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The Responses of Taxable Income Induced by Tax Cuts – Empirical Evidence from the German Taxpayer Panel

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The Responses of Taxable Income induced by Tax Cuts – Empirical Evidence from the German Taxpayer Panel

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November 2009

Abstract
The elasticity of taxable income has gained increasing attention as a fiscal policy parameter. This paper provides empirical evidence for Germany and adds to the relatively small body of literature for European countries. We use a large new panel data set to analyze the taxable income response to tax rate changes in 2004 which were part of an extensive reform programme in Germany at the beginning of this century. We find an average elasticity of approximately 0.6. Separately estimated income effects however are mostly small or insignificant. The results vary when dividing taxpayers by income type and group.

Keywords: elasticity of taxable income; tax reform; net-of-tax rate
JEL classification: H24, H31

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1 Introduction

During the last decade the elasticity of taxable income has gained increasing attention as a fiscal policy parameter. It captures all behavioral responses by which taxpayers strive to reduce their individual tax burden such as increasing the consumption of tax-deductible goods, shifting between different types of income, or even evading the tax to some extent. It is thus considered a more comprising reference for calculating the efficiency costs of income taxation than the labor supply elasticity alone.

Since Feldstein's (1995) seminal paper, data availability has considerably improved and a growing body of empirical literature has emerged. Saez/Slemrod/Giertz (2009) give a critical review of the relevant work. The further development of Feldstein's methodological approach, especially the inclusion of income controls, has in general led to considerably lower estimates. Nevertheless the range of results is still rather wide depending on which data set has been used, which reform has been examined and how non-tax related income trends have been controlled for. The majority of empirical studies is based on income tax return data in the United States, only several studies examine taxpayer behavior in non-US countries, for example Canada (Sillamaa/Veall (2001)) or Scandinavia (Aarbu/Thoresen (2001), Hansson (2007)). In Germany, hardly any empirical evidence has been provided so far, except for Gottfried/Schellhorn (2004) who analyze data from a south-western region.

This paper contributes to the literature with elasticity estimates for Germany. We use a new panel data set of individual tax returns that is currently available for the years 2001–2004 and contains very detailed information on income, deductions and allowances. The balanced panel includes all German taxpayers that could be linked over time (approximately 20 million cases) and thus offers an outstanding data base. Moreover, during the years 2001–2005 a major income tax reform took place in Germany which provides the exogenous tax rate change we exploited in our analysis. The reform itself was designed to perceptibly reduce the tax burden with particular emphasis on low- and middle-income families, employees and small and medium private partnerships.

The empirical approach in this paper follows in large parts the existing literature. In order to address the endogeneity of the net-of-tax rate (NTR – one minus the marginal tax rate) we construct predicted NTRs, based on adjusted income under pre- and post-reform tax laws before any response is taken into account. We use a slightly modified version of the Slutsky decomposition for taxable income that Gruber/Saez (2002) introduced in their study to identify income and compensated substitution effects separately.

The following section outlines the theoretical model our study is based on. The main items of the tax reform are presented in Section 3. Section 4 introduces the data base and gives some information on the composition und development of income for the period under investigation. Section 5 illustrates the econometric approach and presents the estimation results as well as several robustness checks. Section 6 summarizes and concludes.

2 Theoretical framework

The theoretical model we use is basically similar to the one Gruber/Saez (2002) introduce in their study, except that we distinguish between gross and taxable income and define the income effect in a slightly different manner. The basic consumption-income model in a progressive income tax system is

$$C = Y - T(TI) = (1 - \tau)TI + R. \tag{1}$$

where Y is gross income, TI is taxable income, T is tax liability, τ is the marginal tax rate, $(1 - \tau)$ is the net-of-tax rate (NTR) and R is virtual income. Taxable income TI is defined as gross income minus tax-deductible consumption. Virtual income R reflects the difference between the tax amount that would result from applying the marginal tax rate to taxable income and the actual tax amount, $\tau TI - T$, as well as the difference between gross and taxable income, $Y - TI$.

From eq. (1) it can be seen that a tax change affects both the NTR and virtual income, so a taxpayer's reaction of taxable income $TI(1-\tau, R)$ is given by a change in $(1-\tau)$ and a change in R:

$$dTI = \frac{\partial TI}{\partial(1-\tau)} d(1-\tau) + \frac{\partial TI}{\partial R} dR. \tag{2}$$

A change in the NTR affects the relative prices of tax-privileged and non-privileged consumption, and a change in virtual income affects the taxpayer's budget, thus the tax change causes substitution as well as income effects. Using the Slutsky decomposition for taxable income the term $\partial TI/\partial(1-\tau)$ can be written as

$$\frac{\partial TI}{\partial(1-\tau)} = \frac{\partial TI^c}{\partial(1-\tau)} + TI\frac{\partial TI}{\partial R} \tag{3}$$

with $\partial TI^c/\partial(1-\tau)$ capturing the substitution effect resulting from a change in the marginal tax rate and $TI\ \partial TI/\partial R$ capturing the income effect of a change in virtual income. Substituting eq. (3) into (2) leads to

$$\frac{dTI}{TI} = \zeta^c \frac{d(1-\tau)}{1-\tau} + \eta \frac{d(1-\tau)TI + dR}{R} \tag{4}$$

where $\zeta^c = \partial TI/\partial(1-\tau)\ (1-\tau)/TI$ is the substitution (or compensated price) elasticity and the income effect parameter $\eta = \partial TI/\partial R\ R/TI$ is defined as an elasticity as well, while Gruber/Saez (2002) define $\eta = (1-\tau)\ \partial TI/\partial R$. They approximate $TI(1-\tau)$ with $TI - T$ in their estimations and then logarithmize the income effect term to obtain an elasticity parameter. This approximation is certainly not problematic in the context of a bracket system like in the United States where marginal tax rates are constant for relatively wide income ranges. In Germany tax progression is more pronounced with marginal tax rates increasing linearly in income. The latter leads to a larger difference between $TI(1-\tau)$ and $TI - T$ except for the very top incomes. Therefore we use the income effect definition from Eq. 4 and turn it into computable quantities (see Section 5).

