Essays on Behavioral Responses and Tax Incentives
Empirical Results for Germany

INAUGURAL-DISSERTATION

zur Erlangung des akademischen Grades

eines Doktors der Wirtschaftswissenschaft

(doctor rerum politicarum)

des Fachbereichs Wirtschaftswissenschaft

der Freien Universität Berlin

vorgelegt von

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geboren in Kiel

wohnhaft in Berlin

2015

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Tag der Disputation:29.05.2015

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Erklärung über Zusammenarbeit mit Koautoren und Vorveröffentlichungen

Kapitel 2

Das Kapitel *Estimating a Consistent Elasticity of Taxable Income for Germany* ist bislang unveröffentlich und ohne Zusammenarbeit mit Koautoren entstanden.

Kapitel 3

Das Kapitel *Charitable giving and its persistent and transitory reactions to changes of tax incentives: evidence from the German taxpayer panel* ist unter Zusammenarbeit mit Timm Bönke entstanden.

Kapitel 4

Das Kapitel *What Drives Tax Refund Maximization from Inter-temporal Loss Usage? Evidence from the German Taxpayer Panel* ist bislang unveröffentlich und ohne Zusammenarbeit mit Koautoren entstanden.

Acknowledgments

I had the privilege to write this doctoral thesis while working as a research associate at the Chair of Empirical Economics and the Chair of Public Economics of the Freie Universitaet Berlin.

First of all, I am indebted to Viktor Steiner for supervising my thesis with numerous fruitful discussions, his sound advice, invaluable guidance and sharing his experience. He helped me to avoid wicked pitfalls that so easily and unwanted occur with empirical work. I would also like to thank my second supervisor, Giacomo Corneo, for his support, very valuable suggestions and offering me a position to come to the Freie Universitaet Berlin in the first place.

A special thanks goes to my dear colleague and comrade Katharina Jenderny who shared regularly an office and many heated discussions with me over the last few years. I am not sure if I could have finished this doctoral thesis without her.

This thesis would have also not been possible without Carsten Schröder who persuaded me to take a PhD and introduced me to the fascinating world of research. I am thankful for the fruitful collaboration with my co-author Timm Bönke on Chapter 3.

Further, I would like to thank Frank Fossen and Frank Hechtner for helpful comments and advice on a number of econometric and tax code problems throughout the past years. In particular I would also like to thank Trine Vattø for discussions on common research topics and for commenting on earlier drafts of my papers. The weekly PhD candidate research seminar led by Viktor Steiner and Frank Fossen has been very supportive, and I am thankful for multiple valuable comments from participant. I thank Davud Rostam-Afschar and Charlotte Bartels for the great team work on teaching undergraduate classes and the occasional coffee break every now and then.

Further, I am much obliged to the Federal German Statistical Office in Berlin, for providing the opportunity for me as a guest researcher to work with the German taxpayer panel, technical support and a very appreciated coffee machine. Thanks also go to Rafael Beier, Melanie Scheller and Ulrike Gerber and the team of the Destatis Research Data Center's Staff of the German Federal Statistical Office.
Finally, I would like to thank friends and my parents Angelika and Volker Werdt for proofreading, great support and encouragement. A special thanks goes to Aleksandra Szajna for sticking to me during good and bad times.

Contents

Chapter 1

Introduction

1.1 Motivation

Taxes affect our everyday life in numerous ways: they finance public goods provided by the government, redistribute income from the rich to the poor and change absolute and relative prices of a wide range of goods. This is especially true for Germany, where direct taxation has been one of the core revenue sources over the past six decades.[1]Direct taxation, such as income and capital taxes amount to 39.68% of the overall German governmental budget with 245.9 billion Euro in 2013.[2]

While the impact on behavior from direct taxes is of particular interest, revenue of direct taxes play a considerable role for most developed countries and are subject to a lively political debate. The extent to which the actual design of the tax code, however, obeys economical guidelines is unclear and economic consequences are of special interest. But only results from empirical research can shed light on the economic consequences of income taxation.

Since the German tax code consists of non-lump-sum and non-constant tax rates, behavioral responses of unknown quantity are provoked: taxpayers may prefer to work less or may want to consume more leisure than in a world with lump-sum taxation. Reactions

[1]See for instance for an overview for selected countries in Salanie (2003) Table 1, or detailed information for Germany in Bundesministerum für Finanzen (2014) page 262 and following.

[2]The share of 39.68% is computed for the governmental budget excluding social security contributions. See Bundesministerum für Finanzen (2014)), page 282 for an overview of tax revenue for Germany.

of working hours, however, mirror only a fraction of potential behavioral reactions of taxpayers. Alternative reactions would be a change of working effort, in the choice of work, a job change or the preference for an alternative work compensation like fringe benefits, naming just a few.
The German tax code comprises a very steep increase in tax liability with increasing income. Correspondingly, the marginal tax rates for low incomes are fairly small but the top marginal tax rate exceeds .4 for taxable incomes above approximately 52,000 Euro in the early 2000s.[3] The according average tax rates reflect the desire for redistribution from high to low incomes, furthermore raises the question of welfare losses through reduced work for high incomes due to the stronger taxation.

Moreover, other features of the German income tax schedule have severe impact on the taxation and might generate economic consequences. A prominent example is the tax advantage of married couples compared to single taxpayers that calls for special consideration in any empirical analysis. Results from the labor supply literature confirm that secondary earner, in this case married women, respond relative elastic in their choice of working hours to tax rate changes. In contrast, married men show rather weak reactions to tax rates (see Bargain et. al 2012).

In general, economically optimal tax schedules would produce as little behavioral responses as possible but the computation of optimal taxes would require a government with exceptional detailed information and is rather inapplicable in the real-world. Models like Mirrlees (1971) can provide counsel on the construction of tax rates that constitute a desired tax revenue, an income distribution and that maximize social welfare. Furthermore, those models provide evidence on the key parameters that determine the design of the tax construction. However, modern tax codes like the German income taxation include various other features than just the shape of the tax rates. For instance, another prominent feature of the German tax code is the deductibility of income related expenses from taxable income. Designed to increase work incentives through a price reduction of

[3]The top marginal tax rate was until 2003 .485 and decreased until 2005 to .42. In 2007 and 2008 it was raised again to .45 for taxable incomes above 250,000 Euro.

certain costs connected to the generation of income. Examples are travel costs to work or child care costs.
Another and similar example of deductible expenses that are not income related, is donations to charity: the German tax code allows to deduct donations from gross income to support incentives for giving. Through this tax subsidy, the taxpayers tax liability is decreased and the implicit price of giving is reduced. Thus, the tax code affects the consumption decision of taxpayers and reduces tax revenue through the consumption subsidy.[4] This then again also raises the question of efficiency of this tax subsidy. Since foregone tax revenue could be alternatively used to finance charity directly, this is only efficient if tax incentives induce larger donations, following Feldstein's (1975) rule.

The impact of the tax schedule on the individual tax burden is limited to the concept of the taxable income. A standard way for taxpayers to bypass taxation is the investment into tax avoidance to protect a part of their income from taxation. Tax avoidance can both legally and illegally lower taxable income. Whereby legal tax avoidance is based on the utilization of opportunities in the tax code, illegal avoidance shelters income from the tax authorities that otherwise would have been taxed. Tax avoidance is of special interest when it comes to measure disposable income or real income and also income reactions to tax changes.
However, it is difficult to measure tax avoidance behavior because necessary information in the data are only reported up to a certain point.
But the German income tax code provides a remarkable feature that allows the study of legal tax avoidance behavior. Taxpayers with negative income can offset this negative income with positive incomes to lower the tax burden. This works for both contemporary offsetting within a year as well as inter-temporally between years if the aggregate income of one year is negative. Thus, the German tax provides insurance against severe income shocks because tax units can create a tax refund from the loss offsetting. Accordingly this particular type of tax avoidance is maximized if the tax refund from loss offsetting is maximal.

[4] See Andreoni (1990) for modeling donations to charity as a consumption good.

1.2 Contribution to the literature[5]

The first contribution of this doctoral thesis in Chapter 2 provides new empirical insights on the taxable income elasticity for Germany. Two steps of the German income tax reform of 2000 provide significant exogenous variation of the tax rates in 2004 and 2005 and altered the whole tax schedule with a varying extent. Starting with a detailed discussion of the most prominent model of the literature by Gruber and Saez (2002), an alternative dynamic model is provided for cases Gruber and Saez's (2002) model delivers inconsistent results. Finding consistent estimates for the elasticity of taxable income is challenging because of two reasons. First, it is of crucial importance to control for the individual income process. Taxpayers might have heterogenous income growth that is unrelated to the tax rate changes but this might bias identification of the tax rate elasticity without sufficient income controls.

Second, tax rates that increase with increasing income are endogenous and need to be instrumented with strongly correlated instruments. However, it is not necessarily clear that conventional instruments are exogenous and uncorrelated with the residuals. If residual exhibit strong autocorrelation over time, instruments from lagged endogenous variables might still be significantly correlated with the residuals and thus also endogenous. Estimating the elasticity of taxable income for Germany illustrates that an alternative model with a new income control finds significantly different estimates from the most prominent model of the literature by Gruber and Saez (2002).

The elasticity of taxable income for Germany amounts to .36 and is notable smaller than results for the US from Weber (2014), but similar to recent German results by Müller and Schmidt (2012). The elasticity is robust against a number of sensitivity checks, including non-linear income controls such as the prevalent splines, but not robust against the exclusion of low incomes. Results with separated elasticities for single and married taxpayers show that married taxpayers react more than twice as strong as single taxpayers do with an elasticity of .44 for married and .17 for single taxpayers.

[5]Note that this doctoral thesis has two different notations for observations. Chapter 4 refers to observations as *tax units* reflecting the fact that it investigates tax avoidance of tax units who might not pay taxes. Chapter 2 and 3, however, denotes observations as *taxpayers* mirroring the fact that observations of tax units that actually pay taxes.

Chetty (2009) shows that the elasticity of taxable income can only be used to estimate welfare losses of taxation under strong assumptions for tax avoidance. However, one can use the elasticity of taxable income as an upper benchmark. Thus, results from Chapter 2 imply that welfare losses from income taxation are rather modest for Germany.

The second contribution of this doctoral thesis in Chapter 3 estimates the price and income elasticities of charitable giving. The German tax code heavily subsidizes the price of donations according to the taxpayers marginal tax rate which raises the question of tax efficiency. Exploiting the tax reform of 2004 and 2005, this Chapter draws on the significant exogenous variation from the two steps of the tax reforms to determine reactions to tax incentives. Applying the fairly new estimation technique of censored quantile regressions for the first time in a balanced panel setting provides estimates for the whole distribution of donations. Altogether, Chapter 3 presents estimates for five specifications to test for robustness of the preferred quasi-dynamic model. Main results from the preferred specification reveal very heterogenous income and price elasticities along the distribution of donations. Taxpayers in the lower conditional distribution of donors show relatively high values for the income elasticity with estimates greater than one, while donors in the upper part of the distribution qualify as inelastic. A downward sloping pattern of the income elasticities suggest that donations can be categorized as a normal consumption good. Price elasticities are of particular interest due to their policy implications for the optimal design of tax incentives. Across the whole distribution of donors, the price elasticities are very heterogenous and imply an elastic behavior only in parts: tax incentives matter at the very top and lower tail of the whole distribution of donors.

Turning to Feldstein's (1975) rule of treasure efficiency, tax incentives are not efficient to boost giving behavior for a substantial share of donors in the middle of the distribution. The preferred model differs from non-dynamic models by controlling for transitory incomes and prices. Transitory income elasticities are rather small and oscillate around .4, implying that donations do not hinge on temporary one-time income fluctuations but rather permanent income. Transitory price elasticities are much smaller than permanent price elasticities, with estimates below one in absolute value, yet show the same pattern. Furthermore, Chapter 3 shows that tax incentives fail to activate new donors, who are income elastic but price inelastic.

The third and final contribution of this doctoral thesis in Chapter 4 investigates the inter-temporal loss usage of tax units in Germany to study tax avoidance. Tax units that experience an aggregated loss in a year can offset that loss with positive income from adjacent years to receive a tax refund. Similar to companies, tax units can employ losses as carry-back in the year before the loss or as carry-forward in the year following the loss. The tax code does not force a particular loss usage but instead provides tax units with freedom to allocate the loss. This enables tax units to choose an individual allocation of carry-back and carry-forward that can create a maximal tax refund. To the best of my knowledge, there are no studies investigating this particular feature of the German tax code so far. Only a relative small literature estimates effects of losses on individual tax rates and income (e.g. Müller 2006, Bach and Buslei 2009). Chapter 4 interprets the loss usage in the light of tax avoidance for Germany: tax units have a chance to minimize their tax liability (which is equivalent to maximize the tax refund) by choosing the corresponding loss usage allocation. The Probit, logit and the linear probability model are employed to estimate the probability that tax units maximize their tax refund from loss usage. Estimation results show that the probability highly depends on the difference of the tax rates from the loss adjacent years. Results are robust against several sensitivity checks and imply that an increase of 10 percentage points of the tax rate difference increases the probability of maximization of the tax refund by 24.5%. Thus, results from Chapter 4 suggest that tax avoidance is especially strong in Germany when tax incentives have a significant size, but is not strong in case of small tax incentives.

Chapter 5 summarizes the results of this doctoral thesis and provides an outline for future research.

Chapter 2

Estimating a Consistent Elasticity of Taxable Income for Germany

2.1 Introduction

A series of major reforms, the so called *Agenda 2010*, introduced fundamental reforms on both the German labor market and to the German personal income taxation in the early 2000s. The reforms aimed to foster economic growth, reduce unemployment rates and lower the increasing federal debt. Former Chancellor Schröder recently called the reforms a cure for Germany formerly known as the "sick man Europe's" to become the "healthy woman" (see Hengst 2012). One of the reform's cornerstones were the *Hartz Reforms* which changed active labor market policy fundamentally.[1] Another key element were tax reforms which lowered marginal tax rates in several steps for the whole income distribution to increase work incentives and discourage tax evasion.

This reflects an international trend which saw tax rate reductions in a number of developed economies in the recent decades.[2] Moreover, results for the USA by Feldstein (1995) or Auten and Carroll (1998) suggested very elastic income responses to tax rate reductions, making tax reductions an attractive economic tool. Chancellor Schröder's

[1]See for instance Caliendo & Steiner (2006) or Eichhorst & Zimmermann (2007) for an evaluation of the active employment policy implemented by the *Hartz Reforms*.

