates, has to be accounted for in the process of designing efficient tax reforms.

Our paper proceeds as follows. Section 2 presents our identification strategy and a brief conceptual framework. In Section 3, we proceed with a description of the institutional background and the tax reforms that we exploit for identification. Section 4 informs about the data set we use and presents summary statistics. and our results are presented in Section 5. Section 6 briefly concludes the paper.

---

[5] This literature is surveyed in Saez et al. (2012). Recent applications such as Chetty et al. (2011) or Kleven and Schultz (2014) also exploit local kinks in tax schedules to identify the ETI. Such an approach is, however, not applicable to the German case since there are no tax brackets in the German tax code.

[6] There are only a few studies that examine the ETI for Germany (Gottfried and Witczak 2009, Massarrat-Mashhadi and Werdt 2012, Schmidt and Müller 2012) which we extend by using a larger panel data set along with additional estimation methods.

[7] This result for the deductions elasticity is rather surprising considering that deductions become more valuable as taxes go up. At this stage of our study, however, we may falsely estimate the sensitivity of deductions and work-related expenses. If tax decreases were implemented at the same time as reductions (increases) in legislative deduction possibilities, our estimates would be positively (negatively) biased due to mechanical effects. See Section 5 for a more thorough discussion of this important issue.

2 Conceptual Framework

2.1 Empirical Model and Identification

This section describes the empirical model and outlines our identification strategy. In order to estimate the effect of the net-of-tax rate on different income concepts or deduction measures, we employ a panel regression model of the form

$$\Delta \ln Y_{i,t} = \alpha + e\Delta \ln(1 - \tau_{i,t}) + \phi \mathbf{X}_{i,t} + \gamma_t + \epsilon_{i,t} \quad (1)$$

where i stands for an individual tax filer in year t. Y stands for the dependent variable of interest which will differ across specifications and which are described below. $(1 - \tau)$ is the net-of-tax rate, γ is a set of year fixed effects, X is a vector containing standard demographic variables (age, age squared, number of children, West- vs. East-Germany Dummy, and ϵ is an individual error term. In order to wipe out time invariant individual characteristics, the equation is estimated in differences where Δ indicates the difference in a variable between year $t + k$ and t. In our preferred specification, we set $k = 2$ as for example in Chetty et al. (2011).

We start with estimations where Y includes different income concepts (taxable income, broad gross income and adjusted gross income) and proceed with placing tax deduction measures on the left-hand-side of the equation. Section 3 describes how the the left-hand side variables are interrelated and Section 4.2 provides descriptive statistics. Outcome Y and the net-of-tax rate $(1 - \tau)$ enter the regression in logs yielding an elasticity interpretation of e.

Estimating this model without further adjustments does not identify the elasticity of interest mainly because there exists a mechanical relationship between our left-hand-side variables and the net-of-tax rate in (non-linear) progressive tax systems. An increase in income automatically changes the net-of-tax rate because in progressive systems higher incomes are taxed at higher marginal tax rates. The same reasoning applies when tax deductions are used on the left-hand-side of the equation: higher deduction claims reduce taxable income and therefore also affect the tax rate. This mechanical relationship between the left-hand-side variables and $(1 - \tau)$ requires to find an instrument for the net-of-tax rate that is unrelated to the error term in the above regression model. Following Gruber and Saez (2002), most studies in the literature use an instrument which is based on predicted changes in tax rates that are solely due to legislative tax reforms. The individual level net-of-tax rate in year t is instrumented with the individual level "synthetic" tax rate $\tau_{i,t}^{synth}$ that applies the tax schedule in year t to inflation adjusted income in year $t - k$. As a result, the synthetic instrument only captures statutory tax rate changes caused by reforms while it abstracts from mechanical tax rate changes in progressive tax systems that are due to changing taxable income (or deductions). We follow the majority of the ETI literature (e.g. Chetty et al. 2011 and Kleven and Schultz 2014) and also apply the Gruber/Saez instrument in this paper.

However, the fact that the synthetic tax rate is a function of base-year income may leave endogeneity concerns if the base-year income level is correlated with the error term in the regression model. Such a correlation may occur through two distinct channels. First, positive (negative) income shocks in a year t, which obviously also affect deductions, are usually followed by a reduction (increase) of income in the following periods. Along with the progressivity of the tax system, this process of "mean reversion" affects both Y and the tax rate. Second, when tax reforms are exploited that heterogeneously affect different parts of the income distribution, heterogeneous trends in income (and therefore also deduction levels) between different parts of the income distribution need to be accounted for because we may spuriously explain different income changes with changing tax rates although they may have happened if the tax reforms had not taken place.