However, the marginal tax rate is a function of taxable income and thus endogenously determined by the taxpayer. In order to analyze behavioral effects and income adjustments induced by the income tax an external variation in the tax rate is required. Here, the standard approach in the literature is to treat a tax reform as a kind of quasi-natural experiment. In our case, the German income tax reform 2000 provides this exogenous variation. A short outline of the key elements of the reform is presented in the following section.

3 The German tax reform 2000

One of the main purposes of the reform which took place in Germany during the years 2001-2005 was to stimulate economic growth and employment. To achieve this goal the personal income tax schedule was phased down in three consecutive steps – 2001, 2004, and 2005. Various measures were also taken that altered the definition of the tax base. Additionally the corporate income tax was reduced and several tax reliefs for local businesses were introduced.

In the reform steps preceding the period of our study marginal tax rates at the bottom were changed from 25.9 to 23.9 % in 1999 and successively reduced to 19.9 % in 2001. At the top of the tax schedule rates were lowered from 53 to 48.5 % between 1999 and 2001. Various subsequent reform measures were implemented during the period 2001-2004, for which income tax panel data are now available. The basic tax allowance was slightly increased during this period from 7206 € to 7664 €.[1] The tax rate at the bottom of the tax schedule was reduced further from 19.9 % to 16 %. At the top the rate was cut from 48.5 % to 45 % for taxable incomes exceeding 52 152 €, compared to 54 999 € in 2001. Tax rates in the medium range of the schedule were also lowered, as depicted in Figure 1.[2] Taxpayers with a high taxable income and those with a taxable income slightly exceeding the basic tax allowance experienced the largest tax rate cuts.

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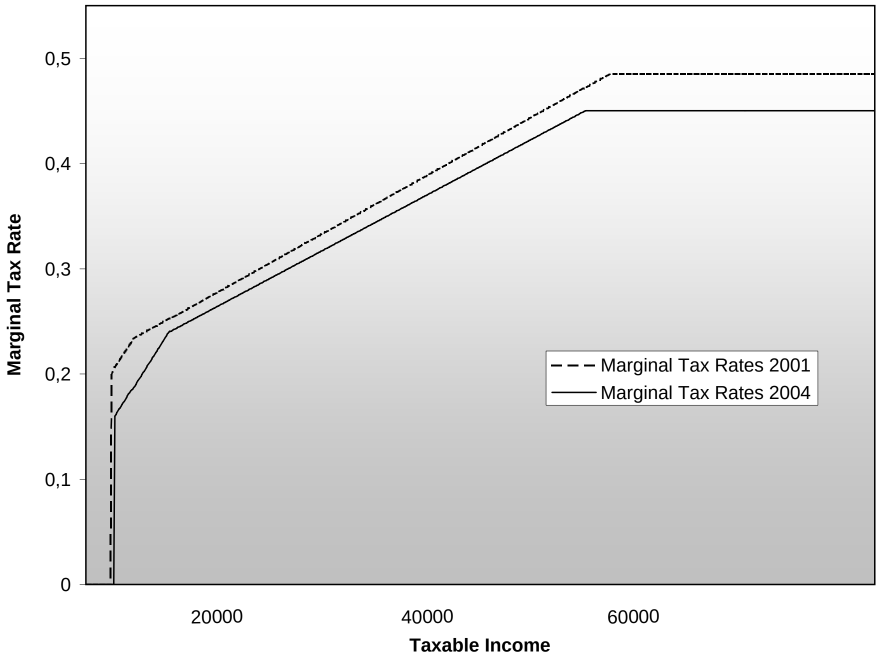
[1] The German income tax schedule 2001 was still stated in DM amounts. For a comparison of the pre- and post-reform schedules we converted the values to € using the exchange rate 1 € = 1.95583 DM.

[2] The tax schedules 2002 and 2003 are the same as in 2001, except for the basic allowance which was slightly increased to 7235 € in 2002 and 2003, and are therefore not depicted here.

Figure 1: Marginal tax rates on taxable income 2001 and 2004



Beside the changes in the tax schedule several other reform measures were taken which altered the definition of the tax base. In order to support families, annual child allowances were raised from 2556 € to 2904 € per child. Loss offsetting restrictions (for single taxpayers as well as between spouses) that were in place until 2003 were cancelled in 2004, and another rather drastic step was implemented when from 2002 on only 50 % of certain capital gains (mainly dividends) entered the tax base. On the other hand, some measures broadened the tax base, for example allowable expenses for non-itemizing employees were cut from 1044 € to 920 €, allowances for single parents were cut from 2871 € to 1308 €, and capital gains exemption was reduced from 1550 € to 1370 €. But all in all, it was not the kind of reform which lowered tax rates and broadened the tax base like many other reforms since the 1980s, and it was not supposed to be revenue-neutral. On the whole the vast majority of taxpayers experienced a perceptible tax relief.

4 Data

The data source we use is the German Taxpayer Panel, a large panel data set of individual income tax returns that is now available for researchers via the German Federal Statistical Office. The cross section data which are linked to a panel by individual tax numbers include the whole population of German taxpayers. The tax number may change, e. g. when a taxpayer moves to another German state or when a couple gets married and opts for joint filing since one of them will give up her tax number (or, in case of a divorce, get a new one). Although the Statistical Office tries to identify and link these cases via their socio-economic characteristics, it is not possible to follow up all taxpayers consistently over time. Still the balanced panel includes around 19 million taxpayers for the years 2001-2004. It contains detailed information on various types of income, deductions and allowances, for employees as well as for entrepreneurs, but also on capital income or income from rent and lease. Demographic information on the taxpayers however is scarcely provided.

Since the aim of our analysis is to identify income changes which are directly attributable to reform incentives, we only analyze taxpayers who are subject to taxation in each year in order to exclude cases with discontinuous working biographies. Furthermore we eliminate cases from the data whose socio-economic characteristics change significantly during the regarded period. More precisely taxpayers are excluded

- whose marital status changes
- who are under age 25 in 2001
- who have their first child,
- who retire during the regarded period
- who receive for the first time an allowance for single parents or for disabled persons and
- whose taxable income does not exceed the basic allowance.