[2]For the period 2000-2010, see for instance Table II.1b, II. 2b and II.3b. of OECD (2010). The Table shows a reduction in average tax rates in a lot of OECD countries for selected positions in the income distribution between 2000 and 2010. See also Salanie (2003) page 5 and 6.

federal government promised a boost in economic growth, employment and justice from the tax reductions. Moreover, the bulk of the reforms' revenue losses were expected to be self-financing.[3] However, a large body of subsequent literature suggests that income is not as elastic to tax rate changes as assumed (see Saez et al. 2012).
The elasticity of taxable income (ETI) has been established to measure income growth in response to changes of the net-of-tax rate, one minus the marginal tax rate. The ETI captures more dimensions of behavioral responses than labor supply elasticities.[4] It is the central fiscal policy parameter and of particular importance for predicting revenue changes from tax reforms (see Feldstein 1995, 1999). Moreover, the elasticity of taxable income allows to calculate deadweight losses of income taxation, if marginal costs of tax evasion and tax avoidance equal the marginal tax rate (see Feldstein 1999).[5] Feldstein's (1995) seminal paper was first to find taxable income elasticity exceeding 1, triggering a large body of literature estimating the size of the elasticity.[6] A very comprehensive overview of empirical results and econometric methodology is provided in Saez et al. (2012). The authors survey the most common estimation strategies, discuss possible drawbacks and identification issues. The majority of previous empirical results have focused on US tax reforms and the estimation of elasticity for the USA, with growing literature in Europe.[7] US results are within a wide range of values between 0.12 and 1 (see Saez et al. 2012), with recent results by Weber (2014) of an ETI of 0.86 for the US.

German findings tend towards a more moderate size: Gottfried and Witczak (2009) were first to adopt the most prominent model by Gruber and Saez (2002) using individual German income tax return data. Their preferred specification estimated an elasticity of taxable income for Germany of 0.6. Müller and Schmidt (2012) adopted the approach of Kopczuk (2005), an extension of Gruber and Saez (2002), and estimated an elasticity

[3] See the coalitions agreement between the social party SPD and the green party Die Grünen in section III.

[4] However, note that the ETI is a local elasticity that measures income changes in response to the actual tax rate change. In contrast to the labor supply elasticity, the ETI does not include tax rate changes at other positions of the income distribution which might have an effect on the individual budget restriction. Unfortunately, German tax data do not comprise information about working hours and allows not to compute labor supply elasticities.

[5] Chetty (2009) shows that in case that income sheltering has transfer and/or resource costs, the taxable income elasticity is not a sufficient statistic to calculate deadweight losses from income taxation.

[6] ETI above 1 is a necessary condition for self-financing tax reductions. See Creedy and Gemmell (2014) for thorough discussion and connection of the Laffer curve with values of the ETI.

[7] Saez et al. (2009) also discuss results for various European countries.

with similar results to Gottfried and Witczak (2009) and elasticities between 0.32 and 0.47.[8]

Estimating the elasticity of taxable income is challenging due to two reasons: applying valid instrumentation for the endogenous net-of-tax rate and using appropriate income controls accounting for income trends such as mean reversion.[9]

This paper contributes to the literature in two ways. First, it discusses Gruber and Saez's (2002) model which uses a flexible income control and base year income as source for the instrumentation of the net-of-tax rate. This model delivers consistent results if residuals do not show significant serial correlation. However, in the case of residuals in first differences or a misspecified model, this requirement could be violated and estimation results would be biased.[10]

Second, I propose an alternative model for the case that residuals show significant serial correlation. That model is a special case of the dynamic model proposed by Holmlund and Söderström (2011) and uses higher lags of base year income as source for the instrumentation and lagged income growth as income control. Employing a recent and very rich German income tax panel data spanning the years 2001 to 2006, the German tax reforms of 2004 and 2005 are used to estimate the elasticity of taxable income. Tax cuts were implemented for the whole distribution of taxable income, with the highest cuts for the lowest tax rates and the top tax bracket. Applying Gruber and Saez's (2002) model suggests an elasticity of taxable income for Germany of 0.46, including non-linear income controls. Tests of serial residual correlation, however, raise doubt about the exogeneity of the instrumented net-of-tax rate and the income control.[11]

Results from the here proposed model suggest a rather modest size of the German elasticity of taxable income of 0.36 in the preferred specification. Results are robust against the exclusion of top incomes (0.36 vs. 0.36), the set of control variables (0.36 vs. 0.31)

[8] One other study for Germany exists: Gottfried and Schellhorn (2004) analyzed the 1990 change in personal income tax schedule for taxpayers in Baden-Wuertemberg. They estimated an elasticity of taxable income of 0.4, but find also high values up to 1.0 when controlling for business income and high-income taxpayers.

[9] The net-of-tax rate is endogenous for a progressive income tax code and correlates negatively with taxable income.

[10] For instance, Gruber and Saez's (2002) model would be misspecified in case of an income process including an individual fixed effect.

[11] A new specification of Gruber and Saez's (2002) model by Weber (2014), increases the elasticity to 0.70. However, tests also indicate systematic serial correlation.

and the inclusion of non-linear income controls such as splines (0.36 vs 0.44).

Surprisingly, results from the preferred specification are remarkably similar to other recent estimates from Müller and Schmidt (2012). Müller and Schmidt's (2012) approach, however, differs from my empirical strategy, apart from the estimation model, in two other crucial aspects: (1) the authors employ weighted IV regressions and (2) use very strong selection criteria excluding lower incomes from the sample.[12] Replicating Müller and Schmidt's (2012) selection criteria significantly increases results for the elasticity to 0.56 and suggests that results might underlie a selection bias.

Elasticities are also estimated separately for married and single taxpayers, taking into account the heavy tax favoring of married taxpayers compared to single taxpayers by the German tax system. Married taxpayers can benefit from filing taxes together, which reduces average and marginal tax rates of the primary earner.[13] Moreover, married taxpayers might differ in other unobserved aspects from single taxpayers. Results promote the separate estimation with the elasticity of taxable income for married taxpayers of 0.44 and a significantly lower elasticity for single taxpayers with 0.17.

The remainder of this chapter is organized as follows: Section 2.2 briefly discusses the data and the data processing. Section 2.3 describes the German tax law and important recent reforms and section 2.4 sheds light on rational loss behavior as well as presents first results. The concluding section 2.5 reviews and interprets the major findings.

2.2 The German Income Tax and Recent Reforms[14]

The German income tax schedule is directly progressive, i.e. marginal tax liability increases with taxable income. Income exceeding the basic tax allowance is divided into several brackets. Contrary to most other progressive tax systems, the German tax schedule increases quadratically with income and is not a step system. The German tax schedule

[12] Taxpayers with base year income below 10,000 Euro are eliminated from their sample.

[13] Joint tax filing reduces the marginal tax rate of the primary earner if the average income of the married falls below the top tax bracket and the spouses have uneven high incomes.

[14] The first half of this section is taken from an earlier joint work with Nima Massarrat-Mashhadi (see Massarrat-Mashhadi and Werdt (2012)).

substantially discriminates between single and married taxpayers.[15] Married taxpayers can opt for the splitting tax schedule to decrease their joint taxation and marginal tax rates.[16] The change of government in Germany in 1998 was associated with intensive discussions about tax and labor market reforms. The new red-green government agreed upon several reforms of income and corporate taxation starting in 1999. It was the biggest bundle of income tax reforms in Germany's history since World War II. Prior to the observation period, two major parts of that reform bundle were implemented. One was a reform affecting personal income taxation indirectly.[17] The other part of the reform was directly related to personal income taxation and reduced all marginal tax rates of the German tax schedule. Between 1999 and 2001 the bottom marginal tax rate was cut from 25.9% to 19.9%, whereas the top marginal tax rate was reduced by 4.5 percentage points from 53% to 48.5%. Marginal tax rates in between were reduced accordingly. The most prominent tax reform was announced and passed in 2000 and consisted of a further gradual reduction of personal income tax schedule, accompanied by a modest tax base broadening. Parallel to the income tax reform, the German government implemented the so called *Hartz Reforms* between 2003 and 2005. These reforms fundamentally changed institutional and legal framework of the labor market and the benefit system that might affect low wage earners.[18]

The tax reform combines several steps which lowered the income tax schedule in 2001, 2004 and 2005. Besides the reduction of all marginal tax rates, the basic tax allowance was slightly increased from 7,206 Euro in 2001 up to 7,664 Euro in 2005.
Figure 2.1 shows the linear increasing marginal tax rates with different slopes in the different brackets. The top marginal tax rate of 48.5% in 2001 (45% in 2004; 42% in

[15]Steiner and Wrohlich (2008) provide evidence that joint taxation in Germany affects economic dimension such as work incentives and household welfare.

[16]Marginal tax rates for married taxpayers are determined as if one single taxpayer would earn the average taxpayers income. Accordingly, the tax burden is calculated as twice as much the single taxpayer with the average income would have to pay. Given the progressive schedule, married taxpayers with uneven distributed incomes can reduce their overall tax burden. Marginal tax rates for married taxpayers decrease until the average income is in the top bracket. ODonoghue and Sutherland (1999) discuss how joint taxation affects work incentives of the secondary earner.

[17]It was a significant paradigmatic change in corporate taxation, taking place between 2000 and 2001. Its main attribute was the reduction of the corporate tax rate from 45% to 25% combined with simultaneous corporate tax base broadening. The reform of corporate taxation also included several adjustments regarding the income taxation.

[18]Unfortunately, tax data do not allow to control for these changes.

2005) begins at a taxable income of approximately 52000 Euro.

Figure 2.1: Marginal tax rates for an individually taxed taxpayer

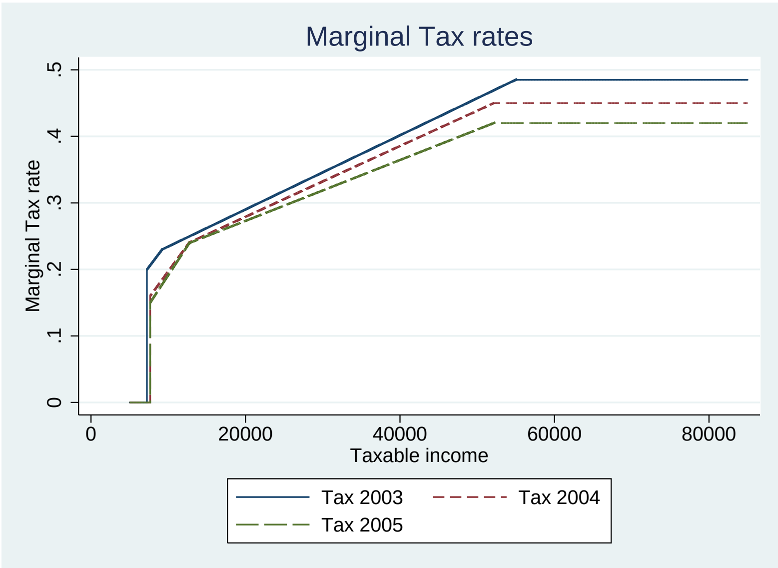
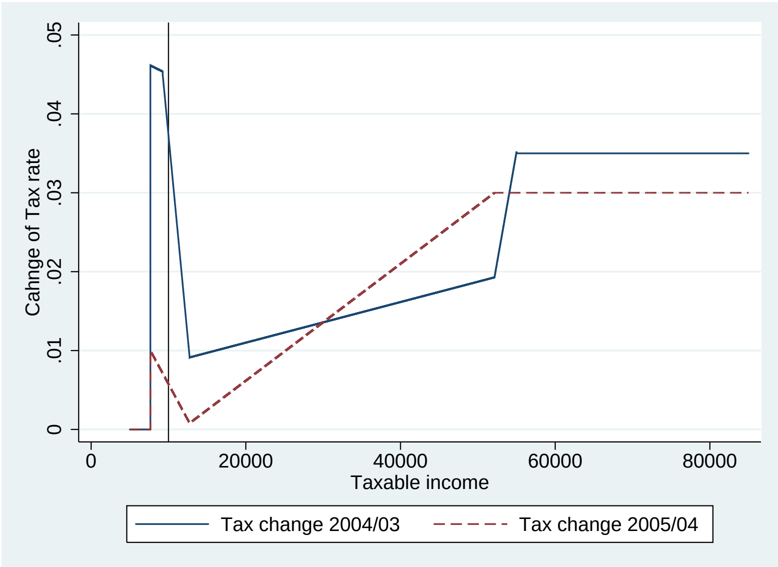


Figure 2.2 shows the tax rate changes in absolute values along the distribution of taxable income for taxable income exceeding the basic allowance in 2004. A small range of income just above the basic allowance experienced the biggest tax cuts up to 4.6 percentage points.[19] The second biggest tax cuts were conducted on the top tax bracket. The brackets in between experienced a lower, but increasing tax cut inducing substantial exogenous tax rate variation.

[19]Results for the elasticity of taxable income are sensitive to the exclusion of taxpayers with less than 10,000 Euro taxable income. Estimates without those taxpayers increase the elasticities significantly.

Figure 2.2: Change of marginal tax rates for an individually taxed taxpayer



2.3 Data and Data Processing[20]

Relevant information generated in the process of taxation is documented in the income tax return: information on the household composition, declaration of income from different sources, granted deductions and exemptions, calculation of taxable income and personal income tax payment.[21] The German Federal Statistical Office collects the official income tax returns electronically as Income Tax Statistics, providing the basis for the German Taxpayer Panel. Individual taxpayers IDs are used to link annual cross section income tax returns over time to create the panel. It contains income tax returns of approximately 19 million observations in a balanced panel.[22] The panel is very representative for top and medium incomes and includes a high share of low incomes who are likely not to file

[20]The first half of this section is taken from an earlier joint work with Nima Massarrat-Mashhadi (see Massarrat-Mashhadi and Werdt (2012)).

[21]German tax data only includes tax relevant information. Further demographic information like education, profession, parents income or wealth are not available.