Since Auten and Carroll (1999), tax unrelated changes in income as well as mean reversion are usually controlled for by adding some variant of base-year income control variables. Adding such base-year income controls extends the above regression model to

$$\Delta \ln Y_{i,t} = \alpha + e\Delta \ln(1 - \tau_{i,t}) + \gamma_t + \phi \mathbf{X}_{i,t} + f(TI_{i,t-k}) + \epsilon_{i,t}, \tag{2}$$

where all definitions are as before and $f(TI_{i,t-k})$ is a function of individual base-year taxable income (TI). As in e.g. Kopczuk (2005) and Kleven and Schultz (2014), we particularly include 10-piece splines based on logged base-year taxable income and the log-deviation between base year and base year+1 income in our specifications.[8] We estimate regression model (2) using two-stage least squares and cluster standard errors on the individual level. First stage regressions (not shown) of $\Delta \ln(1 - \tau_{i,t})$ on $\Delta \ln(1 - \tau_{i,t}^{synth})$ (including the same additional right-hand side variables as the second-stage) are very strong with $F-$statistics exceeding 200.

Note that the challenges to identification are similar for using logged taxable

[8]Several studies, e.g., Weber (2013) and Blomquist and Selin (2010), cast doubt on the exogeneity of the synthetic instrument. Although it is possible to control for base year income in flexible ways (e.g., by including income splines), it is not clear if any correlation between the Gruber/Saez instrument and the error term is controlled for. In an effort to circumvent this concern, Burns and Ziliak (2013) apply a grouping estimator based on cohorts, education and federal state residency in the spirit of Blundell et al. (1998). However, as we do not observe education levels in our data and income taxation does not differ across federal states, this strategy is not applicable to the case of Germany.

income or logged claimed deductions as the left-hand side variable. In progressive tax systems, tax rates increase mechanically if the amount of tax deductions decreases. Moreover, mean reversion and heterogeneous tax-unrelated trends might similarly bias our elasticity estimate. For these reasons we rely on the same identification strategies when estimating the ETI and the deductions elasticity.

2.2 ETI, BTI and deductions elasticity

Several studies present evidence that the elasticity of broad gross income is smaller than the ETI, sometimes concluding that deductions are responsive to tax rate changes.[9] The relationship between the elasticities of taxable income and broad gross income is important in the context of our paper, which is why we briefly formalize it. Denoting taxable income TI, broad gross income BI and deductions D, leads to the following relationship:

$$TI = BI - D.$$

Differentiating with respect to the net-of-tax rate (NTR) and expanding by $(1 - \tau)/TI$ yields

$$\frac{\delta TI}{\delta(1-\tau)} \frac{(1-\tau)}{TI} = \frac{\delta BI}{\delta(1-\tau)} \frac{(1-\tau)}{BI} \frac{BI}{TI} - \frac{\delta D}{\delta(1-\tau)} \frac{(1-\tau)}{D} \frac{D}{TI},$$

which can be written in terms of elasticities with respect to the net of tax rate $1-\tau$:

$$e_{TI} = e_{BI} \frac{BI}{TI} - e_D \frac{D}{TI}. \tag{3}$$

This simple exercise illustrates that the elasticity of taxable income e_{TI} depends on the responsiveness of broad gross income, e_{BI}, and deductions, e_D, as well as the shares of broad gross income and deductions in taxable income, $\frac{BI}{TI}$ and $\frac{D}{TI}$.

While $\frac{D}{TI}$ may be larger or smaller than one, $\frac{BI}{TI}$ is typically larger than one because some type of deductions or exemptions are usually subtracted from broad gross income in any tax system. For Germany, $\frac{BI}{TI}$ is 1.2 on average (see Section 4.2 for more detailed summary statistics). Hence, e_{TI} is larger than e_{BI} even if deductions are non responsive to tax rate changes, i.e. if $e_D = 0$. As a consequence, the conclusion that deduction behavior is responsible for differences between ETI

[9] For example, Saez et al. (2012, page 39) state that "Gruber and Saez's elasticity estimate for broad income, 0.12, is notably smaller than their corresponding estimate for taxable income, suggesting that much of the taxable income response comes through deductions, exemptions, and exclusions".

and the elasticity of broad gross income is not necessarily valid. For that reason, we conduct a decomposition analysis and estimate the single components of equation 3, in order to assess to what extent deduction behavior explains the differences between ETI and EBI.[10]