After these adjustments 12 242 397 cases remain in the data set. Our exclusion strategy is rather restrictive, but it helps to eliminate income volatility which is not related to tax incentives.

Since we drop mainly cases with lower incomes like first-time mothers, trainees, pensioners etc. mean values are higher in the subpanel than in the original panel. In most years taxable income exceeds 40 000 €, the mean income tax amount is around 9 500 € (see Table 5). Wage income is highest on average and most equally distributed since it is hardly negative, in contrast to other income types. The large standard deviations of business and capital income however show how much the level of these income types varies between taxpayers.

Many of the average income values decline in 2002 before increasing again slightly in 2003 and more sharply in 2004, with two exceptions, capital income and income from rent and lease. Unlike most income types, average capital income falls down to 60 % in 2002, due to the aforementioned reform measure concerning dividends, and keeps dropping until 2004. Mean income from rent and lease strikingly changes its sign from negative to positive. There is little doubt on the assumption that this development is for the most part not attributable to the tax reform analyzed here but rather a consequence of a change in deduction rules preceding this reform: After the German reunification acquisition and modernization of real estate in the former GDR was highly privileged. Large investments were made during the post-reunification years, peaking in 1998 when important deduction possibilities expired. Investments taken in 1998 could be depreciated at once or in arbitrary amounts during the next four years, so in 2002/2003 depreciation was mostly completed and balances switched from negative to positive. We try to control for this development in our estimations.

Figure 2 sheds some light on the composition of income in 2001. More than 90 % of the taxpayers included in the panel are wage earners, and wages add up to over 80 % of overall gross income. On the contrary, a quarter of the taxpayers declare capital income, which results only in 3.7 % of total income. Unsurprisingly income composition changes in the top percentile which is dominated by taxpayers with business income. The share of wage income falls to 30 % (see Figure 3). While overall income composition remains relatively stable in the years 2001-2004 (see Table 6), changes over time are more sizeable at the top 1 %. The much more obvious decline in capital income from 2002 on emphasizes that especially taxpayers at the top of the distribution have disproportionately high income from dividends and benefit most from this reform measure.

The distribution of gross income broadens between 2001 and 2004. Table 7 shows a movement from bottom to top when 2001 decile classification is used in every year: The share of taxpayers increases in the upper deciles and declines in the lower deciles over time, by amounts that exceed the usual shifts due to nominal income growth. This shift in income distribution may be partly driven by a different nominal development between wages and pensions on the one hand and business and self-employment income on the other hand in the years 2001 to 2004. While nominal wages and pensions remained almost constant aggregate nominal business and self-employment income increased by more than 12 %. The latter are furthermore concentrated in the upper income percentiles, whereas wages and pensions are the dominating income types in the lower percentiles. We account for these differences by inflating the different income types in the data set with their respective growth rates.

5 Empirical strategy

In the following our empirical approach and the results are presented. We estimate the elasticity of taxable income by 2SLS which is the common approach in the literature.[3] The general equation for our estimations is based on the Slutsky decomposition derived in Section 2. To approximate the growth rate of taxable income with respect to a percentage change in the NTR we use a log-log specification. The income effect term of Eq. 4 is rewritten in terms that can be calculated directly from the data. For the change in taxable income between base year $t-p$ (with $p \geq 1$) and reform year t we get the following equation:

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[3] Holmlund/Söderström (2008) make an interesting suggestion and use a dynamic panel estimator to account for some econometric issues arising from the traditional methodology. This approach is not followed in this paper, but will be a subject of future work. The econometric shortcomings of the current methodology are briefly addressed subsequent to this section.

$$\Delta ln\ TI_{it} = \alpha + \zeta^c ln\ \Delta(1-\tau_{it}) + \eta \frac{-\Delta T_{it}}{(Y_{it-p} - TI_{it-p}) + (\tau_{it-p} TI_{it-p} - T_{it-p})} + \Delta u_{it} \tag{5}$$

with $\Delta ln\ TI_{it} = ln\ TI_{it} - ln\ TI_{it-p}$, $\Delta ln(1-\tau_{it}) = ln\ (1-\tau_{it}) - ln\ (1-\tau_{it-p})$ and so on. ζ^c is the compensated (substitution) elasticity of taxable income with respect to the NTR, and η is income elasticity. The income effect corresponds to the negative change in the tax amount (which is equal to the change in after-tax income) relative to base year virtual income. For the dependent variable, the change in taxable income, we adjust inflated base year income for other changes in the tax code that were part of the reform (e. g. concerning expenses and allowances), taking the 2004 definition as a benchmark. We thus create a taxable base which is consistent over time by eliminating income changes that are not directly attributable to the reform but due to differences in deduction possibilities.

We address the endogeneity problem of the marginal tax rate by calculating synthetic (or predicted) marginal tax rates $\tilde{\tau}_{t-p}$ and $\tilde{\tau}_t$, applying the pre- and the post-reform tax code to inflated base year income $\tilde{TI}_{t-p}$. With $(1-\tilde{\tau}_{t-p})$ we obtain the NTR the taxpayer would face in 2004 if tax law and her real income did not change over time. $(1-\tilde{\tau}_t)$ is the NTR on constant real base year income, under post-reform tax law, but before any behavioral response. The difference between these two NTRs serves as an instrument variable for the truly observed difference between the NTRs.[4] Including log base year income $ln\ TI_{t-p}$ to control for mean reversion and adding a vector of base year covariates X_{it-p} yields our estimation equation

$$\begin{aligned} \Delta ln\ TI_{it} = \alpha + \zeta^c\ ln\ \Delta(1-\tau_{it}) + \eta \frac{-\Delta T_{it}}{(Y_{it-p} - TI_{it-p}) + (\tau_{it-p} TI_{it-p} - T_{it-p})} \\ + \rho\ ln\ TI_{it-p} + \gamma' X_{it-p} + \Delta u_{it} \end{aligned} \tag{6}$$

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[4] The endogeneity problem analogously applies to the tax amount T_{it} which is needed to calculate the income effect term. We therefore calculate a synthetic tax liability $\tilde{T_{it}}$ that the taxpayer would face under post-reform law, but with constant real base year income. The observed income effect is then instrumented with the synthetic one, exchanging T_{it} with $\tilde{T_{it}}$.