[22]The German Taxpayer Panel does not include tax returns which are only available for a subset of years and are not consistently linkable. I assume that the probability of being included in the sample is random and uncorrelated with income and especially with income growth. This might be a strong assumption, however, confidential restrictions do not allow to match the data with other data to test this assumption.

a tax return in all six years of the data.[23] Unfortunately, German wage earners might be underrepresented, since they were not forced to file tax return unless they have other additional incomes.[24] Taxpayers with demographic changes such as marriage or divorce are also only partially included.[25] In some cases, taxpayers that move from one state to another might also change their taxpayers ID and are not consistent linkable. Several socio-demographic characteristics of taxpayers, such as age, number of children, church membership and marital status are observable. A sample of 5% is drawn and made available for scientific purposes, based on four stratification criteria, i.e. federal state, assessment type, main type of income and total income. High incomes above 150,000 mean income are highly over-sampled and 85% of those are included in the 5% sample. The stratification procedure aims to optimize the sample with regard to standard errors of total income over time. Observation weights are generated accordingly.[26]

The sample for the analysis consists of three one-year-pairs, pooling the years with the income growth from 2003 to 2004, 2004 to 2005 and 2005 to 2006.[27] Each pair consists of 928,993 taxpayers resulting in a balanced panel of 2,786,979 observations. Results are dawn from a sub-sample which excludes observations according to three categories: (1) observations which do not satisfy technical model requirements: models in the literature of taxable income elasticity are based on log-log specifications, accordingly negative incomes are not defined, which deletes 455,193 observations.[28] (2) Taxpayers that do not pay taxes in the base year $t-1$ and in year t, thus have marginal tax rates of zero, are excluded. That reduces the sample by 383,015 observations.[29] (3) Taxpayers with severe demographic changes such as marriage, divorce or one-time exceptional profits are

[23] Jenderny (2014) compares the panel data with the cross sectional basis and shows that only incomes close to zero are low represented in the data.

[24] Cross sectional tax data from 2004 already includes all wage earners even when they did not file a tax report. Now, employers have to report wage income of their employees electronically to the tax authorities, but were not forced to in earlier years.

[25] This has two reasons: (1) only one person of the married couple keeps the individual taxpayer ID after marriage or divorce and is consistent linkable. In most cases, this is the primary earner. (2) sometimes the individual taxpayers IDs are newly created or changed and not consistently linkable.

[26] These weights allow to infer properties of the full balanced panel with the 19 million observations but are not designed to make projection for the whole German population.

[27] The data starts in 2001, the regression model in section 2.4.2 does not permit earlier year pairs.

[28] One way to avoid that selection mechanism would be the calculation of arc-elasticities instead. This, however, is not standard in the literature and I refrain from doing that.

[29] This is standard in the literature of taxable income and I assume that this exclusion is random and does not correlate with income growth. Moreover, results confirm that this selection is not crucial.

also excluded, deleting 260,786 observations and leaving a sample of 1,690,685.[30] This exclusion is innocuous and results including these observations are virtually unchanged and not different from results without these observations.

2.4 Econometric Specification

This section discusses the model by Gruber and Saez (2002) and compares it to an alternative model introduced in this section.

2.4.1 Gruber and Saez

Gruber and Saez's (2002) model is a generalization of Auten and Carroll (1998). In this model the individual taxpayer's income growth rate $ln\left(\frac{y_{it}}{y_{it-1}}\right)$ is estimated by the growth rate of the net-of-tax rate $ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)$ with elasticity of taxable income β, demographic characteristics from the base year W_{it-1} to control for heterogeneity of taxpayers with coefficient vector γ,[31] base year income $ln(y_{it-1})$ with elasticity ρ_1 controlling for heterogeneous income trends and constant c.[32]

$$ln\left(\frac{y_{it}}{y_{it-1}}\right) = \beta ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right) + \rho_1 ln(y_{it-1}) + \gamma W_{it-1} + c + \epsilon_{it} \tag{2.1}$$

ϵ_{it} is the individual residual in period t and assumed to be independent of the control variables W_{it-1} and $ln(y_{it-1})$ and uncorrelated over time. The literature widely recognizes that the net-of-tax rate is endogenous for a progressive tax schedule and 2SLS regressions are applied.[33] Gruber and Saez (2002) simulate an instrument based on the counterfactual growth rate of the net-of-tax rate which is strongly correlated with the endogenous

[30] Furthermore, a small group of taxpayers that are not fully taxable, because they do not live in Germany for instance are excluded.

[31] See Table 2.A.1 for a depiction of the control variables.

[32] Gruber and Saez (2002) modify this model by using 10 piece-wise linear splines of base year income instead base year income.

[33] See Saez et al. (2012) for an interpretation of the endogeneity problem and different potential solutions.

variable.[34]

Note that Gruber and Saez's (2002) assumption of uncorrelated residual over time in equation (2.1) allows them to treat base year income y_{it-1} as exogenous and as source for the simulation of the counterfactual net-of-tax rate.[35] Appendix (2.7.1) presents a possible level equation of Gruber and Saez's (2002) model that satisfies that assumption. However, the assumption of uncorrelated residuals over time is potentially violated in two cases: (1) if equation (2.1) is nevertheless in first differences and so are residuals which then follow a moving average process of at least order one. Moreover, this also implies that base year income systematically correlates with the residuals and would be endogenous. Weber (2014) shows in great detail that the endogeneity of base year in equation (2.1) is inevitable if it follows from first differences and cannot be avoided using instruments based on the base year, regardless of additional functional forms of the base year income controls.[36] (2) if income follows an individual fixed effect but equation (2.1) is not in first difference, the fixed effect would be embedded in the residuals which would then have significant serial correlation and high correlation with base year income.

2.4.2 An alternative approach

To introduce the alternative model, equation (2.2) presents the level equation of individual income y_{it} for period t. Income follows an individual fixed effect i, its own lag, base year income y_{it-1} with elasticity ρ_2, the net-of-tax rate $1 - \tau_{it}$ with elasticity β, a linear time trend t with coefficient c and current demographic characters W_{it} with a vector of coefficients γ_1. To allow for a dynamic influence of demographic characteristics, income

[34] This is done by deriving a counterfactual income for year t by inflating the individual base year income y_{it-1} and computing tax rates using the tax schedule of year t. To avoid that taxpayers with the same taxable income in the base year have the same counterfactual growth rate, incomes and taxable deductions are inflated by different growth rates. Income is inflated by using the GDP growth rate and individual deductions are inflated by using the consumer price index.

[35] See Gruber and Saez (2002), page 10 ff. with a detailed discussion of the potential endogeneity of base year income. Gruber and Saez argue that using an appropriate functional form of base year income solves all endogeneity problems and also controls for mean reversion. Growth rates of the inflation rate and the GDP are obtained from the German federal statistical office and can be downloaded at `https://www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/VGR/Inlandsprodukt/Inlandsprodukt.html`.

[36] To overcome this, Weber (2014) proposes the usage of higher lags of base year income as source for the instruments. Weber's (2014) specification includes income controls from the first and second lag of base year income.

also follows W_{it} interacted with the time trend t and coefficient vector γ_2.[37]

$$ln(y_{it}) = i + \beta ln(1-\tau_{it}) + \rho_2 ln(y_{it-1}) + \gamma_1 W_{it} + t \cdot (c + \gamma_2 W_{it}) + \epsilon_{it}{}^{38} \tag{2.2}$$

ϵ_{it} is the individual residual in period t and assumed to be independent of the control variables in W_{it} and $ln(y_{it-1})$ and uncorrelated over time.

Taking first differences eliminates the individual fixed effect and the estimation model becomes:

$$ln\left(\frac{y_{it}}{y_{it-1}}\right) = \beta ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right) + \rho_2 ln\left(\frac{y_{it-1}}{y_{it-2}}\right) + (\gamma_1 + t\gamma_2)\Delta W_{it} + c + \gamma_2 W_{it-1} + \Delta\epsilon_{it} \tag{2.3}$$

Now, the growth rate of the net-of-tax rate and the lagged income growth correlate systematically with ϵ_{it-1} and are endogenous.
Equation (2.3) estimates income growth in several aspects differently than Gruber and Saez's (2002) equation (2.1) does. First, equation (2.3) depends on the endogenous lagged income growth instead of the assumed exogenous base year income. Second, residuals in equation (2.3) follow a moving average process of order one instead of residuals assumed to be only from period t. Third, due to the endogeneity of base year income, a higher lag of base year income is used as sources for the counterfactual income and as instrument.[39]

[37]Including a dynamic influence of demographic characteristics controls for heterogeneous income growth and increases comparability between the alternative model and the Gruber and Saez's 2002 model from equation (2.1).

[38]This model is a special case of the model of Holmlund and Söderström (2011) if γ_2 is zero. Their model also includes the lagged net-of-tax rate and the demographic control variables from period t and period $t-1$.

[39]Instruments for the net-of-tax growth rate are computed analog to the procedure by Gruber and Saez (2002) introduced in the previous subsection. Source for the counterfactual net-of-growth rates are the lagged individual base year income y_{it-2} and the second lag of base year income y_{it-3}. The instruments for the lagged income growth is the lag of individual base year income y_{it-2} and the second lag of income growth $ln\left(\frac{y_{it-2}}{y_{it-3}}\right)$.

2.5 Results

Note: the data I use is not a random draw, but a 5% stratified sample (see section 2.3 for a description). To control for the non-random properties of the data, results in this section are estimated with the stratification criteria as control variables.[40] Results are computed on a constant definition of taxable income, based on the tax law from 2001.[41] This section presents results according to the modeling section, starting with results for Gruber and Saez's (2002) model from equation (2.1) presented in Table 2.2. Subsequently follow results for the alternative model from equation (2.3) presented in Table 2.3 including an extensive sensitivity analysis of the model in Table 2.4.

In Table 2.1, some mean values and standard deviations (in brackets) of the sample are presented. The table is divided into two panels, the left panel shows average values for the sample without weighting factors, the right panel presents average values for weighted observations. Taxable income is very high in the unweighted sample with an average of 141,706 Euro and weighted clearly smaller with an average of 43,854, which reflects the strong over-sampling of the high taxpayers. Average values for the income growth, average tax rate the net-of-tax rates are also smaller for the weighted observations. The average age of the taxpayer is 47, 61% are married, 2.4% of taxpayers have newborn children and 0.4% change their residency from one federal state to another.

[40] See Solon et al. (2013) for an extensive discussion about estimating causal effects in non random sample and an evaluation of the usage of sample weights.

[41] All changes of the definition of taxable income between 2002 and 2006 are corrected as long as the data allows for a consistent correction. This includes annual child allowances which were increased from 2556 Euro per year and child to 2904 Euro per year and child, allowed expenses for non-itemizing employees which were reduced from 1044 Euro to 920 Euro, allowances for single parents which were cut from 2871 Euro to 1308 Euro and capital gain exemptions which were reduced from 1550 Euro to 1370 Euro per year. I assume that these changes only induce mechanical reactions and do not affect the measured elasticity of taxable income.

Table 2.1: Descriptive Statistics

	Unweighted	Weighted
	Mean (Std. Deviation) (1)	Mean (Std. Deviation) (2)
Taxable income	141706	43854
	(948274)	(204818)
Average tax rate	.365	.311
	(.088)	(.069)
Income growth	.035	.015
	(.397)	(.247)
Net-of-Tax Rate	.023	.012
	(.063)	(.049)
Counterfactual Net-of-Tax Rate Based on y_{it-1}	.022	.010
	(.029)	(.019)
Counterfactual Net-of-Tax Rate Based on y_{it-2}	.019	.010
	(.031)	(.020)
Counterfactual Net-of-Tax Rate Based on y_{it-3}	.022	.009
	(.030)	(.022)
	Demographic control variables	
Age	49.98	46.82
	(41.75)	(32.98)
Married Dummy	.67	.61
	(.473)	(.489)
New Child Dummy	.023	.024
	(.163)	(.162)
Change of State Dummy	.024	.004
	.058	(.066)
Number of observations	1,690,685	37,100,000

Source: Own computation based on German Taxpayer Panel 2001-2006.

2.5.1 Regression results

Results in Table 2.2 are from 2SLS regression and serve as comparison results based on Gruber and Saez‘s (2002) model from equation (2.1). All models include further control variables for the stratification criteria (strat. controls) and demographic variables (demo. controls).[42] Table 2.2 consists of five columns, with the first three columns reproducing Gruber and Saez's (2002) model with base year income as income control and as source for the counterfactual net-of-tax rate. As argued in the previous section, base year income is likely to be endogenous, thus column (4) and (5) use lagged base year income as source for the counterfactual net-of-tax rate and lagged base year income as control.[43] Column (1) estimates the equation with 2SLS without income control, column (2) and (4) use the log of income control and column (3) and (5) use 10 piece linear splines of the income control. Results for OLS are presented in Table 2.A.3 of Appendix 2.7.4. The estimated ETI is very sensitive to the inclusion of the income controls. Results in column (1) are without income control and the estimated ETI is negative and large with -0.77. Including base year income as control variable increases the ETI significantly to 1.23 in column (2) and using 10 linear splines of base year income reduces the ETI to 0.46 in column (3).[44] Using lagged base year income and according instruments in column (4) results in an ETI of 0.91 and using splines also reduces the ETI significantly to 0.70 in column (5).

[42] Demographic control variables are age, age squared, young and old dummies, taxpayer moving the federal state (Bundesland), taxpayer with newborn children, two earner taxpayers, handy-capped taxpayers, single parents taxpayers, and retired taxpayers. Variables controlling for the stratification are income from the first year of the data and dummies for joint tax filing and for tax code related main income source. Additionally all regressions include time dummies. See Table 2.A.1 for a detailed description.

[43] These specifications are also conducted in Weber (2014).

[44] This is not unusual in the literature. Gruber and Saez 2002 obtain an ETI -0.462 without income control, of 0.611 with log of base year income and an ETI 0.4 with splines. Müller (2012) and Schmidt estimate for Germany an ETI of -0.189 without income control, 0.99 with the lagged income growth rate and the log of the lag of base year, and 0.32 with splines.