If $e_D \neq 0$, the relation between e_{TI} and e_{BI} depends on whether e_D is larger or smaller than zero. Typically one would expect $e_D \leq 0$. In the (unlikely) case where deduction claims increase in a response to a higher net-of-tax rate, i.e. $e_D > 0$, e_{TI} may even become smaller than e_{BI} and could also turn negative. Such a finding could be explained by a mechanical effect of tax changes on deductions if both are changed at the same time by a reform. An example of such a reform often advocated in the public is to close loopholes in the tax base (reducing deductions possibilities) and to increase tax rates (decreasing NTRs). Clearly, a mechanical effect could also bias estimates in the opposite direction. For instance, in reforms of the type tax rate cut cum base broadening, tax rates decrease (NTRs increase) and deductions decrease. Here, we would expect a negative mechanical effect of NTR changes on deduction claiming. These mechanical effects induced by simultaneous tax rate and tax base reforms have important implications for the definition and construction of variables for our analysis. Typically, previous studies used the broadest definition of the tax base (see Saez et al. 2012) when tax base changes occur at the same time as tax rate changes. However, this approach is not directly applicable to a setting estimating deduction elasticities.[11] For example, consider the case of a deduction with an upper limit of 1000 in year t which increases to 1500 in $t+1$. If we observe an individual below the threshold in year t with deductions of, say, 800, any change in deductions observed in year $t+1$, e.g. to 1200, will indeed indicate a behavioral response.[12] However, if we observe an individual claiming 1000 in year t and 1200 in $t+1$, we do not know whether this is a behavioral or a mechanical effect (the individual had expenses of 1200 before the reform but the deductible amount was capped at 1000) and hence we have to assign a zero change to this difference in order to arrive at a conservative estimate. Therefore, in order to isolate true behavioral effects from mechanical ones, we need to manipulate the definition of the tax base such that we only exploit changes that can be attributed to behavioral responses. This has to be done separately for each deduction. At the same time, one has to account

[10] [Note: in the future, we will also investigate specific deductions which were not changed (or changed differentially) to isolate the effects of tax rate changes on deduction behavior.

[11] [Note to discussants: this can be seen from the current (surprising) results. See also the examples below.]

[12] In the standard approach, this behavioral response would be underestimated if the deduction increases above 1000 (where the deduction would be capped in the broadest definition approach) in $t+1$.

for the different forms of deductions: (i) unlimited deductions, (ii) deductions with a cap (as in the example), (iii) deductions with a minimum amount (non-itemizer allowance)[13], and (iv) a combination of (ii) and (iii). Hence, it is important to use deduction-specific rules to construct the tax base for the estimation of elasticities and not just the broadest (or widest) definition.

3 Institutional Background

3.1 The personal income tax in Germany

All individuals in Germany are subject to personal income taxation. Residents are taxed on their global income; non-residents are taxed on income earned in Germany only.[14] The basic steps for the calculation of the personal income tax under German tax law are illustrated by table 1.

Table 1: Calculation of the personal income tax

	Sum of broad gross income (BI) from 7 sources (3 types of self-employment income; labor income; 3 types of capital income)
-	income-related expenses
=	Adjusted gross income (AGI)
-	Deductions and allowances for "Special expenses"
-	Deductions and allowances for "Extraordinary burden"
-	Child allowance
=	Taxable Income (TI)
·	tax formula
=	Tax liability
+	Tax credits
=	Tax due T

Broad gross income, BI. The first step is to determine a taxpayer's broad gross income from different sources and to allocate it to the seven forms of income, the German tax law distinguishes between[15]: income from agriculture and forestry,

[13]This case is more complicated than the cap-case (ii). For example, the minimum amount increases from 1200 to 1500. If an individual claims 1400 in year t and 1500 in $t+1$, we do not know whether this is due to a behavioral response or a mechanical effect. A conservative estimate of the behavioral estimate would assign a value of zero to this difference. Using the broadest tax base, we would use the two observed values and use a difference of 100 for the estimation.

[14]The legal norm setting up the German tax system is called *Einkommensteuergesetz (EStG)*.

[15]See EStG §§13 - 23.

business income, self employment income, salaries and wages from employment, investment income, rental income and other income (including, for example, annuities and certain capital gains.)[16]

Adjusted gross income, AGI. Secondly, for each type of income, the tax law allows for certain income-related expenses (*Werbungskosten*). In principle, all expenses that are necessary to obtain, maintain or preserve the income from a source are deductible from the receipts of that source. These include, for instance, commuting costs, expenses for work materials or costs of training. For non-itemizing taxpayers, there is an allowance for labor earnings (920€ in 2008) and capital income (750€ in 2008). The sum of broad gross income minus income-related expenses per income source yields the adjusted gross income.

Taxable income, TI. As a third step, deductions are taken into account and subtracted from adjusted gross income yielding taxable income. Deductions comprise special expenses (*Sonderausgaben*) and expenses for extraordinary burden (*außergewöhnliche Belastungen*). A detailed list of deductions is shown in Table 2.[17]

Moreover, negative income from the preceding assessment period (loss deduction carried back) can be subtracted from adjusted gross income.[18] Last, each tax unit with children receives either a child allowance[19] or a child benefit[20] depending on which is more favorable[21].

Taxable income is computed by subtracting deductions, loss deductions and child allowances from adjusted gross income.

[16] The following types of income are tax exempt: payments from health insurance, accident insurance and insurance for disability and old age, welfare benefits, and scholarships.