This specification basically corresponds to the approach used in most studies, except for the income effect which is seldom included. A control variable for mean reversion effects has been used in almost every specification since Auten/ Carroll (1999). Some studies include more sophisticated controls like 10-piece splines in base year income to control more accurately for mean reversion and exogenous income trends (e. g. Gruber/Saez (2002), Giertz (2007)). In case of strong correlation between the change in marginal tax rates and the level of taxable income such detailed income controls may destroy identification of the true response, especially when using only two years of data. Since in our case tax rate changes are not limited to a certain range of incomes or monotonically increasing in income as in other studies, we additionally use a 10-piece splines specification in order to test the sensitivity of our results (see column (2) in Table 1).

The vector X includes number of children, age (and age squared) and dummy variables controlling for the main income type (wages or income from business/self-employment) and for joint filing in order to address the fact that joint filers are treated differently from single filers. The number of children as well as age and age squared serve as proxy variables for life-cycle effects.

In a third specification another dummy is added which indicates whether a taxpayer declares rent and lease income in every year to control for the development in rent and lease income noted in Section 4. The dummy enters the estimation equation directly and interacted with the NTR elasticity. By adding a dummy for taxpayers declaring rent and lease income in every year and additionally interacting this dummy with the change in NTR we get the general positive effect of the rent and lease trend on income growth as well as the marginal NTR effect for taxpayers declaring this income type. Since the interaction term is also endogenous, it is instrumented analogously to the NTR elasticity.

Although the three-year difference between 2001 and 2004 would include the whole range of data available we use the difference between 2002 and 2004 in the main specification of our estimations for different reasons. First, the reform measures from 2001 to 2004 were embedded in a greater reform program starting in 1999 and ending in 2005. In 2001 tax rates had been lowered from 22.9 % to 19.9 % at the bottom and from 51 % to 48.5 % at the top, so observed income in

2001 might already reflect a certain degree of behavioral response. Second, from 2002 on only 50 % of certain types of capital income (primarily dividends) entered the tax base, which, as shown in Figure 3, had a huge impact on the level of declared capital income of high income taxpayers. Since the data do not contain detailed information on the composition of capital income, it is rather difficult to create a consistent definition of 2001 taxable income over time. Third, the one-year difference between 2004 and 2003 might include anticipation effects since the tax rate cut in 2004 was known in advance. Therefore we opt for the two-year difference ($p = 2$) and use the one-year difference ($p = 1$) for robustness checks.

Results

The basic results of the 2SLS regressions are presented in Table 1.[5] 11 369 226 observations could be used in the estimations. Column (1) shows the results from the basic specification with the log in 2002 taxable income as a control variable. In this case the overall NTR elasticity is 0.937. The income effect is not only insignificant but also practically zero. The other demographic control variables are all significant, but rather small in value. Joint filers realize a slightly higher income growth than single filers. The negative sign of the self-employed dummy is surprising since taxpayers with income from business and self-employment usually have more possibilities to rearrange components of their income than employees. Interpreting age as a life-cycle proxy, the negative sign implies that income is more stable when taxpayers get older. To a certain degree the number of (tax relevant) children is correlated with taxpayers' age and thus reflects life-cycle effects as well.

An NTR elasticity of 0.94 is relatively high compared to the results in recent work which mainly range from 0.2 to 0.6. An interesting point is made by Slemrod/Kopczuk (2002) who argue that taxable income elasticity is not a fixed parameter but depends on the deduction possibilities defined by tax law and thus can to some extent be controlled by policy makers. Since German income tax law offers various possibilities to narrow the tax base along the whole income distribution, it seems possible that behavioral response is more pronounced than in other countries.

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[5] The F statistics for the NTR instrument and the income effect instrument (and in specification (3) also for the interaction term instrument) in the first stage are very high, so the instruments can be considered strong.

Table 1: Basic estimation results

Variable	(1) Basic specification	(2) 10-piece splines	(3) Rent/Lease controls
NTR elasticity (ζ^c)	0.937***	0.435***	0.555***
	(0.006)	(0.005)	(0.008)
ζ^c × Rent/Lease	–	–	1.22***
			(0.014)
Income elasticity (η)	< 0.001	$< 0.001^{**}$	< 0.001
	(0.0001)	(0.0001)	(0.0001)
Joint filing	0.024***	0.018***	0.027***
	(0.000)	(0.000)	(0.000)
Number of children	0.018***	0.009***	0.018***
	(0.000)	(0.000)	(0.000)
Age	-0.004^{***}	-0.003^{***}	-0.004^{***}
	(0.000)	(0.000)	(0.000)
Age squared	$< 0.001^{***}$	$< 0.001^{***}$	$< 0.001^{***}$
	(0.000)	(0.000)	(0.000)
Self-employed	-0.052^{***}	-0.059^{***}	-0.062^{***}
	(0.000)	(0.000)	(0.000)
Rent/Lease	–	–	0.028***
			(0.000)
ln(income)	-0.164^{***}	–	-0.175^{***}
	(0.0001)	(0.000)	(0.0001)
10-piece splines(income)	–	yes	–
Constant	1.878***	4.318***	1.997***
	(0.002)	(0.009)	(0.002)
Observations		11 369 226	

Note: Estimates based on the years 2002 and 2004. Standard errors in parentheses. $^{***}/^{**}/^{*}$ denote significance on the 1 %, 5 % and 10 % level. Instrument variables are created as described in the text. Coefficients on 10-piece splines range from -0.427 (1st decile) to 0.012 (9th decile).