Table 2.2: Results for estimating the ETI from equation (2.1)

	Instruments based on $t-1$			Instruments based on $t-2$ and $t-3$	
	(1)	(2)	(3)	(4)	(5)
$ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)$	-0.748***	1.237***	0.460***	0.909***	0.701***
	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)
$ln\left(y_{it-1}\right)$		-0.145***	10 Piece		
		(0.00)	-Spline		
$ln\left(y_{it-2}\right)$				-0.041***	10 Piece
				(0.00)	-Spline
D new child	-0.002	0.002	-0.002	-0.003	-0.004
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D change of state	0.082***	0.087***	0.083***	0.102***	0.093***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
D marriage	0.031***	0.100***	0.080***	0.057***	0.055***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Income 2001	-0.000	0.000***	0.000***	0.000***	0.000*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Strat. controls	Yes	Yes	Yes	Yes	Yes
Age controls	Yes	Yes	Yes	Yes	Yes
Demo. controls	Yes	Yes	Yes	Yes	Yes
	Tests of weak Instruments				
First stage F-Statistic	262353	43299	38988	20087	16959
Partial R^2	.134	.071	.065	.038	.032
	Test of Moving Average				
Arellano-Bond test, order 1	-265	-187	-93	-107	-105
(p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Arellano-Bond test, order 2	-20	31	-11	-3.07	-5.33
(p value)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
Number of Observations	1690685	1690685	1690685	1690685	1690685

Notes: * p<0.05, ** p<0.01, *** p<0.001. All regressions include a constant and year dummies. Sample control variable are dummy variables for main income source and dummy controls for the level of income in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Demographic control variables are dummy variables for single parents, handicapped taxpayers, two earner taxpayers, retired taxpayers and non-taxable income. Partial R^2 is the partial R-squared for the growth rate of the net-of-tax rate, see Shea (1997) and Godfrey (1999) for a description. The Arellano-Bond tests for first-order and second-order of moving average is asymptotically N(0,1) distributed.
Source:Own computation based on German Taxpayer Panel 2001-2006.

Results of the F-statistic and the partial R^2 confirm that instruments in the first stage are strong in all regressions and the weak instrument problem is not a threat. The F-statistics are very high with values above 10,000 in all specifications and the partial R^2 is high in all columns but (5).[45] However, the Arellano-Bond tests of moving average reject

[45]The F-statistic and the partial R^2 are the two most common used criteria for assessing the instrumental strength in single endogenous models. Critical values of the F-test statistic are around 20

the null hypothesis of no serial correlation for the first and for the second order. The Arellano-Bond test is asymptotic standard normal N(0,1) distributed, test values exceed critical values at all significance levels and p values are 0 in all specifications.[46] This confirms, for the German case, that neither base year income nor lagged base year income are exogenous and valid income controls for a model of type equation (2.1). Moreover, these results indicate that standard tests of instrumental validity such as the Sargan Test (1958) are potentially misleading if instruments are based on lagged dependent variables.[47]

Table 2.3 reports 2SLS regression results for the regression model in equation (2.3). Column (1) shows results for a restricted income growth model, setting the influence of lagged income to zero $\rho_2 = 0$[48], column (2) allows ρ_2 to differ from zero and is the benchmark result that follows directly from equation (2.3). Column (3) is a sensitivity check estimating equation (2.3) only with a subset of control variables, column (4) adds a selection control following Heckman (1979) using W_{it-1} and indicator variables from the first year of the panel as exclusion restrictions, columns (5) and (6) are a reproduction of the benchmark equation but without taxpayers with the highest 1% incomes in (5) and without taxpayers with base year income below 10,000 Euro in (6). The ETI in the restricted specification in column (1) is relatively small with 0.03 and insignificant but positive. First stage results suggest that the 2SLS estimation is not likely to suffer from a weak instrument problem and instruments for the net-of-tax rate are strongly correlated, confirmed by the partial R^2 of 0.065 and the F-statistic of 59,230.

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depending on the size and power of the test, see Stock and Yogo (2002) for a derivation of critical test values. However, the F-statistic can be misleading in large samples. The F-statistic measures the reduction in the sum of squared residuals (RSS) when adding the instruments and increasing the number of explanatory variables. With increasing sample size, this statistic could become significantly different from zero even for weak instruments. In contrast, the partial R^2 is independent of sample size and measures the additional explained variance of the instruments on the endogenous variable, see Shea (1996) and Godfrey (1999) for an introduction to the measure.

[46] See Arellano and Bond (1991) for an introduction of the test.

[47] Weber (2014) proposes the use of the Sargan Test to test for endogeneity of the instrument based on base year. However, the Sargan Test is conditional on the validity of the other instruments, which would be problematic if the other instruments are based on higher lags of base year income and residuals have a high persistence in the residual autocorrelation structure.

[48] This specification corresponds to a level equation of income independently of lagged income and equals the benchmark model from Weber (2014).

Table 2.3: Results for estimating the ETI from equation (2.3)

	(1)	(2)	(3)	(4)	(5)	(6)
$ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)$	0.032	0.364***	0.307***	0.340***	0.362***	0.561***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$ln\left(\frac{y_{it-1}}{y_{it-2}}\right)$		0.117***	0.116***	0.088***	0.121***	0.076***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D new child	0.014***	-0.003	0.016***	0.015***	-0.003	-0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
D change of state	0.122***	0.091***	0.109***	0.105***	0.091***	0.060***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
D marriage	-0.001*	0.039***	0.003***	0.003***	0.040***	0.042***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Income 2001	-0.000**	-0.000	-0.000	-0.000	-0.000***	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
λ				0.026***		
				(0.00)		
Strat. controls	Yes	Yes	Yes	Yes	Yes	Yes
Age controls	Yes	Yes	Yes	Yes	Yes	Yes
Demo. controls	Yes	Yes			Yes	Yes
	Tests of weak Instruments					
First stage F-Statistic	59230	18890	19088	19700	18367	20418
Partial R_1^2	.065	.055	.056	.057	.053	.059
Partial R_2^2		.154	.147	.084	.164	.173
	Tests of Moving Average					
Arellano-Bond test, order 1	-223	-165	-159	-126	-166	-155
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Arellano-Bond test, order 2	-15	-0.93	2.65	-0.360	-0.379	-4.67
(p-value)	(0.000)	(0.353)	(0.008)	(0.69)	(0.718)	(0.000)
Number of Observations	1690685	1690685	1690685	1690685	1668493	1616385

Notes: * p<0.05, ** p<0.01, *** p<0.001. All regressions include a constant and year dummies. Sample control variable are dummy variables for main income source and dummy variables for the level of income in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Age control variables in 1, 2, 5 and 6 are the full set with the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. The first difference of those control variables are included in 3 and 4. Demographic control variables are dummy variables for single parents, handicapped taxpayers, two earner taxpayers, retired taxpayers and non-taxable income. λ denotes the inverse Mills ratio from the Heckman sample selection model. The first stage F-Statistic is the Cragg-Donald Wald F statistic with critical values of 11.04 for 5% relative IV bias and 16.87 for 10% IV size, source Stock and Yogo (2005). Partial R_1^2 is the partial R-squared for the growth rate of the net-of-tax rate, Partial R_2^2 is the partial R-squared for the lagged income growth, see Shea (1997) and Godfrey (1999) for a description. The Arellano-Bond tests for first-order and second-order of moving average is asymptotically N(0,1) distributed.
Source:Own computation based on German Taxpayer Panel 2001-2006.

However estimates from this restricted model in column (1) have to be viewed with caution. The Arellano-Bond tests of moving average reveal significant negative first- and negative second-order autocorrelation in the residuals. This implies potential model misspecification which could be induced by restricting the influence of lagged income zero.

Including lagged income growth in column (2) increases the estimated ETI to 0.36, with a positive and significant coefficient of the lagged income growth with 0.12. Note that equation (2.3) contains more than one endogenous variable once lagged income growth is included, increasing the number of endogenous variables to two. In the case of multiple endogenous variables both Shea's partial R^2 and the standard F-statistic can be problematic when assessing the instrumental validity.[49] The Cragg-Donald F-test can be used in the case of multiple endogenous variables to test if the instruments strongly correlate with the endogenous variables.[50] Checking nevertheless first stage statistics, show high partial R^2s of 0.055 and 0.154 and a large F-statistic with 18,890. Table 2.A.2 presents further descriptive results for the instrumented net-of-tax rate and compares them to descriptive results for the net-of-tax rate. The first order moving average test is significant and negative, but the second order with a p-value of 0.35 is insignificant at any conventional significance levels.[51]

Column (3) is a robustness check restricting lagged demographic variables of equation (2.3) to zero by setting $\gamma_2 = 0$. Thus, now control variables are only included in first differences.[52] Column (3) shows that demographic control variables have little influence on the measured ETI and the lagged income growth. Both are only slightly smaller with an ETI of 0.31 and lagged income elasticity of 0.12. First stage results change only little with partial R^2s of 0.056 and 0.146 and the F-statistic of 19,080.

As described in section (2.3), results are based on a selective sub-sample of taxpayers. Arguably the most crucial selection is that only taxpayers with taxable income exceeding the basic allowance in base year $t-1$ and year t are included. This serves two purposes: it excludes taxpayers with marginal tax rates equal zero in t or $t-1$ and it excludes

[49] Valid IV estimation needs at least as many instruments as endogenous variables. However, both the F-statistic and the partial R^2 are estimated for joint validity of all instruments and will have high test values once at least one of the instruments is strong, even when the other is not.

[50] The Cragg-Donald F-test is equal to the F-test in the case of one endogenous variable. The test uses canonical correlations, testing the smallest canonical correlation between the set of instruments and the set of endogenous variables.

[51] This is consistent with residuals uncorrelated over time in the level equation (2.2).

[52] However, most models in the literature of the elasticity of taxable income use demographic variables to control for the heterogeneity between different types of taxpayers. Excluding the demographics reduces the comparability to Gruber and Saez's (2002) model in equation (2.1). See Table 2.A.1 for a description of all control variables.

taxpayers with potential high mean reversion unrelated to the tax reform. However, that non-random selection might bias the estimation result of the elasticity.

Column (4) demonstrates the effect of controlling for the non-random selection by including the inverse Mills ratio λ from a Heckman selection control estimation.[53] The inverse Mills ratio is small but significant with an estimate of 0.03. However, including the selection control does not have a statistically significant effect on the estimated ETI with 0.34. That estimate is not different from the estimated ETI in column (2) with 0.36 and the elasticity in column (3) with 0.31. Hence, I assume that results are not source to a selection bias and the alternative model from equation (2.3) in column (2) is consistently estimated for the German case.

Bach et al. (2009) document that top incomes in Germany had dramatic income increase by partially more than 50% between 2001 and 2005. Moreover, there is a large literature estimating income responses to taxation only for the top incomes (see Saez et al. 2102). This is motivated by two aspects of taxpayers with high incomes: (1) a special interest in the responses of the group of taxpayers paying the most taxes[54], (2) taxpayers at the top might substantially differ from the remaining taxpayers which might be hard to control in this type of model. To control for the influence of top incomes in an easy way, results in column (5) are estimated on a sub-sample that excludes taxpayers who belong to the top 1% of taxable income which excludes 22,192 observations. Results are not sensitive to this selection and are virtually unchanged with an ETI of 0.36 and the lagged income growth of 0.12.[55]

Most studies of the elasticity of taxable income literature exclude the lowest incomes from their sample.[56]

[53]See Heckman (1978) for an introduction to the model. To compute the selection control λ, the selection equation needs so employ valid and strong exclusion restrictions. I use the demographic control variables also excluded in column (3) as exclusion restrictions in column (4). Furthermore I produce indicator variables from the first year of the panel: (1) Indicator for the number of different income sources, (2) the variance of the incomes between the income sources and (3) an indicator for negative incomes are used as exclusion restrictions.

[54]Note that the German income tax schedule arrives at the top marginal tax rate at a taxable income of approximately 52,000 Euro. The top 10% of incomes in Germany, however, have already an average annual income of 83,400 Euro between 1992 and 2001 (see Bach et al. 2009). Calculating an ETI just for top incomes in Germany with my data would suffer from very low variation and most incomes would face the same tax rate change and the ETI would simply be a constant.

[55]Excluding only taxpayers with top 0.1% of taxable income gives even more similar results.

[56]This has two reasons. One reason is that mean reversion is supposed to be strongest at the lower end of the income distribution. Another reason is that most recent tax reforms lowered the tax rate for

As a robustness check in column (6), I employ a strong selection on lower incomes and exclude taxpayers with base year income below 10,000 Euro. This reduces the number of observations by 74,300 to 1,616,385.[57] Results for the ETI and the lagged income growth change significantly: the ETI is now 0.56 and the lagged income growth decreases to 0.08. This raises some doubt about appropriateness of this strong selection and suggests that this result is driven by selection bias.
This strong selection is copied from another recent study for Germany by Müller and Schmidt (2012). Their results are remarkably similar to my benchmark results with an ETI of 0.32. However, when applying their selection criteria, my results differ severely. Müller and Schmidt (2012) differ from this study in four other aspects: (1) the authors employ the specification by Kopczuk (2005), an approach based on the Gruber and Saez (2002) model. Thus, their results might suffer from serial correlation, which the authors also acknowledge but do not provide test results to support their model. (2) The authors estimate the model on the popular three years lag basis, which however potentially induces serial correlation of a higher order. (3) Following Gruber and Saez (2002), the authors only report weighted regression results.[58]

Comparing my results for Germany with results from the US is challenging due to the wide range of results, with values between 0.12 and 1 (see Saez et al. 2012).

A recent study by Weber (2014) estimates high values of ETI for the US with an approach similar to my model.[59] Weber's baseline result for the elasticity of taxable income is 0.86, thus more than twice the size of the German ETI. This could be related to the fact that the German welfare state is generally more redistributive than the US welfare state. It would be interesting to compare US results to the German results for an income elasticity to a joint measure of taxes, transfers and social security contributions. Transfers and social securities are especially high at the lower end of the German income distribution, including transfer withdrawal rates of 80 and 90%, with implicit marginal

the top incomes but kept tax rates for the lower and middle part of the distribution constant. Dropping the lowest part of the sample, serves then comparability between the treatment and the control group in the sense of a difference-in-difference estimation.

[57] Despite including a potential selection bias with this exclusion of the lowest taxpayers, this also excludes the group of taxpayers with the highest tax rate changes, see Figure 2.2.

[58] This might produce inconsistent results when one tries to estimate causal effects, see Solon et al. (2012) for an extensive discussion about weighting factors in regressions.