[17] In contrast to many other countries, mortgage interest payments are not tax deductible.

[18] See EStG §10d.

[19] Cf. EStG §32.

[20] The amount of child benefits can be found in §66 of the EStG.

[21] See EStG §31.

Table 2: Overview of deductions

Category	
Special Expenses	Alimony payments Church tax Tax consultant fees Expenses for professional training School Fees of children Charitable Donations Donations to political parties Insurance fees Social insurance contributions
Extraordinary Burden Expenses	Expenses for the education of dependents, for the cure of illness, for home help with elderly or disabled people, commuting expenses caused by disability Child care costs Tax allowances for self used proprietary, premises and historical buildings Allowances for disabled persons, surviving dependents and persons in need of care

Tax due The income tax is calculated by applying the tax rate schedule to taxable income. In contrast to most other countries who use a bracket system with constant marginal tax rates within a bracket, Germany uses a formula (which is quadratic in income) to compute tax liability. As a consequence, marginal tax rates increase linearly in income (up to an top marginal tax rate of 42%). The formula for the year 2008 is defined as follows:

$$T = \begin{cases} 0 & \text{if } TI \leq 7,664 \\ (883.74\frac{TI-7{,}664}{10{,}000} + 1,500)\frac{TI-7{,}664}{10{,}000} & \text{if } 7,664 < TI \leq 12,739 \\ (228.74\frac{TI-12{,}739}{10{,}000} + 2,397)\frac{TI-12{,}739}{10{,}000} + 989 & \text{if } 12,739 < TI \leq 52,151 \\ 0.42TI - 7,914 & \text{if } 52,151 < TI \leq 250,000 \\ 0.45TI - 15,414 & \text{if } TI > 250,000 \end{cases} \tag{4}$$

where x is annual taxable income in Euros.[22]

In addition to the personal income tax, households additionally pay the "Solidaritätszuschlag", a (time limited) tax supplement to finance the German reunification. During the period of interest, 2000 - 2008, the supplement amounts to 5.5%

[22]See EStG §32a.

of the income tax liability.[23]

For married taxpayers filing jointly, the tax is twice the amount of applying the formula to half of the married couple's joint taxable income.

$$T(TI_1 + TI_2) = 2 * T\left(\frac{TI_1 + TI_2}{2}\right)$$

3.2 Reforms 2001–2008

Between 2000 and 2005, a major reform of the German personal income tax took place.[24] The basic tax allowance was increased in several steps from 6902€ in 2000 to 7664€ (2004–2008) with 7206€ in 2001 and 7235€ in 2002/03. The lowest marginal tax rate decreased from 22.9% in 2000 to 15% (2005–2008) with 19.9% (2001–03) and 16% (2004) in between. The top marginal tax rate was reduced from 51% in 2000 to 42% in 2005 with 48.5% (2001-03) and 45% (2004) in between. The threshold where the top marginal tax rate kicks in was reduced from 58,643€ in 2000 to 52151€ in 2004 with values of 55007 (2001-03) in between. In 2007, an additional tax bracket at the top (for taxable income above 250,000€) was introduced with a top marginal tax rate of 45%.

Tax rates in the medium range of the schedule were lowered as well. Figure 1 shows the marginal tax rate schedule for the years 2001-3, 2004 and 2005-8. Taxpayers with a high taxable income and those with a taxable income slightly exceeding the basic tax allowance experienced the largest marginal tax rate cuts.