Another explanation which is more related to the estimation strategy is that most studies use more sophisticated income controls in their estimations. Therefore we enter 10-piece splines in log base year income in the estimation equation instead of simply log base year income to see how much this influences our results (column (2)). The elasticity falls by more than 50 % to 0.435, indicating that such detailed income controls capture a considerable part of the NTR elasticity, especially when using only two years of data. Interestingly the income effect is now significant at a 5 % level, although economically negligible.

Another factor that obviously drives the results is the striking development of rent and lease income. Assuming that this trend is for the most part not directly related to the analyzed tax reform it needs to be controlled for. We do this by adding a dummy and an interaction term as described in section 5. The results are shown in column (3). The NTR elasticity falls to 0.56, whereas the interaction term parameter exceeds one (1.22), both being highly significant. The rent and lease dummy itself is significant, but small in value. Income effects are again insignificant.

These figures indicate that, holding all other factors constant, taxpayers with rent and lease income have experienced a higher income growth between 2002 and 2004 than those who did not declare this income type, in general as well as with respect to changes in the NTR. The development of rent and lease income is a good example of how results are driven by changes in the income distribution and not mainly by increases in the top income range where, as we can see in Figure 3, even in 2004 the share of rent and lease income does not exceed 2 % of total income. Many taxpayers move upwards along the income distribution because rent and lease losses cease to reduce their total income and not because they increase their economic income in response to a tax rate cut. This is why decile-based splines have such a high explanatory power for income growth, even when, as in our case, tax rate changes are not directly related to the level of income.

Robustness checks

In order to test how sensitive the results are to our base year choice we use a one-year difference with 2003 as base year. The results are displayed in column (1) of Table 2. The elasticity falls by almost 20 % from 0.937 to 0.759. This reflects the observed income growth between 2002 and 2003 which can be considered unrelated to reform incentives: Starting from a higher level in 2003 but under the same pre-reform law, NTR effects on income growth become smaller. When rent and lease controls are included, the elasticity falls to 0.506, the interaction term is 0.894 (column (2)), which is again lower than the results of the two-year difference. In both specifications, the income effect is now significant, but still very small.

Even though we try to control for mean reversion and to capture exogenous trends, there may still be many unobserved factors that determine individual income growth over time, leading to very large results which are wrongly attributed to tax incentives. Therefore we divided taxpayers by three main income sources (business, self-employed and dependent), sorted them by the magnitude of their relative income change between 2002 and 2004 and cut off successively 1 %, 2,5 % and 5 % at both tails of this distribution, i. e. those taxpayers with the largest negative and positive income differences per group. The division by income source serves the purpose to maintain a similar population structure after dropping the extreme values. The results for the 1 % and 2,5 % thresholds are displayed in columns (3)/(4) and (5)/(6) of Table 2.[6] The NTR elasticity is already rather sensitive to the 1 % cutoff, falling to 0.691 and even to 0.522 with rent and lease controls. This trend continues when cutting off 2,5 % at the edges, falling to 0.451 and 0.347, respectively. In fact the overall elasticity seems to be driven by a small number of taxpayers. The more extreme values are cut off, the more the impact of the interaction term decreases, indicating that taxpayers with the largest income changes are also those with income from rent and lease. Although the largest income differences may partly contain true behavioral response, at least the results when using a 1 % threshold seem to be mostly reliable.

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[6] For the sake of clarity the results of the 5 % cutoff are not displayed, but they continue the observed decline in values (0.286 and 0.235 resp., with an interaction term of 0.146).

Table 2: Robustness checks

	One-year difference (2004/2003)		Cut-off in income change			
			1% pos./neg.		2,5% pos./neg.	
	(1)	(2)	(3)	(4)	(5)	(6)
NTR elasticity	0.759***	0.506***	0.691***	0.522***	0.451***	0.347***
	(0.002)	(0.006)	(0.003)	(0.004)	(0.000)	(0.000)
ζ^c × Rent/Lease	–	0.894***	–	0.521***	–	0.315***
		(0.011)		(0.008)		(0.000)
Income elasticity	0.0001**	0.0001**	< 0.001	< 0.001	0.000***	0.000***
	(< 0.0001)	(< 0.0001)	(0.0002)	(0.0002)	(0.000)	(0.000)
Observations	11 369 226		10 931 959		10 597 308	

Note: Standard errors in parentheses. ***/**/* denote significance on the 1 %, 5 % and 10 % level respectively. Cutoff thresholds denote the 1 %/2,5 % of the taxpayers with the largest negative and the 1 %/2,5 % with the largest positive income changes over time, respectively.

Thirdly we follow an interesting approach employed by Giertz (2008) (and also already used as a robustness check by Auten/Carroll (1999)) and invert the panel, i. e. we use 2004 as base year and simulate the effects of a tax rate *increase* from 2004 to 2002. The idea is that the results should be close to the original value if no mean reversion is present: If the response is positive and taxpayers react with an income increase to a tax rate decline, then it should be true that they reduce their income when tax rates increase. The estimation equation has then the following form:

$$ln(\frac{TI_{02}}{TI_{04}}) = \alpha + \zeta^c\ ln(\frac{(1-\tau_{02})}{(1-\tau_{04})} + \eta \frac{T_{04} - T_{02}}{(Y_{04} - TI_{04}) + (\tau_{04} TI_{04} - T_{04})} + \gamma\text{'}X_{04} + \Delta u \quad (7)$$

with X_{04} including $ln\ TI_{04}$. The NTR instrument is calculated analogously to the original analysis by applying both 2004 and 2002 tax law to 2004 taxable income and taking the difference. The same applies to the interaction term. The income values used for the dependent variable are again based on a consistent 2004 tax law defitinion. The results are displayed in Table 3.

Table 3: Inverted panel analysis

	(1) Basic specification	(2) Rent/Lease controls	(3) 10-piece splines
NTR elasticity	-0.499^{***}	-0.222^{***}	0.438^{***}
	(0.006)	(0.006)	(0.007)
ζ^c × Rent/Lease	–	-1.251^{***}	–
		(0.012)	
Income elasticity	-0.0001^{***}	-0.0001^{**}	-0.0002
	(< 0.0001)	(< 0.0001)	(< 0.0001)
Observations		11 369 226	

Note: Standard errors in parentheses. ***/**/* denote significance on the 1 %, 5 % and 10 % level respectively.