[59] Section 2.7.2 in the Appendix presents Weber's (2014) model and results from column (1) correspond to Weber's baseline model.

tax rates near one. Such an income elasticity would have a pronounced relevance on the governmental budget and extents the picture from tax revenue to tax-transfer revenue.[60]

The following Table 2.4 presents 2SLS result for further sensitivity checks of the benchmark result from the alternative model of equation (2.3) in two dimensions, one is the usage of a non-linear income control with 10 linear piece splines, the second is the separation of the elasticity of taxable income for married and for single taxpayers. Column (1) of Table 2.4 is a reproduction of column (2) of Table 2.3 and is the benchmark result with an elasticity of taxable income of 0.36. Column (2) uses a non-linear function of the lagged income growth with a 10 piecewise linear splines.[61] Gruber and Saez (2002) were the first in the literature of taxable income elasticity to use splines as non-linear income control and its usage has become popular in most papers.[62] The ETI in column (2), including the non-linear income splines, is 0.44 with high standard errors of 0.06 and is not statistically different from the benchmark elasticity with 0.36. However, using splines on lagged income growth in the alternative model of equation (2.3) increases the number of endogenous variables to 11.[63] First stage statistics raise concern about a weak instrument problem which questions the liability of results in column (2): the F-statistic has a value of 1 which is very low for 11 endogenous variables and 1,690,685 observations.

[60]See a similar approach by Bartels (2013) computing long-term participation tax rates for Germany and their influence on work incentives.

[61]Break points and distribution of the splines are based on the lagged income growth using the Stata command *mkspline*.

[62]See for instance Weber (2014), Heim (2009), Kopczuk (2005) and Giertz (2007) using 10 piecewise linear splines of income controls in their estimations.

[63]Instruments for the 10 splines are the 10 linear splines of the second lagged income growth.

Table 2.4: Sensitivity results for estimating the ETI from equation (2.3)

	(1)	(2)	(3)	(4)	(5)
$ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)$	0.364***	0.441***			
	(0.02)	(0.06)			
$ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)_{single}$			0.170***	0.166***	0.408***
			(0.03)	(0.03)	(0.03)
$ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)_{married}$			0.442***	0.439***	0.619***
			(0.03)	(0.02)	(0.03)
$ln\left(\frac{y_{it-1}}{y_{it-2}}\right)$	0.117***	10 Piece	0.114***	0.119***	0.074***
	(0.00)	-Spline	(0.00)	(0.00)	(0.00)
D new child	-0.003	0.009	-0.003	-0.003	-0.002
	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
D change of state	0.091***	0.157***	0.088***	0.087***	0.058***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
D marriage	0.039***	0.033***	0.033***	0.034***	0.037***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Income 2001	-0.000	0.000	-0.000	-0.000***	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Strat controls	Yes	Yes	Yes	Yes	Yes
Age controls	Yes	Yes	Yes	Yes	Yes
Demo. controls	Yes	Yes	Yes	Yes	Yes
	Tests of weak Instruments				
First stage F-Statistic	18890	1.01	11960	11587	12897
Partial R_1^2	0.055				
Partial R_{11}^2			0.07	0.068	0.074
Partial R_{12}^2			0.082	0.080	0.086
Partial R_2^2	0.154		0.150	0.161	0.170
	Tests of Moving Average				
Arellano-Bond test, order 1	-165	-14	-162	-163	-153
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Arellano-Bond test, order 2	-0.93	1.92	-1.10	-0.536	-4.82
(p-value)	(0.353)	(0.054)	(0.273)	(0.592)	(0.000)
Number of Observations	1690685	1690685	1690685	1668493	1616385

Notes: * $p<0.05$, ** $p<0.01$, *** $p<0.001$. All regressions include a constant and year dummies. Sample control variable are dummy variables for main income source and dummy variables for the level of income in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Demographic control variables are dummy variables for single parents, handicapped taxpayers, two earner taxpayers, retired taxpayers and non-taxable income. The first stage F-Statistic is the Cragg-Donald Wald F statistic with critical values of see Stock and Yogo (2005). Partial R_1^2 is the partial R-squared for the growth rate of the net-of-tax rate. Partial R_{11}^2 is the partial R-squared for the growth rate of the net-of-tax rate for single taxpayers, Partial R_{11}^2 is the partial R-squared for the growth rate of married taxpayers. Partial R_2^2 is the partial R-squared for the lagged income growth, see Shea (1997) and Godfrey (1999) for a description.
For sake of brevity, no partial R-squared for specification (2) and (3) are reported as the number of endogenous variables increases to 6, respectively 11. The Arellano-Bond tests for first-order and second-order of moving average is asymptotically N(0,1) distributed.
Source:Own computation based on German Taxpayer Panel 2001-2006.

The German tax law discriminates heavily between married and single taxpayers. Married taxpayers can opt for the splitting tax schedule to decrease their joint taxation and marginal tax rates. Results in columns (3), (4) and (5) interact the marriage dummy with the growth rate of the net-of-tax rate to allow different elasticities for single and married taxpayers. Separating elasticities is common practice in micro-econometric analysis, for instance, in the labor supply elasticity literature.[64] Column (3) is the interaction for the whole sample with 1,690,685 observations and shows that the ETI for single taxpayers is 0.17 and significantly smaller than the ETI for married taxpayers with 0.44. The ETI of married taxpayers exceeds the elasticity of single taxpayers by 0.27, which supports separate estimations. This reflects the higher tax-planing potential of married taxpayers and could be related to the opportunity of inter-personal transfers and different utility functions of the married. The coefficients of the control variables and the lagged income growth are virtually unchanged. First stage statistics are high with a F-statistic of 11960 and partial R^2s above 5%.[65] Column (4) and (5) are results from the selective samples and serve as comparison to the results from column (3). Results in column (4) show that the separated elasticities of married and single taxpayers are not sensitive to the exclusion of the top 1% taxable income. The elasticity for the married is 0.44 and the elasticity for single taxpayers is 0.17. Results are not statistically different from the results of the full sample in (3) and first stage statistics indicate strong instruments.

Column (5) shows the reproduction of the selection of column (6) from Table 2.3 for the separation of the ETI for married and single taxpayers by deleting taxpayers with taxable income below the 10,000 Euro in the base year $t-1$. The ETIs are again significantly higher than in the benchmark results in column (3) with an elasticity of 0.62 for married taxpayers and an elasticity of 0.41 for single taxpayers. These estimates confirm the evidence for selection bias that is caused by the the income cut off at the lower end of the income distribution.

[64] Bargain et. al (2012) provide a survey of recent labor supply elasticities for 17 European countries and the US. The estimation and results of labor supply elasticities are divided for single and couple households.

[65] The number of endogenous variables increases to three through the interaction with the marriage dummy, all instruments for the growth rate of net-of-tax are interacted accordingly.

2.6 Conclusion

This paper provides new insights for the elasticity of taxable income for Germany. Results are based on a rich and unique German panel data for six straight years from 2001 to 2006. That data over-samples high incomes and comprises two major reforms in 2004 and 2005 that were part of a bundle of reforms, the so called *Agenda 2010*. The tax reforms induced substantial exogenous variation on personal income taxation along the whole income distribution. Marginal and average tax rates were lowered for the whole income distribution, with biggest reductions at the lower and top end of the tax bracket. The elasticity of taxable income is of particular interest for assessing tax revenue changes from tax reforms. The current paper proposes an alternative model to measure the elasticity of taxable income which avoids potential pitfalls of models from the literature. Beginning with an introduction of the most prominent model in the literature by Gruber and Saez (2002) in equation (2.1), the paper argues that results from this model might be biased in the case of residuals with significant serial correlation. For the case that Gruber and Saez' (2002) model suffers from serial correlation, an alternative model, that delivers un-biased estimates, is introduced in equation (2.3).

The Gruber and Saez (2002) model from equation (2.1) estimates an ETI of 0.46 for Germany. However, tests of residuals suggest significant serial correlation in equation (2.1) and the estimates suffer from a remaining endogeneity problem. Estimating the alternative model from equation (2.3) suggests an ETI of 0.36 for Germany. Tests of residual serial correlation show that results are consistent and do not suffer from a weak instrument problem. Results for the ETI are very robust against a number of sensitivity checks: excluding the top 1% taxable incomes, the amount of control variables and non-linear income controls.

My result for the ETI of 0.36 is remarkably similar to results from a recent study by Müller and Schmidt (2012). Which is surprising, since Müller and Schmidt (2012) differ in various important aspects from my study. However, when I reproduce their sample selection, my result for the ETI increases significantly to 0.56. This questions the validity of that selection and supports the presence of a selection bias in their results. Accounting for the heavy tax favoring of married taxpayers compared to single taxpayers, the elasticity of taxable income is also estimated separately for both types of taxpayers. Married taxpayers have a larger ETI of 0.44 than single taxpayers with 0.17. The difference of the ETI between the married and single is robust against the exclusion of the top 1% taxable incomes or exclusion of low taxable incomes.

The ETI for Germany with 0.36 is significantly lower than recent results for the USA from Weber (2014). Employing a model similar the alternative model from equation (2.3), Weber finds an ETI of 0.86 which exceeds my result by 0.5.

This paper provides reactions to the change of taxation for an income concept that is defined by the tax code. Employing the same model for a more general income concept like some gross income concept would be fruitful and add another perspective of behavioral responses to taxation for future research. Moreover, this is common practice in the literature, for instance, Gruber and Saez (2002) find an insignificant elasticity of broad income to changes in taxation.

Another aspect of future research would be the inclusion of transfer withdrawal rates. The German welfare state is very redistributive and provides significant income insurance. This induces very high transfer withdrawal rates for low incomes of 80 and 90% and implicit marginal tax rates near one. An elasticity of taxable and transfer income would be worthwhile to estimate and compare it to the elasticity of taxable income. Unfortunately, German tax data are not as representative for lower incomes than they are for top incomes and do not allow to derive the full household context necessary to compute transfers. Survey panel data like the SOEP are very representative at the lower end of the income distribution and allow to include the household context of taxpayers.[66] This comes with the price of of low representativity of top incomes. Matching both data sources would be an obvious instrument to capture the entire German income distribution. Confidentiality restrictions, however, do not allow to combine the data and use it as one. Furthermore, in 2006/07, the marginal top tax rate was increase again to 45%, while the remaining tax schedule was unchanged. Employing model (2.3) on data for the years until 2007 would be an interesting and important result since taxpayers with top

[66] A promising opportunity of the SOEP would be usage of the tax and transfer simulation model STSM provided by DIW, see Steiner et al. (2012) for a documentation of the STSM.

incomes contribute the most tax revenue in Germany.

2.7 Appendix

2.7.1 The Level Equation of Gruber and Saez (2002)

An underlying level equation to Gruber and Saez's (2002) model, in which residuals are not serial correlated, can look like:

$$ln(y_{it}) = \beta ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right) + (1+\rho_1)ln\left(y_{it-1}\right) + \gamma W_{it-1} + c + \epsilon_{it} \tag{2.4}$$

Since residuals are not in first difference and do not follow a moving average process, base year income is exogenous and a valid control and valid source for the instrument. However, note two things about this model: first, income follows its own lag with coefficient $(1+\rho_1)$ and second, the elasticity of taxable income, β, depends on the growth rate of the net-of-tax rate rather than on the net-of tax rate.[67]

2.7.2 Weber's (2014) model

A recent model by Weber (2014) is based on the decomposition of individual income of period t y_{it} into a permanent μ_i, transitory η_{it} and an income component that depends on the net-of-tax rate $(1-\tau_{it})$ with elasticity β:

$$ln(y_{it}) = \beta ln(1-\tau_{it}) + ln(\mu_i) + ln(\eta_{it}) \tag{2.5}$$

Taking first differences, assuming that permanent income is time invariant, delivers the following estimation model:

$$ln\left(\frac{y_{it}}{y_{it-1}}\right) = \beta ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right) + \Delta ln(\eta_{it}) \tag{2.6}$$

[67]Gruber and Saez (2002) derive the elasticity of taxable income from a consumption model and result to an estimation question quite different from this.

Weber (2014) estimates this equation also with additional control variables including lagged base year income, or splines of lagged base year income. Weber (2014) discusses the serial correlation of the transitory income in great detail and tests instrumental validity with the help of over-identifying restrictions. Since base year income y_{it-1} systematically correlates with the $\Delta ln(\eta_{it})$, it is endogenous and is not a valid instrument. Weber (2014) uses the Sargan Test (1958) to show the endogeneity of instruments created from base year income. Over-identifying restrictions are drawn from instruments based on higher lags of base year income. However, this is potentially problematic if higher lags of base year income also correlate with $\Delta ln(\eta_{it})$. This would be the case if, for instance, transitory income follows a moving average of order one. Then the first difference of transitory income also systematically correlates with the lag of base year income y_{it-2} through η_{it-2}:

$$\Delta ln\left(\eta_{it}\right) = \theta_1 ln\left(\frac{\eta_{it-1}}{\eta_{it-2}}\right) + ln\left(\frac{\varsigma_{it}}{\varsigma_{it-1}}\right)$$

with θ_1 as the coefficient of persistence of the transitory income and ς_{it} and ς_{it-1} as uncorrelated innovations. Once θ_1 is of considerable size, also other higher lags of base year income would correlate with the residuals and be endogenous.

A simple way to avoid this endogeneity problem is by using the lagged income growth as further control variable in equation (2.6):

$$ln\left(\frac{y_{it}}{y_{it-1}}\right) = \rho ln\left(\frac{y_{it-1}}{y_{it-2}}\right) + \beta ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right) + \Delta ln(\eta_{it})$$

In case there was no tax reform in the year between lagged base year and base year, lagged income growth $ln\left(\frac{y_{it-1}}{y_{it-2}}\right)$ corresponds to $ln\left(\frac{\eta_{it-1}}{\eta_{it-2}}\right)$ and lagged base year income y_{it-2} is not endogenous anymore and a valid instrument. This specification corresponds to my alternative model from equation (2.3).[68]

2.7.3 Control variables

A detailed description of construction of the sample is available upon request.[69]

[68] This special case of Weber's (2014) model differs from equation (2.3) regarding the control variables, which however could easily be adjusted.

[69] Business activity includes taxable income from agriculture and forestry, from unincorporated business enterprise and from self-employed activities.