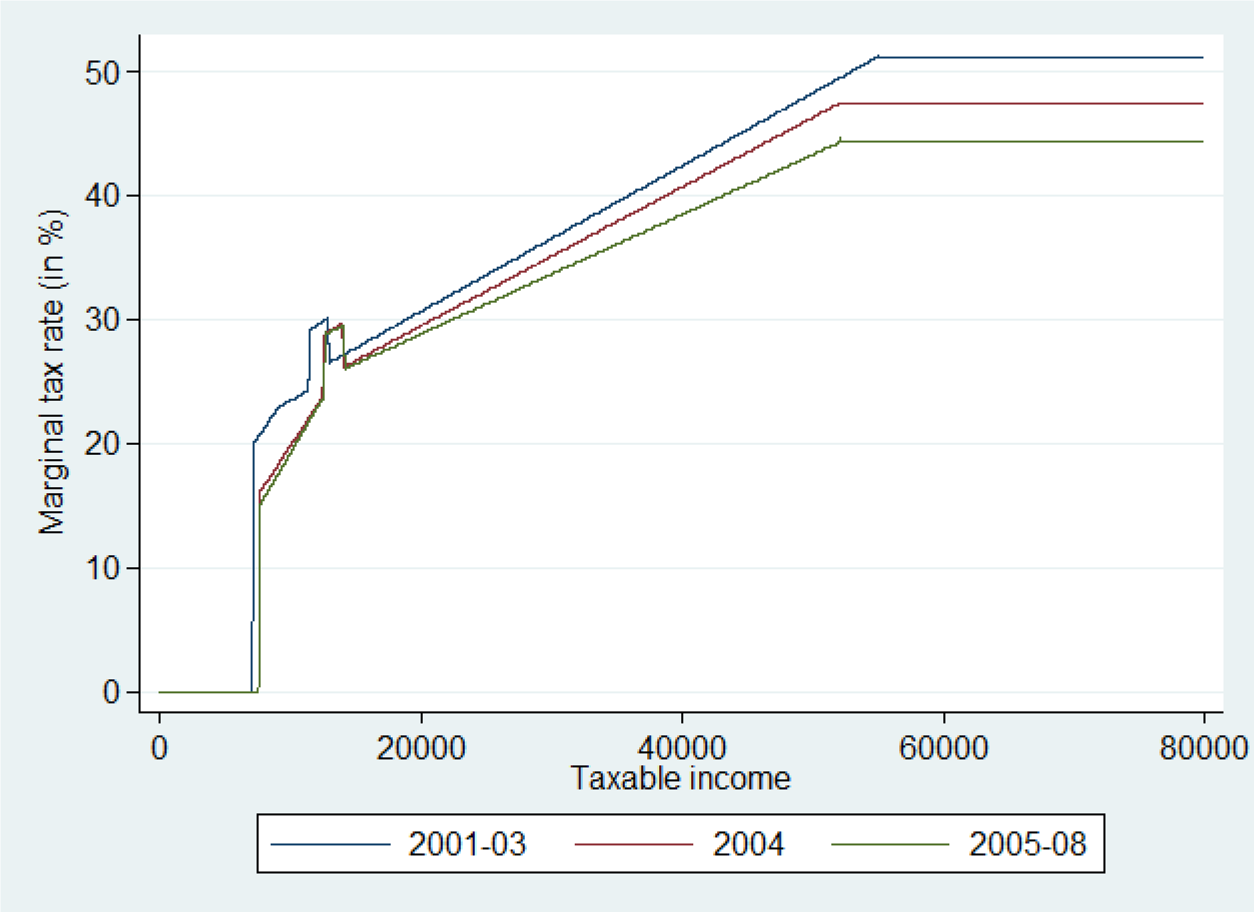
Beside changes in the tax schedule, the definition of the tax base was reformed as well. Child allowances were raised from 5080€ (in 2000) to 5808€ (since 2003) per child. Loss offsetting restrictions (for single taxpayers as well as between spouses) that were in place until 2003 were abolished in 2004. Allowable expenses for non-itemizing employees were cut from 1044€ (until 2003) to 920€ (since 2004), allowances for single parents were cut from 2871€ to 1308€ and capital income allowance was reduced from 1550€ (until 2003) to 1370€ (2004-06) and then 750€ (since 2007). In 2005, a new deduction for social security contributions was introduced (60% of the contributions up to 12,000€). On the whole the vast majority of taxpayers experienced a perceptible tax relief over the period under investigation.

---

[23] The exact rule is a bit more complicated with a minimum tax amount resulting in the kink visible in Figure 1 at roughly 15,000€ .

[24] In addition, the corporate tax was also reformed. See Keen (2002) for an overview of both reforms.

Figure 1: Marginal tax rates



4 Data and Summary Statistics

4.1 Data

Data set We use the German Taxpayer Panel, which is an administrative data set collected by German tax authorities, provided and administered by the German Federal Statistical Office.[25] The unit of observation is the taxpayer that is either single individuals or couples in case of joint tax filing. The panel covers all German taxpayers (approximately 28 million per year) from 2001 to 2008. For computational reasons, we use a 5% random sample of the Taxpayer Panel and employ the respective weights provided by the Statistical Office.[26] The dataset contains all information necessary to calculate a taxpayer's annual income tax, this includes basic socio-demographic characteristics such as birth date, gender, family status, number of children as well as detailed information on income sources and tax base

[25]For a more detailed, but slightly out-dated description of the data, see Kriete-Dodds and Vorgrimler (2007)

[26][Note: we will be able to run our analysis for the universe of taxpayers in the future.]

parameters such as work-related expenses and deductions.

Sample selection We restrict our estimation sample to individuals with positive income that is above a threshold of 10.000 EUR (in real 2001 terms).[27] We further exclude taxpayers who change their marital status throughout the sample period because this implies a change from individual filing to joint filing or vice versa, and restrict the sample to individuals in the age range 18 to 65 (the pension age in Germany). We also have to exclude a few taxpayers with implausible demographic characteristics (e.g., change of gender or date of birth) that are most likely due to data errors. These restrictions leave us with a sample of about 36 million taxfiler-year observations using weights in the unbalanced panel and about 14 million weighted observations in the balanced panel used for the regression analysis. Summary statistics and variable selection are presented in the next subsection.