The results in the basic specification and with rent and lease controls are negative, meaning that the reaction of taxpayers increasing their income after the tax rate increase overweighs the reaction of those who reduce their income. This indicates that some kind of severe mean reversion is present, although the effect is not as clear as it is in Giertz (2008) or Auten/Carroll (1999)). Since the 2004 tax rate cuts did not only affect high incomes but all taxpayers, effects of movements in both directions along the income distribution may partly cancel out each other. An explanation for the negative results could be that there are in fact taxpayers with lower incomes who show a negative response to the tax rate cuts (see Table 4), which turns into an income increase in the inverted panel. In the inverted case however the relative changes increase in value due to the lower starting level of income. This rather technical effect may be one reason for the negative results, but there is evidence that the results are influenced by other effects not fully controlled for. When 10-piece splines are included the elasticity switches from a negative to a positive value of 0.438, which is almost exactly the same result as in the original analysis that included splines (0.435). These results confirm the evidence found in other studies that non-linear income controls are obviously better suited to account for mean reversion effects. But again, as we have only very few years of data available, detailed controls tend to capture a great deal of the NTR elasticity.

Results by income type and income group

The magnitude of the NTR elasticity varies strongly when we look at the results per income group and income type. We divide taxpayers by their dominating income type in combination with their level of taxable income, taking an arbitrary threshold of 50 000 €. We keep the income type classification we used for the cutoff of extreme values (business, self-employed and dependent). Since the 1 % cutoff rule seems to produce the most plausible results without taking the risk of losing too much of the true response, we continue with the subpopulation of 10 931 959 observations. The results are displayed in Table 4.

Taxpayers with high dependent income show the strongest response, whereas the elasticity of wage earners with taxable incomes below 50 000 € is close to zero. Surprisingly, within the group of self-employed, those with lower incomes react stronger than high income taxpayers, which is also true for the interaction term. The elasticity of taxpayers with business income in the lower income range even has a negative sign, meaning that these taxpayers reduce their income in spite of the NTR increase, and there is no compensation by a positive income effect, which is insignificant. Interestingly, the interaction term is positive and very strong, indicating that a drop in income in this group is only true for those cases without rent and lease income. The opposite holds for taxpayers with high dependent income, where the interaction term is negative.

The most interesting thing about the group specific results is that now the income effect becomes highly significant for some subgroups. For self-employed in the lower income range the income effect is positive, meaning that in addition to the positive NTR effects, for these taxpayers the reduced tax burden is an incentive to further increase their income. For taxpayers with primarily dependent income, income effects are negative, in the lower range even with a value of -0.64, resulting in an overall negative response for this group as well.

Table 4: Results for different groups

	Business		Self-employed		Dependent	
	$\leq$ 50 000	$>$ 50 000	$\leq$ 50 000	$>$ 50 000	$\leq$ 50 000	$>$ 50 000
ζ^c	-0.109^{***}	0.383^{***}	0.538^{***}	0.249^{***}	0.015^{***}	1.479^{***}
	(0.030)	(0.034)	(0.083)	(0.036)	(0.005)	(0.021)
$\zeta^c \times$ R/L	0.408^{***}	0.563^{***}	0.323^{*}	0.175^{***}	0.024^{***}	-0.243^{***}
	(0.070)	(0.038)	(0.188)	(0.043)	(0.016)	(0.024)
η	-0.0006	-0.0004	0.166^{***}	-0.0001	-0.639^{***}	-0.014^{***}
	(0.0004)	(0.0003)	(0.043)	(0.0004)	(0.008)	(0.002)
Observations	1 031 059	508 970	326 413	315 692	7 220 900	1 528 925

Note: Estimates based on the years 2002 and 2004. Standard errors in parentheses. $^{***}/^{**}/^{*}$ denote significance on the 1 %, 5 % and 10 % level respectively.

6 Summary and conclusions

This paper contributes to the body of literature on the elasticity of taxable income and provides new results for Germany which add to the scarce empirical evidence for European countries so far. When we control for the striking rent and lease income growth, we find an overall elasticity of 0.56, assuming that the rent and lease income development is mostly independent from the tax reform under observation. The results are rather sensitive to robustness checks, e. g. the inclusion of splines, the choice of base year and the exclusion of extreme income differences, ranging altogether from 0.35 to 0.76.

A part of the large response of taxpayers with rent and lease income might also be related to the reform, whereas the results including splines as controls tend to underestimate the true value. Taking the possibility into account that large differences which are cut off partly contain real response, an overall elasticity of approximately 0.6 seems realistic and reliable. Income effects are insignificant or economically negligible throughout the different specifications, which implies that there is practically no difference between compensated and uncompensated elasticity. All in all the results are considerably higher than the rather moderate labor supply elasticities (see e. g. Wagenhals (2000)) and shed a new light on the efficiency cost of taxation in Germany as well as on predicting revenue effects of future reforms.

Some econometric issues of the methodology are to be mentioned, which so far only Holmlund/Söderström (2008) deal with in their study. Using base year income for creating instrumental variables is somewhat problematic since it is probably correlated with the error term and therefore endogenous. Holmlund/Söderström (2008) use a dynamic panel estimator to solve the endogeneity problem which seems a promising step to a further improvement of the estimation methodology and will be considered in upcoming work.

In the context of previous work, the range of our results confirms that it is essential to control accurately for exogenous income trends and mean reversion to obtain a response that is directly related to an NTR change. This seems to be a problem in all studies so far. Furthermore, the inclusion of splines reveals how difficult it is to compare NTR elasticities when different income controls are used. With improving data availability and longer time periods the effects of more than one tax reform can be analyzed simultaneously and changes in the income distribution can be controlled for in a more accurate way, as already done by Gruber/Saez (2002), Giertz (2007) or Heim (2009). The time dimension of our panel is still too short at the moment, but more years of data will allow a better control for the development of incomes in years with and without tax reforms under different economic conditions.