Table 2.A.1: Coding and Construction of control variables

D new child	Taxpayer has a new child between base year $t-1$ and year t	Dummy (1 = yes; 0 =no)
D change of state	Taxpayer moves from one federal state to another between base year $t-1$ and year t	Dummy (1 = yes; 0 =no)
	Stratification controls	
D marriage	Taxpayer is a married couple	Dummy (1 = yes; 0 =no)
Income 2001	Taxpayers gross income in 2001	In level
D_1 main income	Dependent employment is main income source	Dummy (1 = yes; 0 =no)
D_2 main income	Income from business activity is main income source	Dummy (1 = yes; 0 =no)
D_3 main income	Income from others is main income source	Dummy (1 = yes; 0 =no)
D_1 income 2001	Gross income in 2001 is lower 150000	Dummy (1 = yes; 0 =no)
D_2 income 2001	Gross income in 2001 is between 150000 and 1000000	Dummy (1 = yes; 0 =no)
D_3 income 2001	Gross income in 2001 is higher than 1000000	Dummy (1 = yes; 0 =no)
	Age controls	
D age	Taxpayers age	In level
D age^2	Taxpayers age squared	In level
D old	Taxpayer older than 55 in 2001	Dummy (1 = yes; 0 =no)
D young	Taxpayer younger than 21 in 2001	Dummy (1 = yes; 0 =no)
	Demographic controls	
D handicapped	Taxpayers with allowance for disability	Dummy (1 = yes; 0 =no)
D retired	Taxpayer who is retired	Dummy (1 = yes; 0 =no)
D prog	Taxpayer with non-taxable income with influence on the marginal tax rate	Dummy (1 = yes; 0 =no)
D two earner	Married taxpayers with two earner	Dummy (1 = yes; 0 =no)
D single parent	Single taxpayer with children	Dummy (1 = yes; 0 =no)
	Further controls	
Constant		
Year dummy		Dummies for 2003 and 2004

2.7.4 More Results

Descriptive Results for the Instrumentation

Table 2.A.2 shows results for the instrumentation of the net-of-tax rate in the alternative model (2.3). The descriptive results for the whole sample in the top block show that the instrumentation results to a significantly smaller variance in the instrumented net-of-tax rate than in the initial true net-of-tax rate. The middle block, however, shows that the variation of the net-of-tax rate and its instrumented version is much similar, once the top 1% and the lowest 1% of the net-of-tax rate are excluded. Furthermore, excluding the top 5% an lowest 5% of the net-of-tax rate in the lowest block shows that the instrumentation produces a similar variation of the instrumented net-of-tax rate then the true net-of-tax rate, and deviations in the top block are mainly driven from outliers.

Table 2.A.2: Instrumentation based on alternative model (2.3)

		Growth rate of Net-of-tax rate	Growth rate of Instrumented Net-of-tax rate
All	Mean	.023	.023
	Std	.063	.028
	N	1690685	1690685
p(99)$<$ and $>$P(1)	Mean	.023	.023
	Std	.049	.028
	N	1656871	1656871
p(95)$<$ and $>$P(5)	Mean	.023	.023
	Std	.035	.028
	N	1521616	1521616

Source: Own computation based on German Taxpayer Panel 2001-2006.

Results from OLS

Table 2.A.3: Comparing OLS with 2SLS

	(1)	(2)	(3)	(4)
	OLS		2SLS	
$ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)$	-4.668***	-4.655***	0.307***	0.364***
	(0.00)	(0.00)	(0.02)	(0.029
$ln\left(\frac{y_{it-1}}{y_{it-2}}\right)$	-0.076***	-0.080***	0.116***	0.117***
	(0.00)	(0.00)	(0.00)	0.00)
D new child	0.009***	0.008***	0.016***	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)
D change of state	0.010**	0.008*	0.109***	0.091***
	(0.00)	(0.00)	(0.01)	(0.01)
D marriage	-0.004***	0.011***	0.003***	0.039***
	(0.00)	(0.00)	(0.00)	(0.00)
Income 2001	0.000***	0.000***	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Strat. controls	Yes	Yes	Yes	Yes
Age controls	Yes	Yes	Yes	Yes
Demo. controls		Yes		Yes
	Tests of weak Instruments			
First stage F-Statistic			19088	18890
Partial R_1^2			.056	.0548
Partial R_2^2			.147	.154
	Tests of Moving Average			
Arellano-Bond test, order 1			-159	-164.6
(p-value)			(0.000)	(0.000)
Arellano-Bond test, order 2			2.65	-0.929
(p-value)			(0.008)	(0.353)
Number of Observations	1690685	1690685	1690685	1690685

Notes: * p<0.05, ** p<0.01, *** p<0.001. All regressions include a constant and year dummies. Sample control variable are dummy variables for main income source and dummy variables for the level of income in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Demographic control variables are dummy variables for single parents, handicapped taxpayers, two earner taxpayers, retired taxpayers and non-taxable income. λ denotes the inverse Mills ratio from the Heckman sample selection model. The first stage F-Statistic is the Cragg-Donald Wald F statistic with critical values of 11.04 for 5% relative IV bias and 16.87 for 10% IV size, source Stock and Yogo (2005). Partial R_1^2 is the partial R-squared for the growth rate of the net-of-tax rate, Partial R_2^2 is the partial R-squared for the lagged income growth, see Shea (1997) and Godfrey (1999) for a description. The Arellano-Bond tests for first-order and second-order of moving average is asymptotically N(0,1) distributed.
Source:Own computation based on German Taxpayer Panel 2001-2006.

Table 2.A.3 presents results from OLS and reproduces results from 2SLS. Column (1) and (2) are OLS results for the elasticity of taxable income, column (3) and (4) reproduces results from the alternative model from equation (2.3) from Table 2.3. Comparing results

for the elasticity of taxable income reveals the strong differences of the estimates: OLS results are very large negative with -4.67 and -4.66, depending on the amount of control variables. Hausman-Wu Tests (not reported) strongly indicate that the net-of-tax rate is endogenous and the OLS estimates are different from 2SLS results. The large negative correlation is as expected and is offspring to the progressive tax schedule which decreases the net-of-tax rate for increasing income.
Results for the lagged income growth are also very different for OLS in column (1) and (2) with -0.08 from 2SLS with 0.12.

Results with restricted sets of control variables

Results in Table 2.A.4 of equation (2.3) are with very restricted sets of control variables. The left block in column (1), (2) and (3) shows results without lagged income growth $ln\left(\frac{y_{it-1}}{y_{it-2}}\right)$. Results show very small ETI in all specification with a small but significant ETI of 0.06 in the most restrictive specification without control variables in column (1). Including control variables in column (2) and (3) results to an insignificant ETI of 0.032 in column (2) and a significant ETI of 0.06 in column (3). All results without lagged income growth need to be viewed with caution. Results for the tests of serial correlation cannot reject a moving average of at least order 2 which raises questions about the exogeneity of the employed instruments.[70] The right block of Table 2.A.4 shows results for equation (2.3) including lagged income growth without control variables in column (4), with reduced amount of control variables in column (5) and with the full set of control variable corresponding to the full model from equation (2.3) in column (6). Estimates for the ETI are positive in all specifications and increase with increasing extent of control variables. First stage statistics are high in all specifications, especially in column (4) with an ETI of 0.22. Including control variables from first differences and stratification control in column (5) presents a higher ETI of 0.31. Including all control variables in column (6) deliver an ETI of 0.36 with residuals that have no serial correlation of order 2 which corresponds to uncorrelated residuals in the level equation of the model in equation (2.2).

[70] Instruments are counterfactual net-of-tax growth rates based on lagged base year income and the second lag of base year income. If those lags of base year income are still significantly correlated with the residuals, estimates of the ETI are biased. My data comprise only six years and do not allow to include higher lags of base year income for computation of additional and alternative counterfactual net-of-tax rates.

Table 2.A.4: Results for variation of controls

	(1)	(2)	(3)	(4)	(5)	(6)
$ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)$	0.058***	0.032	0.062**	0.219***	0.307***	0.364***
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
$ln\left(\frac{y_{it-1}}{y_{it-2}}\right)$				0.105***	0.116***	0.117***
				(0.00)	(0.00)	0.00)
D new child		0.014***	-0.004*		0.016***	-0.003
		(0.00)	(0.00)		(0.00)	(0.00)
D change of state		0.122***	0.099***		0.109***	0.091***
		(0.01)	(0.01)		(0.01)	(0.01)
D marriage		-0.001*	0.035***		0.003***	0.039***
		(0.00)	(0.00)		(0.00)	(0.00)
Income 2001		-0.000**	-0.000		-0.000	-0.000
		(0.00)	(0.00)		(0.00)	(0.00)
Strat. controls		Yes	Yes		Yes	Yes
Age controls		Yes	Yes		Yes	Yes
Demo. controls			Yes			Yes
	Tests of weak Instruments					
First stage F-Statistic	192433	59230	57553	43517	19088	18890
Partial R_1^2	.185	.065	.063	.164	.056	.0548
Partial R_2^2				.136	.147	.154
	Tests of Moving Average					
Arellano-Bond test, order 1	-250	-223	-227	-171	-159	-164.6
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Arellano-Bond test, order 2	-14	-15	-21	2.59	2.65	-0.929
(p-value)	(0.000)	(0.000)	(0.000)	(0.009)	(0.008)	(0.353)
Number of Observations	1690685	1690685	1690685	1690685	1690685	1690685

Notes: * p<0.05, ** p<0.01, *** p<0.001. All regressions include a constant and year dummies. Sample control variable are dummy variables for main income source and dummy variables for the level of income in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Demographic control variables are dummy variables for single parents, handicapped taxpayers, two earner taxpayers, retired taxpayers and non-taxable income. λ denotes the inverse Mills ratio from the Heckman sample selection model. The first stage F-Statistic is the Cragg-Donald Wald F statistic with critical values of 11.04 for 5% relative IV bias and 16.87 for 10% IV size, source Stock and Yogo (2005). Partial R_1^2 is the partial R-squared for the growth rate of the net-of-tax rate, Partial R_2^2 is the partial R-squared for the lagged income growth, see Shea (1997) and Godfrey (1999) for a description. The Arellano-Bond tests for first-order and second-order of moving average is asymptotically N(0,1) distributed.
Source:Own computation based on German Taxpayer Panel 2001-2006.

Including Taxpayers with Demographic Changes

Table 2.A.5: Results including taxpayers with demographic changes

	(1)	(2)
$ln\left(\frac{1-\tau_{it}}{1-\tau_{it-1}}\right)$	0.381***	0.328***
	(0.02)	(0.03)
$ln\left(\frac{y_{it-1}}{y_{it-2}}\right)$	0.119***	0.090***
	(0.00)	(0.00)
D new child	-0.010***	-0.009***
	(0.00)	(0.00)
D change of state	0.086***	0.087***
	(0.01)	(0.01)
D marriage	0.038***	0.036***
	(0.00)	(0.00)
Income 2001	-0.000	-0.000
	(0.00)	(0.00)
λ		0.003
		(0.00)
Strat. controls	Yes	Yes
Age controls	Yes	Yes
Demo. controls	Yes	Yes
	Tests of weak Instruments	
First stage F-Statistic	19572	32811
Partial R_1^2	0.152	0.072
Partial R_2^2	0.049	0.042
	Tests of Moving Average	
Arellano-Bond test, order 1	-174	-128.5
(p-value)	(0.000)	(0.000)
Arellano-Bond test, order 2	1.791	-3.41
(p-value)	(0.073)	(0.001)
Number of Observations	1951471	1951471

Notes: * p<0.05, ** p<0.01, *** p<0.001. All regressions include a constant and year dummies. Sample control variable are dummy variables for main income source and dummy variables for the level of income in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Age control variables are the taxpayers age, age squared, a dummy for taxpayers over 55 and a dummy for taxpayers younger than 21 in 2001. Demographic control variables are dummy variables for single parents, handicapped taxpayers, two earner taxpayers, retired taxpayers and non-taxable income. λ denotes the inverse Mills ratio from the Heckman sample selection model. The first stage F-Statistic is the Cragg-Donald Wald F statistic with critical values of 11.04 for 5% relative IV bias and 16.87 for 10% IV size, source Stock and Yogo (2005). Partial R_1^2 is the partial R-squared for the growth rate of the net-of-tax rate, Partial R_2^2 is the partial R-squared for the lagged income growth, see Shea (1997) and Godfrey (1999) for a description. The Arellano-Bond tests for first-order and second-order of moving average is asymptotically N(0,1) distributed.
Source:Own computation based on German Taxpayer Panel 2001-2006.

Table 2.A.5 presents results of equation (2.3) including taxpayers that have severe demographic changes such as marriage, divorce or one-time exceptional profits which increases

the sample to 1,951,471 observations. Column (1) shows 2SLS results for the full model of equation (2.3) with an ETI of 0.38 which is statistically not different from the benchmark result from Table 2.3 with an ETI of 0.36. Results in column (2) are based on the 1951471 observations and include a selection control following Heckman (1979) λ.[71]

These results imply that the employed observation selection does not induce a selection bias.

[71] Exclusion restrictions for the estimation of the selection control are obtained from the first year of the panel data. (1) Indicator for the number of different income sources, (2) the variance of the incomes between the income sources and (3) an indicator for negative incomes are used as exclusion restrictions.

Chapter 3

Charitable Giving and its Persistent and Transitory Reactions to Changes of Tax Incentives: Evidence from the German Taxpayer Panel

3.1 Introduction

A common feature of income tax codes is the favorable tax treatment of charitable giving. Whether these tax incentives are suitable to boost charitable giving and whether tax incentives are an efficient policy instrument is an ongoing debate (Peloza and Steel 2005).[1] On that account, the last decades have seen a lively interest in the theoretical, empirical and experimental analysis on the motives of charitable giving and responses of donors to the key issues of tax incentives. The scale to which tax incentives are suitable to raise donations depends if they are price elastic, and if so, to what extent. One straight forward reason to investigate price and income elasticities is to establish, whether tax reliefs are effective to stimulate giving to the extant that they offset forgone tax revenues, which could otherwise have been used to provide public goods directly (Feldstein and Clotfelter 1975, Feldstein 1980). However, this fiscal rule might be relaxed when taking an overall welfarist point of view and for example allowing the donor to derive utility from the act

[1] Donations to charity also offer a chance to investigate tax noncompliance (see Feldman and Slemrod (2007).

of giving per se (Andreoni 1990).[2]

Following Taussig's (1967) seminal study analyzing US tax return data, numerous approaches were conducted. A review of 69 empirical studies covering five decades conducted by Peloza and Steel (2005) leads to ambiguous findings, mainly due to a number of technical reasons. For example, a large share of taxpayers might not donate at all, thus the problem of censoring demands models like the Tobit. However, that comes at the price that potential individual fixed effects cannot be eliminated by first differences. Moreover, recent results suggest that donors behave very heterogenous along the distribution of donations and models like Tobit can only capture the conditional mean, but not to present the whole distribution of reactions. Furthermore, results from Tobit models might be only driven from a fraction of the population and could be only representative on average.[3] Peloza and Steel (2005) also highlight how results are driven from heterogenous data sources, statistical methods and different time periods. In addition, recent results are mainly obtained from panel data.[4]

In sum, most studies reviewed by Peloza and Steel (2005) support the hypothesis that tax deductions for charitable giving are treasury efficient. However, more recent studies have provided a different picture. Based on either panel data or alternative estimation methods, they find that previous studies might have overestimated the price elasticity (Bakija and Heim 2011) or even that giving behavior qualifies as price inelastic (Fack and Landais 2010).[5]

In the current study we use panel data recently available for Germany to complement the aforementioned research and previous studies investigating the German case. For Germany, several studies establish the giving behavior to be price and income elastic. Using aggregated cross-sectional income tax data, Paqué (1986) finds average giving behavior to be price and income elastic. These result are also supported by more recent findings of Auer and Kalusche (2010). Based on micro level cross-sectional income tax data they

[2]There is a large literature estimating utility from giving, see for instance Crumpler and Grossman (2008) for an experimental investigation.