4.2 Summary Statistics

For our analysis, we look at 5 different dependent variables (see Sections 2 and 3.1): (1) taxable income TI; (2) adjusted gross income AGI; (3) broad gross income BI; (4) income related expenses E with $E = BI - AGI$; and (5) deductions D, with $D = AGI - TI = BI - E - TI$.[28]

Table 3: Descriptive statistics, full sample, 2001-2008

	mean	sd	p1	p25	p75	p99
broad gross income	52128	146423	14674	29558	58390	214021
adjusted gross income	49382	145934	12964	27351	55293	209483
taxable income	43216	140434	9310	23296	49216	190251
expenses	2746	4828	0	1045	3555	11485
deductions	6166	9523	1998	2795	6794	26699

Source: German Taxpayer Panel. *Notes:* All money variables in 2001 euros. N=36,061,886 (using sample weights), unbalanced panel.

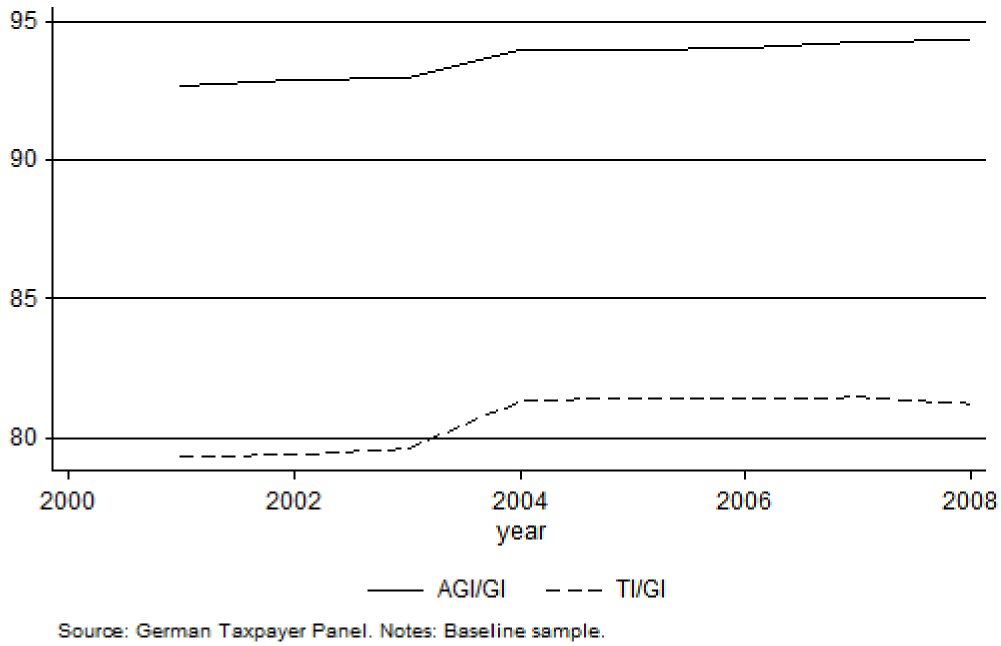
Table 3 shows descriptives statistics of these five variables. On average, the ratio between AGI and BI is 0.94 and the ratio between TI and BI is 0.82. Thus, deductions are relatively more important in reducing the tax base. Interestingly, when looking at top incomes (p99), the share of AGI in BI is 0.98 and the ratio TI to BI is 0.88 – hence deductions and expenditures are relatively less important for higher income groups.

[27] Note that the basic tax-free amount is a little lower (7664 EUR in 2008).

[28] [Note that in the future we will also look at specific sub-categories of deductions]

Figure 2 shows the shares of adjusted income and taxable income in broad gross income over time. Both expense and deductions possibilities declined over time as both plotted shares increase. The figure in combination with Figure 1 give a full picture of the German tax reform from 2001 to 2008. Note that, as mentioned above, we have not yet corrected the legislative changes to the deductions thoroughly discussed in Section 2.2.[29]

Figure 2: Shares of adjusted gross income and taxable income in broad gross income



5 Results

This section presents regression evidence using all tax reforms between 2001 and 2008 for identifying variation. The results are based on equation 2 and stem from 2SLS regressions using the Gruber/Saez type instrument. We show different estimations for different dependent variables in Table 4.[30] The dependent variables in Models I to V are two-year growth rates of taxable income (TI), broad income (BI), adjusted gross income (AGI), work-related expenses (EXP), and deductions (D) (see section 3.1 for more information on the definition of each of these variables). Panels A and B differ with respect to the type of income control: In Panel A, we use 10-piece splines in logged base-year income along with 10-piece splines in the logged

[29]In the future, we will provide two additional lines for the adjusted shares of AGI and TI.