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Appendix: Summary statistics

Table 5: Summary statistics of income and tax variables (in €)

	2001		2002		2003		2004	
Income type	Mean	Std.-dev.	Mean	Std.-dev.	Mean	Std.-dev.	Mean	Std.-dev.
Agriculture	15 388	35 699	14 354	37 517	14 046	34 276	15 415	36 814
Business	27 378	285 900	24 806	291 541	24 821	355 119	27 786	433 339
Self-employed	39 785	87 185	39 817	92 210	39 677	89 672	42 419	93 320
Wages	40 842	39 755	41 492	37 044	42 103	34 174	43 079	36 325
Capital	12 203	153 878	7 623	65 820	7 012	55 151	6 511	65 273
Rent and Lease	-537	29 419	-329	32 400	83	31 414	1 004	29 826
Pensions	4 700	37 973	4 834	32 966	5 005	22 666	5 041	24 172
Taxable income	40 500	130 703	39 732	121 444	40 346	144 182	42 380	172 567
Income Tax	9 538	63 451	9 362	59 172	9 562	70 639	9 425	78 418

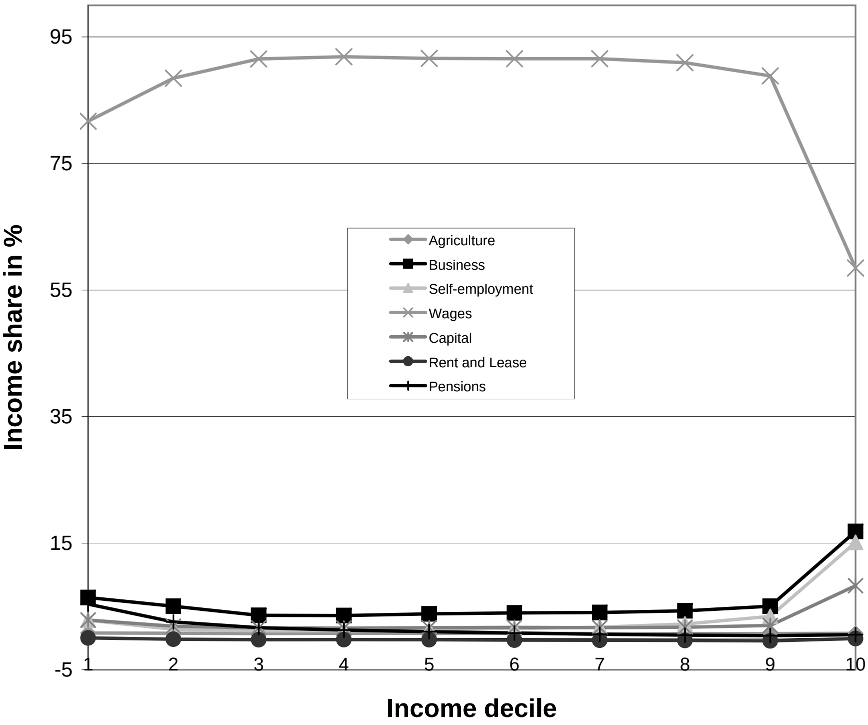
Note: Calculations based on 12 242 397 observations and on annual nominal values.

Table 6: Share of income and taxpayers by income type 2001-2004

	2001		2002		2003		2004	
Income type	€	n	€	n	€	n	€	n
Agriculture	0.75	2.42	0.71	2.44	0.69	2.47	0.75	2.49
Business	8.01	14.65	7.44	14.89	7.59	15.37	8.36	15.58
Self-employed	5.84	7.35	5.94	7.41	5.94	7.53	6.18	7.54
Wages	81.00	92.93	82.66	92.58	82.58	92.44	81.18	92.24
Capital	3.69	24.18	2.43	23.13	2.17	22.86	2.13	24.56
Rent and Lease	-0.24	21.92	-0.15	22.24	0.04	22.66	0.44	22.74
Pensions	0.95	9.86	0.98	9.77	0.99	9.72	0.96	9.58

Note: Calculations based on 12 242 397 observations and on annual nominal values.