[3]Linear models like Tobit might also deliver inconsistent results in case of a non-linear process and results could be driven from outliers.

[4]See, for instance, Clotfelder (1980), Barrett (1991), Auten et al. (2002) for results for the US from analyses with panel data.

[5]Fack and Landais (2010) find price elasticities for French taxpayers to range between -0.2 and -0.6. Thus they are inelastic to price incentives and heterogenous.

establish price and income elastic behavior for high and low income classes. They face the censoring issue by deploying Tobit and thus estimated elasticities are again population averages. Taking into account the possibility of heterogonous giving behavior, Bönke et al. (2013) derive estimates from a censored quantile regression approach which confirms price and income elastic behavior in parts of the distribution of donors. Adena (2014), in the spirit of Bakija and Heim (2011) and also making use of the recent available tax panel data, estimates a panel fixed effect OLS model for four different income groups. Her results suggest no income elastic behavior but very different price elasticities across income groups.

Exploiting the panel structure of our data, we estimate price and income elasticities while disentangling persistent and transitory effects of giving behavior. In addition, we follow Fack and Landais (2010) and Bönke et. al (2013) in applying the non-parametric estimation technique of quantile regression to derive estimates at different points of the conditional distribution of charitable giving. In short, our approach is not restricted to answer whether current tax incentives are suitable to foster charitable giving but also aims at determining for whom tax incentives matter most. The current study can thus complement former research in three ways. First, the estimation technique helps us to connect the amount given to income and price elasticities, rather than obtaining an estimate for the population average. This matters if giving behavior is indeed heterogenous as suggested by Bönke et al.(2013) and only the tails of the conditional distribution are price elastic. This has direct implications for the optimal design of tax incentives: the tax induced price of giving should hinge upon the amount given rather than the tax rate. Moreover, results confirm that the income elasticity of donations is declining with increasing donations which supports the general assumption that donations to charity are a normal good. Second, our data highly over-samples top incomes and presents results including the highest incomes.[6] Keeping in mind that there is a large literature suggesting severe differences in various aspects between top incomes and the remaining income distribution, this is a valuable asset. For example, Bach et. al (2013) show income sources and effective taxation are distinct for top income earners in Germany. Hence, this might also suggest distinct behavioral responses to tax incentives (e.g. tax planning) and especially

[6]Bönke et. al (2013) do not include gross incomes above 153,000 Euro.

for donations to charity for this income group.

Third, for the first time we use panel data to differentiate between persistent and transitory changes in income and prices in this kind of econometric setting. The remainder of the chapter is organized as follows: Section 3.2 discusses briefly the conceptual framework regarding the efficiency of tax incentives. Section 3.3 describes the data and its preparation. Section 3.4 presents the main results of our econometric exercise and section 4.5 concludes by reviewing key findings.

3.2 Efficiency of Tax Incentives

The optimal theoretical design of tax incentives has been discussed in the literature extensively.[7] Depending on the modeling of philanthropy, a range of efficient setups to encourage charitable giving can be derived. The modeling may for instance allow for crowding out, impure altruism or warm glow of giving. Therefore, we will briefly review some theoretically founded results to define treasury-efficient policies relevant for our study. In the standard approach, individuals donate voluntarily some amount to the public good. In absence of government activity (no public contributions to the public good and no tax incentives regarding donations), the total of private donations amount to the level of the publicly provided good and, following Samuelson's famous rule (Samuelson 1954), this level will be inefficiently low.

If government activities try to raise the privately provided charity to an efficient level, it faces the challenge of crowding out. Either crowding out will be next to complete or the individuals gain utility not only from the public good but from the act of giving per se (Andreoni 1990). Unfortunately, in contrast to Bönke et al. (2013), the case of crowding out can due to data limitations not be considered.[8]

Besides providing for the public good directly, the government can introduce tax incentives to boost voluntary contribution by lowering the price of giving. Hence, whether tax incentives work as desired hinges on the price elasticity of giving. Not taking the pos-

[7] See for instance Feldstein and Clotfelter (1975), Feldstein (1980), Andreoni (1990) and Seaz (2004).

[8] Information on the federal state of residency which is needed to control for crowding out is due to confidential restrictions not available for taxpayers with an average total income above 165,000 Euro.

sibility of crowding out into account, this leads to Feldstein's rule of treasury efficiency (Feldstein 1975): Tax incentives are classified as effective in terms of "treasury efficient" if the tax-defined price elasticity is greater than one (in absolute value) and therefore more than offsets each dollar of forgone tax revenue. Accordingly, a price elasticity below minus one rules the tax incentives as treasury efficient.[9]

$$\frac{\partial[\text{donation}]}{\partial[\text{price of giving}]}\frac{\text{price of giving}}{\text{donation}} < -1 \tag{3.1}$$

To derive meaningful tax policy recommendation from an empirical exercise, some important assumptions regarding the underlying utility function are needed (Saez 2004). First, utility depends on net-of-tax gross income at the individual level and income effects arise only from net-of-tax gross income. Second, the level of the contributions to charity and the tax price of giving do not affect gross income before taxes. Third, changes of the tax rate affect income elastic responses of contributions only to the extent the net-of-tax gross income is affected. Under these assumption, in the presence of price elastic behavior and in the absence of crowding out, the rule for assessing the effectiveness of tax incentives follows the rule by Feldstein (e.g., Feldstein 1975 and Saez 2004). It is essential for the empirical assessment to identify if reactions to prices are persistent or transitory. Only persistent price elasticities can be used to indicate the efficiency of the tax treatment. While transitory adjustments are caused by the re-timing of giving due to non-permanent price or income shocks, efficiency hinges on the permanent responses to incentives. In the case of a diverging permanent and transitory price elasticity the optimal rule asks for the permanent price elasticity to be greater than one (in absolute value).

3.3 Data and Institutional Setting[10]

All information generated in the process of taxation is documented in the taxpayer's income tax return. All relevant information on the family situation, the declaration of

[9]In the case of crowding out or warm glow of giving this efficiency rule is relaxed (e.g. Saez, 2004).
[10]The first half of this section is taken from an earlier joint work (see Massarrat-Mashhadi and Werdt 2012).

income from different sources, granted deductions (including donations) and exemptions, calculation of taxable income and personal income tax payment are included. We can observe several socio-economic characteristics of taxpayers such as age, number of children, church membership and marital status. Unfortunately, liable information about the gender of the taxpayer is not provided. Albeit recorded, validating the information for single and married tax units reveals the accuracy to be insufficient. The German Federal Statistical Office assembles the income tax returns electronically as *Income Tax Statistics*, providing the basis for the *German Taxpayer Panel* (TPP). The Income Tax Statistic is collected every year and in order to form the TPP, consecutive years are linked by exploiting the individual taxpayer's ID and a balanced panel is compiled. The panel contains individual income tax returns of 19 million observations, covering years 2001 to 2006. However, in very few cases this procedure does not yield a perfect match. In the event of marriage, divorce or moving to another federal state, individual taxpayer's ID will be reissued or changed. On basis of four stratification criteria, i.e. federal state, assessment type, main type of income and total income, a 5% sample is drawn and made available for scientific purposes. The stratification procedure aims at optimizing the sample with regard to standard errors of total income over time and according observation weights are generated.

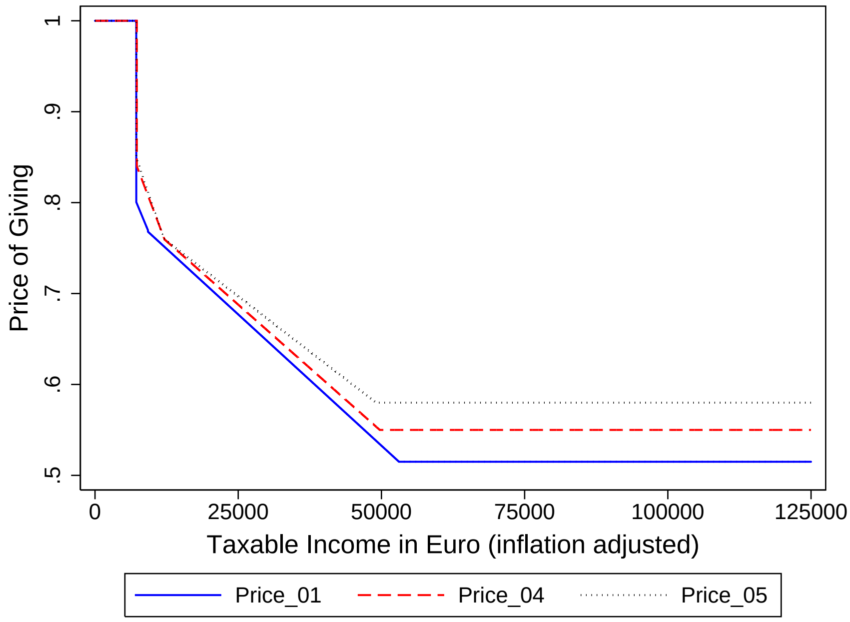
In Germany, two basic rules for donations are in place. The first rule applies to contribution that are regarded to be beneficial to the common good (e.g. donation to charity organisations, to churches, science or culture). In this case, donations are deductable from the tax base up to a certain limit.[11] Thus, the implicit price of giving one Euro equals one minus the marginal tax rate (see Figure 3.1). The second rule concerns donations to political parties. Here, for every donated Euro the donor gets a tax cut of fifty cents (and the price of giving is the same for all donors). For several reasons we are only concerned with the first rule and the resulting tax-defined prices of giving for 2001, 2004 and 2005 are presented in Figure 3.1.[12] The price of giving varies over time and across taxable income. For taxable incomes below the basic allowance the price is one, than it gradually

[11] In 2004, the maximal amount of charitable contributions eligible for deduction are 5% of total income (Gesamtbetrag der Einkünfte).

[12] Contribution to political parties have to be evaluated differently. For example, political parties are not considered per se a charity and most donation are from party members and the motive for party membership can hardly be considered charitable.

decreases to almost 0.5 in 2001 for taxpayers in the highest income bracket. As the tax price of giving mirrors the tax tariff, the tax reforms of 2004 and 2005 increased the tax defined price of giving substantially and especially in the top income bracket from 0.515 in 2003 to 0.58 in 2005.

Figure 3.1: Tax-defined price of giving for a single taxpayer



Furthermore, the German tax code provides a blanket allowance for personal expenses and the tax price of giving is only lower one if itemized deductions exceed the blanket allowance.[13] Taxpayers that do not exceed their blanket allowance, thus do not itemize but donate have a tax price of giving of one. Consequently, those donations are not audited by tax authorities and the data on those donation are not reliable. The overall impact of this group can be considered negligible regarding the fiscal relevance, hence we exclude these observations. Further, we assume that they are not different from taxpayers that remain in the sample and our results do not suffer from selection bias.

Another sub-population of taxpayers, the borderline itemizers, are taxpayers that only exceed their blanket allowance because of their donations to charity. However, only the donations that exceed the blanket allowance are deductable from taxable income and only

[13] The blanket allowance is relative small with 36 Euro for a single taxpayer and 72 Euro for a married taxpayer.

those have a tax price below one. We follow the literature by excluding those taxpayers which is standard and not harmful to our results since they are only a relatively small group of 0.18%.

Donations to charity can increase the marginal price of giving which induces a potential endogeneity of the price of giving for a progressive tax schedule.[14] The more an individual gives, the potentially lower is the marginal tax rate and higher the tax price. One way to avoid the potential endogeneity is taking the price of the first donated Euro (Peloza and Steel 2005). Another strategy is to calculate the (endogenous) average price and instrument it with the price of the first Euro donated. Both strategy are employed here and we find the results to be robust to both approaches. This does not come as a surprise as calculated prices do not differ very much and especially for tax payers in the top income bracket both strategies yield to the same tax price of giving. Following the literature we report only results based on the tax price for the first Euro donated. The core sample for the analysis consists of observation from four assessment years, 2002 to 2005. Thereby we obtain for every year one lag and one future year.[15] Each year consists of 928,993 taxpayers resulting in a balanced panel of 3,715,972 observations. Summing up, we exclude the following taxpayers to obtain a sample with reliable information: First, taxpayers with exceptional capital gains and taxpayers with incomes that are not fully taxed in Germany (2.45% or 91,244 observations). Further, taxpayers that have negative taxable income in one year (18.8% or 697,544 observations), boarderline itemizers (0.18% or 6,760 observations) and non-itemizing taxpayers (19.67% or 730,541 observations). All in all, pooling our balanced panel we obtain an unweighted sample containing 2,189,883 taxpayers for the period 2002 to 2005.[16]

Table 3.1 presents some sample descriptive statistics. The left panel shows mean and standard deviations including weighting factors for the weighted sample of 44 million taxpayers and the right panel shows unweighted descriptive results for the estimation sample only. 67.7% of taxpayers in the estimation sample donate to charity, which corresponds to 55% of weighted observations. 67% of taxpayers are married and the average marginal

[14]See Triest (1998) about a discussion of possible ways for taxpayers to influence their marginal tax rate through economic activities.

[15]The sample encompasses assessment years 2001 to 2006.

[16]Note that the term *taxpayer* denotes both married and single tax units. In case of a married taxpayer, this refers to two persons.

tax rate of donors equals the average marginal tax rate of taxpayers that do not donate with 0.30. The log price is on average -0.48, while log income is on average 11.