[30][Note: full regression results will be included in the next version]

deviation of base-year and base-year+1 incomes, whereas Panel B solely includes 10-piece splines in logged base-year income.

Table 4: Elasticity Estimates

Model	(I)	(II)	(III)	(IV)	(V)
Variable	TI	BI	AGI	Exp	D
Panel A: splines in $logTI_{t-2}$ *and splines in* $log(TI_{t-1} - TI_{t-2})$					
$\Delta log(1-\tau)$	0.1603***	0.2022***	0.1765***	0.4745***	0.7911***
	(0.0380)	(0.0333)	(.0345)	(0.0878)	(0.0744)
Panel B: splines in $logTI_{t-2}$					
$\Delta log(1-\tau)$	0.1404***	0.1833***	0.1611***	0.5186***	0.7224***
	(0.0432)	(0.0380)	(0.0393)	(0.0682)	(0.0552)

Notes: Elasticity estimates based on equation 2. 2SLS regressions with standard errors (in parentheses) clustered by individuals. Significant levels are * < 0.10, ** < 0.05, *** < 0.01. Data from German administrative tax records for the period 2001 to 2008. The results are based on a 5% random sample of the universe of German taxpayers. The weighted number of observations in all specifications is 14,148,898. The dependent variables are different in each model. Model I: taxable income (TI), II: broad income (BI), III: adjusted gross income (AGI), IV: work-related expenses (EXP), V: deductions (D). All dependent variables are two year growth rates (i.e., $\Delta logY$). The independent variable of interest is the two-year growth rate in the marginal net-of-tax rate (i.e., $\Delta log(1-\tau)$, instrumented with the two-year growth rate in the synthetic net-of-tax rate ($\Delta log(1-\tau^{synth})$) based on base-year $t-2$ behavior (i.e., mechanical tax rate changes due to reforms). The reported coefficients can be interpreted as elasticities from tax reforms. All specifications include year fixed effects, region fixed effects (East vs. West Germany) as well as controls for demographic variables (age, age squared, number of children). Panel A includes 10-piece splines in logged base-year income $t-2$ as well as 10-piece splines in logged deviations between income in $t-2$ and $t-1$. Panel B only includes 10-piece splines in logged base-year income $t-2$. The sample is restricted to individuals with taxable income above 10.000 EUR (in real 2001 terms), who are between 18 and 65 years old and do not change their filing status throughout the sample period.

The results for taxable income in Model I suggest an elasticity of taxable income of around 0.15. While being moderate, this estimate is statistically significant from zero and roughly in line with the Danish results in Kleven and Schultz (2014). The comparison between Panel A and B shows that the results are relatively robust to the type of income control; something which is not standard in previous ETI contributions. As opposed to most previous studies, the elasticities of broad and adjusted gross income are larger than for taxable income. Models II and III depict that the elasticity of broad income is around 0.2 and the elasticity of adjusted gross income is slightly lower at around 0.17. The estimates are again statistically different from zero and robust to the type of income control.

Following our discussion in 2.2, one reason for higher broad income than taxable income elasticities may be rooted in the positive elasticity estimates that we find for tax-related expenditures (Model IV) and deductions (V). The estimates suggest that a one-percent increase in the marginal net-of-tax rate is associated with a 0.5 and 0.7% increase in itemized work-related expenses and deductions, respectively. These estimates are again robust to the type of income control.

The results for the expenses and deductions elasticities are rather surprising considering that deductions become more valuable as taxes go up (i.e., as the net-of-tax rate goes down). Note that at this stage of our study, however, we may falsely estimate the sensitivity of deductions and work-related expenses because as for now we have not used the right tax base for estimating the deduction elasticity (as discussed in Section 2.2). If tax decreases were implemented at the same time as reductions (increases) in legislative deduction possibilities, our estimates would be negatively (positively) biased. As our description of the institutional background suggest, our estimations cover a time period that indeed faces changes in deduction possibilities that affected different taxpayers differently (broadening or narrowing of the tax base for some).

6 Conclusion

[to be completed]

References

Andreoni, J. (2006). Philanthropy. In S.-C. Kolm and J. Mercier Ythier (Eds.), *Handbook of the Economics of Giving, Altruism and Reciprocity* (1 ed.), Volume 2. Elsevier.

Auerbach, A. J. and J. Slemrod (1997). The Economic Effects of the Tax Reform Act of 1986. *Journal of Economic Literature 35*(2), 589–632.

Auten, G. and R. Carroll (1999). The effect of income taxes on household income. *Review of Economics and Statistics 81*(4), 681–693.

Bach, S., G. Corneo, and V. Steiner (2013). Effective taxation of top incomes in germany. *German Economic Review 14*, 115 – 137.