Figure 2: Overall share of income and taxpayers by income type and deciles 2001



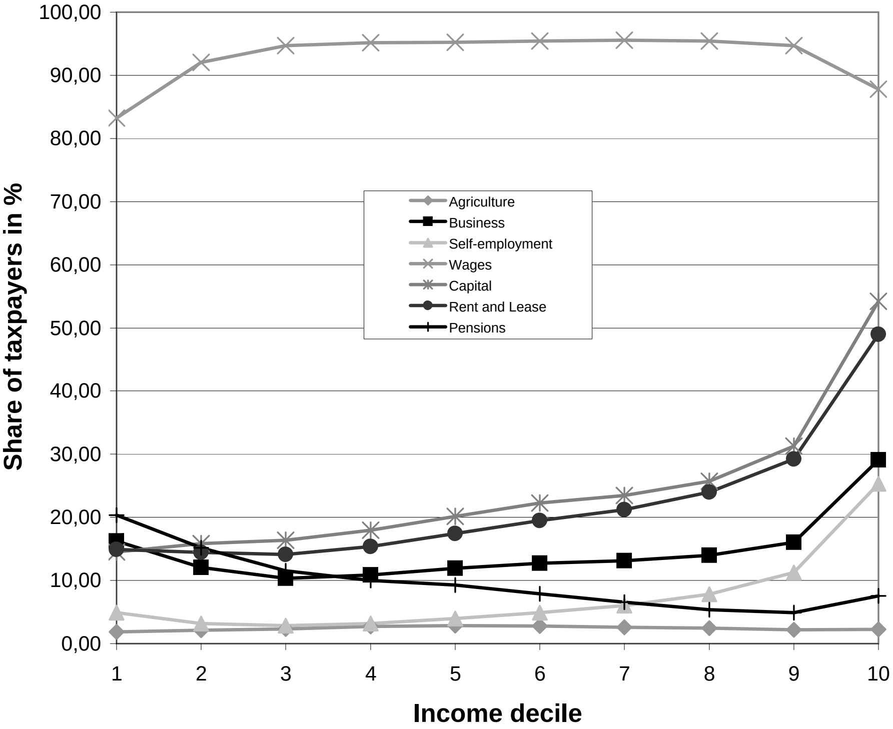
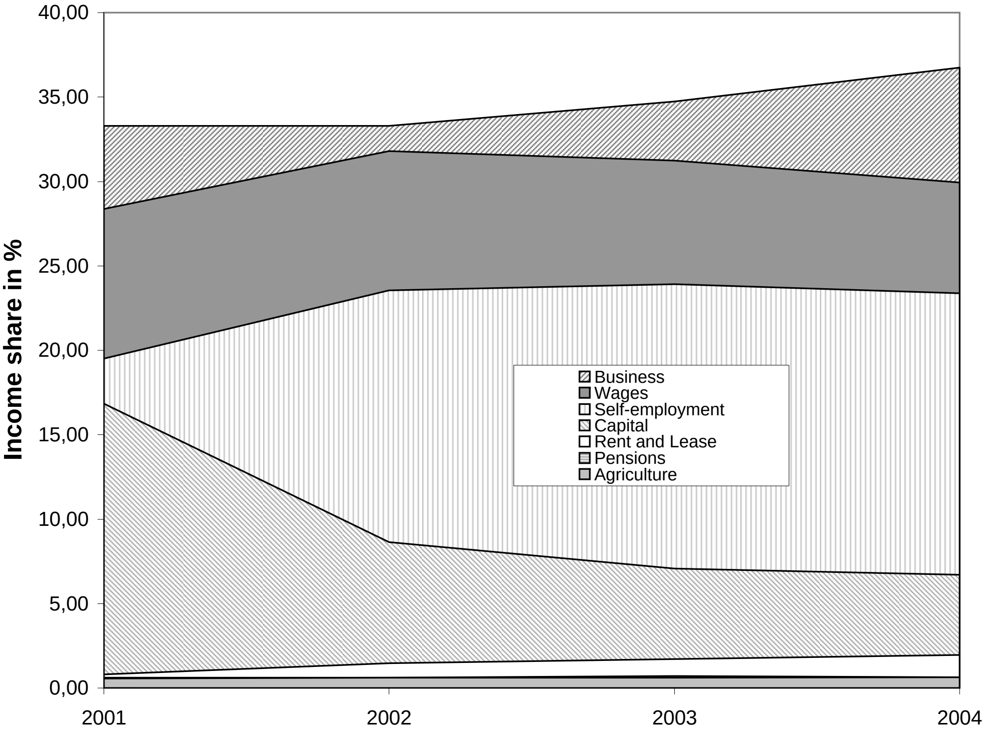


Figure 3: Share of income and taxpayers by income type in the top percentile



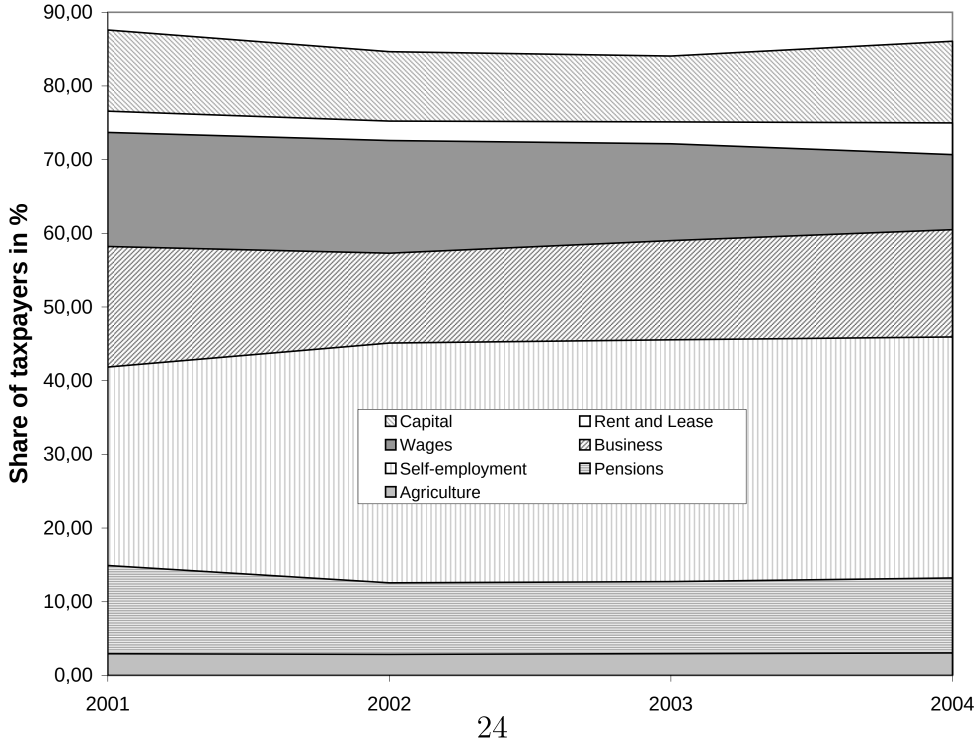


Table 7: Changes in taxpayer distribution by income deciles 2001

Decile	Change of taxpayers (in %)			
2001	02/01	03/02	04/03	04/01
1	+5.16	-0.96	-6.37	-2.48
2	-7.96	-4.85	+2.06	-10.63
3	-4.47	-3.99	-1.60	-9.76
4	-2.19	-1.53	-0.51	-4.18
5	-0.49	-0.39	+0.09	-0.78
6	+0.21	+0.10	-1.11	-0.81
7	+0.74	+0.27	-0.74	+0.27
8	+2.08	+1.18	-0.13	+3.15
9	+3.94	+3.77	+1.56	+9.54
10	+2.97	+5.52	+6.47	+15.68

Note: Calculations based on 12 242 397 observations and on annual nominal values.

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