Bargain, O., K. Orsini, and A. Peichl (2014). Comparing Labor Supply Elasticities in Europe and the US: New Results. *Journal of Human Resources forthcoming.*

Blomquist, S. and H. Selin (2010). Hourly wage rate and taxable labor income responsiveness to changes in marginal tax rates. *Journal of Public Economics 94*(11-12), 878–889.

Blundell, R., A. Duncan, and C. Meghir (1998). Estimating Labor Supply Responses Using Tax Reforms. *Econometrica 66*(4), 827–862.

Blundell, R. and T. MaCurdy (1999). Labor Supply: A Review of Alternative Approaches. In O. Ashenfelter and D. Card (Eds.), *Handbook of Labor Economics*, Volume 3A, Chapter 27. Elsevier North-Holland.

Burns, S. K. and J. P. Ziliak (2013). Identifying the Elasticity of Taxable Income. mimeo.

Chetty, R., J. N. Friedman, T. Olsen, and L. Pistaferri (2011). Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from danish tax records. *The Quarterly Journal of Economics 126*(2), 749–804.

Feldstein, M. (1995). The effect of marginal tax rates on taxable income: A panel study of the 1986 Tax reform act. *Journal of Political Economy 103*(3), 551.

Feldstein, M. (1999). Tax avoidance and the deadweight loss of the income tax. *Review of Economics and Statistics 81*(4), 674 – 680.

Gottfried, P. and D. Witczak (2009). The Responses of Taxable Income Induced by Tax Cuts. Empirical Evidence from the German Taxpayer Panel. IAW Diskussionspapier Nr. 57.

Gruber, J. and E. Saez (2002). The elasticity of taxable income: evidence and implications. *Journal of Public Economics 84*(1), 1–32.

Joulfaian, D. (2000.). Estate Taxes and Charitable Bequests by the Wealthy. *National Tax Journal 53*(3), 743–764.

Keen, M. (2002). The german tax reform of 2000. *International Tax and Public Finance 9 (5)*, 603–621.

Kleven, H. and E. Schultz (2014). Estimating taxable income responses using danish tax reforms. *American Economic Journal: Economic Policy*. forthcoming.

Kleven, H. J., M. B. Knudsen, C. T. Kreiner, S. Pedersen, and E. Saez (2011). Unwilling or unable to cheat? evidence from a tax audit experiment in denmark. *Econometrica 79*(3), 651–692.

Kopczuk, W. (2005). Tax bases, tax rates and the elasticity of reported income. *Journal of Public Economics 89*(11-12), 2093–2119.

Kreiner, C. T., S. Leth-Petersen, and P. E. Skov (2013). Tax Reforms and Intertemporal Shifting of Wage Income: Evidence from Danish Monthly Payroll Records. CEPR Discussion Paper No. 9697.

Kreiner, C. T., S. Leth-Petersen, and P. E. Skov (2014). Year-End Tax Planning of Top Management: Evidence from High-Frequency Payroll Data. *American Economic Review, Papers and Proceedings 104*(5), 154–158.

Kriete-Dodds, S. and D. Vorgrimler (2007). The German Taxpayer-Panel. *Schmollers Jahrbuch 127*(3), 497–509.

Massarrat-Mashhadi, N. and C. Werdt (2012). Estimating dynamic income responses to tax changes: Evidence from Germany. Free University Berlin Discussion Papers Nr. 2012/22.

Matikka, T. (2014). Taxable income elasticity and the anatomy of behavioral response: Evidence from Finland. Technical report, Government Institute for Economic Research Working Papers No. 55.

Ramsey, F. P. (1927). A Contribution to the Theory of Taxation. *The Economic Journal 37*(145), 47–61.

Saez, E. (2003). The effect of marginal tax rates on income: a panel study of "bracket creep". *Journal of Public Economics 87*(5-6), 1231–1258.

Saez, E. (2004). The optimal treatment of tax expenditures. *Journal of Public Economics 88*(12), 2657 – 2684.

Saez, E., J. Slemrod, and S. H. Giertz (2012). The elasticity of taxable income with respect to marginal tax rates: A critical review. *Journal of Economic Literature 50*(1), 3–50.

Schmidt, T.-P. and H. Müller (2012). Die Elastizität des zu versteuernden Einkommens in Deutschland. ARQUS Discussion Paper Nr. 132.

Slemrod, J. (1996). *Empirical Foundations of Household Taxation*, Chapter High income families and the tax changes of the 1980s: The anatomy of behavioral response, pp. 169–192. University of Chicago Press.

Slemrod, J. and W. Kopczuk (2002). The optimal elasticity of taxable income. *Journal of Public Economics 84*(1), 91–112.

Weber, C. (2013). Toward obtaining a consistent estimate of the elasticity of taxable income using difference-in-differences. Unpublished Working Paper.

Yörük, B. K. (2013). The impact of charitable subsidies on religious giving and attendance: Evidence from panel data. *Review of Economics and Statistics 95*(5), 1708–1721.