Table 3.1: Sample Descriptives

	Weighted		Unweighted	
	Mean	(Std. Dev.)	Mean	(Std. Dev.)
Share of Donors	0.55	(0.497)	0.677	(0.467)
Share of Married	0.68	(0.466)	0.674	(0.469)
Share of Church Members	0.74	(0.439)	0.724	(0.447)
Share of Taxpayers with Children	0.80	(0.400)	0.795	(0.404)
Marginal tax rate	0.30	(0.106)		
Marginal tax rate of donors	0.30	(0.110)		
Donation	205.77	(1306)		
Income	48003	(172799)		
p_{it}	-0.48	(0.20)		
y_{it}	11.16	(0.98)		
Δp_{it}	0.01	(0.10)		
Δy_{it}	0.05	(0.37)		
Δp_{it+1}	0.02	(0.08)		
Δy_{it+1}	0.05	(0.29)		
Number of Observations	43,702,689		2,189,883	

Note: Descriptive Results are produced from the sample including weighting factors. p_{it} denotes the logarithm of the tax price of giving, y_{it} is the logarithm of the net-of-tax gross income, Δ denotes the growth rate.

Source: Own computation based on TPP 2001-2006.

3.4 Empirical estimation

The standard model of donations to charity, G_{it} in time period t for taxpayer i, models giving depending on the adjusted net-of-tax gross income $Y_{it} - T(X_{it})$,[17] the price of giving P_{it} and socio-demographics contained in z_{it}.[18]

$$G_{it} = G\left(Y_{it} - T(X_{it}), P_{it}, z_{it}\right) \tag{3.2}$$

Note that this equation models donations to charity as a consumption good including income effects arising from the adjusted net-of-tax gross income (henceforth referred to as net income) and price effects from the tax price of giving. However, to identify both, the

[17] Y_{it} depicts adjusted gross income, X_{it} taxable income and $T(\cdot)$ is tax liability.

[18] See Table 3.2 for an overview of the dependent, the control and the socio-demographic variables.

net income cannot be perfectly correlated with prices but needs sufficient variation. We ensure that variation by constructing an adjusted income by re-including individual tax reliefs, allowances and specific depreciations, tax free earnings and tax motivated losses. This approach is similar to Bach et. al (2009), Bönke et. al (2013) and Bönke et. al (2007). Further information on the construction of the adjusted income is provided in Table 3.A.3.

The correlation coefficient between the tax price of giving and the net income confirms medium sized correlation with a correlation coefficient of -0.596. Thus we assume, that we can interpret estimated coefficients of price and income as partial effects.

In case of income- or price shocks triggering exceptional or one-time donations, estimating equation (3.2) might not deliver consistent elasticities. To disentangle those transitory responses from persistent effects, panel data offers the inclusion of the income and price growth rates from years surrounding the donation. Empirically, this extents equation (3.2) in the following way:

$$G_{it} = G\left(Y_{it} - T(X_{it}), \Delta(Y_{it} - T(X_{it})), \Delta(Y_{it+1} - T(X_{it+1})), P_{it}, \Delta P_{it}, \Delta P_{it+1}, z_{it}\right) \quad (3.3)$$

In order to control for transitory effects, we start with a strictly non-dynamic model that only uses cross-sectional data following equation (3.2) in a log-log design, allowing to interpret coefficients directly as elasticities:

$$g_{it} = \alpha + \beta_1 p_{it} + \gamma_1 y_{it} + \theta' z_{it} + \epsilon_{it}. \quad (3.4)$$

with $ln(G_{it}) = g_{it}$ as the log of giving for taxpayer i at time t, p_{it} is the log of the price of the first donated Euro and y_{it} is the log of the net income net taxes, ϵ_{it} represents some white noise error. β_1, γ_1 and θ' are price, income elasticity and coefficient vector of socio-demographic control variables of giving. This model is similar to Bönke et. al (2013) and allows the comparison to their results.

Subsequently, we compute a quasi-dynamic specification that controls for the growth rate of prices and incomes surrounding the donation. This enables us to compute next to the permanent elasticities also transitory elasticities:

$$g_{it} = \alpha + \beta_1 p_{it} + \beta_2 \Delta p_{it} + \beta_3 \Delta p_{it+1} + \gamma_1 y_{it} + \gamma_2 \Delta y_{it} + \gamma_3 \Delta y_{it+1} + \theta' z_{it} + \epsilon_{it} \tag{3.5}$$

where Δ denominates the first difference such as $\Delta p_{it} = p_{it} - p_{it-1}$ and $\Delta p_{it+1} = p_{it+1} - p_{it}$. As suggested by Bakjia and Heim (2011) this specification allows to differentiate between the persistent price (income) elasticity β_1 (γ_1) and the transitory price (income) elasticity which takes the form: $\beta_1 + \beta_2 - \beta_3$ ($\gamma_1 + \gamma_2 - \gamma_3$).[19]

The transitory price or income elasticity implies, how the donor would react to a temporary change of tax prices or income between periods $t-1$ and t and a subsequential return in $t+1$ to the level of $t-1$. Note, that equation (3.5) demands assumptions regarding the future income and price growth rates. In our preferred quasi-dynamic estimation approach we imply perfect foresight, hence we assume the donor has complete knowledge of income and prices that are actually realized in $t+1$. As a test of robustness, in a second scenario we relax the assumption of perfect foresight and predict future incomes and prices with the information available in t. Results for the model of imperfect foresight are presented in Table 3.A.1 in the appendix of this chapter.

Donations to charity are very heterogenous for given prices and income levels, promoting to allow for a more heterogenous estimation technique that is not based on strong assumptions about homogeneity. Therefore, following Feldstein and Lindsey (1981), Fack and Landaise (2010) and Bönke et al. (2013) we allow price and income elasticities to depend on the amount given to charity. Additionally, we observe heavy left censored observations with a high fraction of taxpayers who do not donate. However, according to Randolph (1995), the exclusion of the censored taxpayers would raise the issue of endogenous selection. Thus, following Boskin and Feldstein (1977) we assign a fictitious gift to all taxpayers by adding 1 Euro to the donations of each taxpayer. Boskind and Feldstein (1977) also discuss the sensitivity of the adjustments to charitable giving in the econometric context, promoting the use of 1 unit as adjustment entity. Since estimated price and income elasticities refer to marginal changes, this data modification poses only a mi-

[19]Bakjia and Heim compute more dynamic effects by adding another lagged difference for price and income elasticities. Due to data limitations of the TPP our panel is too short to include extensive controls like Bakjia and Heim (2011) in the estimation model.

nor influence. Given only the censoring problem, one could easily implement a standard estimation technique such as the prominent Tobit model. However, for suitable policy analysis the Tobit demands some form of homogeneity within the error terms which could be violated given our heterogenous observations or a non-linear data process. Moreover, we are interested in the shape of the distribution of giving, conditional on price and income. Chernozhukov and Hong (2002) propose a well behaved three step estimation procedure deploying quantile regressions which are able to derive efficient estimates.[20]

Quantile regressions were first introduced by Koenker and Bassett (1978) and are a non-parametric estimation technique. They allow for covariates to shift location, scale and shape according to the dependent variables distribution. It has the advantage that the error term only needs to obey the relative weak assumption of white noise with $E[\epsilon] = 0$.[21] Given that the conditional quantile regressions can vary for different quantiles of the dependent variable, it allows for heterogenous behavior and is robust to censoring.

According to Koenker and Hallock (2001), with respect to β_q the sample regression quantiles for the q^{th} quantile can be expressed as the solution the minimum of the (as-) symmetric sum of:[22]

$$Q(\beta_q) = \sum_{t=1}^{T} \sum_{i:g_{it} \geq X'_{it}\beta}^{N} q|g_{it} - X'_{it}\beta_q| + \sum_{t=1}^{T} \sum_{i:g_{it} \leq X'_{it}\beta}^{N} (1-q)|g_{it} - X'_{it}\beta_q| \tag{3.6}$$

Where the set of explanatory variables including p_{it}, y_{it} and z_{it} are captured in matrix X_{it}. Accordingly, the β_q-vector comprises of coefficients described in equation (3.4) or (3.5) depending on the chosen estimation equation including price and income elasticities.

[20]Efficient estimates are derived after performing two selection steps. Find a detailed description of the procedure and an empirical application in their paper.

[21]In contrast to linear regression models, this approach does not require assumptions about the errors distribution, variance and correlation of observations.

[22]A prominent case is the median regressor for $q = 0.5$, where the quantile regression estimator minimizes the sum of absolute values of error.

Table 3.2: Dependent variables and covariates

Variable	Decription	Coding/construction
g_{it}	Charitable giving plus 1 Euro	Log of charitable giving
p_{it}	Tax defined price of giving	Log of tax defined price of giving for the first Euro of donation
Δp_{it}	$p_{it} - p_{it-1}$	Log of first difference of price
Δp_{it+1}	$p_{it+1} - p_{it}$	Log of first difference of price
y_{it}	gross income	Log of net income
Δy_{it}	$y_{it} - y_{it-1}$	Log of first difference of net income
Δy_{it+1}	$y_{it+1} - y_{it}$	Log of first difference of net income
D child	Taxpayer has children	Dummy variable (1=children;0=else)
D married	Taxpayer opts for spouse splitting	Dummy variable (1=yes;0=else)
D church	Taxpayer pays church tax	Dummy variable (1=yes;0=else)
Age	Age of taxpayer	Age in Years
Age^2	Age of taxpayer squared	Age in Years; squared
D limit	Donating more than taxable accountable	Dummy variable (1=yes;0=else)
Base year income	Gross income from first year of panel	In 2001 Euro
D West Germany	Taxpayer lives in East or West Germany	Dummy variable (1=yes;0=else)
D $year_t$	Assessment year	Dummy variable (1=t;0=else)
		t is 2002 to 2004 (base category 2005)
Main $income_k$	Main income source of taxpayer	The taxpayer can have three different main income sources:
		$k = 1$ is dependent employment income, $k = 2$ is business income
		$k = 3$ is other income sources (base category)

Controlling for time effects, we use year dummies, additionally, we include socio-demographic control variables such as age, age squared and dummy variables for children, church membership, employment status and marriage.[23] Table 3.2 introduces the dependent and the explanatory variables.

3.5 Results

3.5.1 Cross-sectional Estimation

Due to data limitations, the majority of the literature is restricted to use control variables from contemporary data. Usually, these studies rely on pooled cross sections (e.g. Bönke et al. 2013). To assess, whether this non-dynamic approach yields reliable estimates of price and income elasticities and to test our data, we treat the panel years as repeated cross sections and estimate the model outlined in equation (3.4). The estimation results for the 0.35 until 0.99 quantile are displayed in Table 3.3. Since quantiles are sorted according to the size of donations, quantiles 0 to 0.34 consist only of non-donors which are censored and quantile regressions do not allow to compute the according effects.

We find that giving behavior is (very) heterogeneous and, therefore, our results confirm the suitability of censored quantile regressions to detect that heterogeneity. Albeit signs of coefficients do not change across quantiles, magnitudes vary significantly. Looking at the influence of socio-demographic characteristics first, the coefficients show the expected signs: The impact of children, marriage and age is positive; if the taxpayers pays church taxes (D church=1), less is donated. This is plausible as church taxes are voluntary and are treated by the German income tax code very similar to donations. Hence, paying a church tax is likely to be regarded as a donation from the taxpayer's perspective. Coefficients for the three subsequent assessment years (D $year_1$, D $year_2$, D $year_3$ with base year 2005) are negative for all quantiles. Amongst others, these year effects are likely to capture two mayor events boosting donations: First, in the summer of 2002, the flooding of the East

[23]Since we use tax return data, we are limited to information relevant to a tax report. Hence, data irrelevant for tax assessment such as gender or education of the taxpayer are either not included in the data or may not be reliable.

German river Oder.

Table 3.3: Quantile regression results for pooled cross sections

Parameter	$Q = 0.35$	$Q = 0.40$	$Q = 0.45$	$Q = 0.5$	$Q = 0.55$	$Q = 0.6$	$Q = 0.65$
C	-13.31***	-12.22***	-11.41***	-10.59 ***	-9.44***	-7.86***	-6.69***
y_{it}	1.12***	1.07***	1.02***	0.97***	0.91***	0.86***	0.84***
p_{it}	-1.97***	-1.34***	-1.02***	-0.96***	-1.00***	-0.93***	-0.82***
D child	0.19***	0.23***	0.28***	0.31***	0.30***	0.23***	0.17***
D married	0.33***	0.56***	0.63***	0.59***	0.48***	0.31***	0.19***
D church	-0.59***	-0.58***	-0.56***	-0.55***	-0.52***	-0.43***	-0.36***
Age	0.06***	0.06***	0.06***	0.07***	0.06***	0.05***	0.04***
Age^2	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D limit	4.27***	3.97***	3.78***	3.64***	3.55***	3.47***	3.38***
Base year income	0.00***	0.00***	0.00**	0.00	0.00***	0.00***	0.00***
D West Germany	0.66***	0.54***	0.42***	0.33***	0.31***	0.26***	0.21***
D $year_1$	-0.22***	-0.13***	-0.07***	-0.05***	-0.06***	-0.06***	-0.05***
D $year_2$	-0.46***	-0.35***	-0.27***	-0.25***	-0.26***	-0.23***	-0.19***
D $year_3$	-0.17***	-0.12***	-0.08***	-0.08***	-0.08***	-0.07***	-0.06***
Main $income_1$	-0.02	0.00	0.10***	0.17***	0.19***	0.18***	0.15***
Main $income_2$	-0.85***	-0.68***	-0.50***	-0.38***	-0.31***	-0.26***	-0.25***
Number of observations	2156937	2179630	2185528	2187696	2188925	2189514	2189759

Parameter	$Q = 0.70$	$Q = 0.75$	$Q = 0.8$	$Q = 0.85$	$Q = 0.9$	$Q = 0.95$	$Q = 0.99$
C	-5.92***	-5.33***	-4.84***	-4.32***	-3.67***	-2.48***	-0.66***
y_{it}	0.82***	0.81***	0.81***	0.80***	0.77***	0.72***	0.70***
p_{it}	-0.77***	-0.77***	-0.77***	-0.81***	-0.91***	-1.15***	-1.43***
D child	0.14***	0.12***	0.10***	0.09***	0.09***	0.10***	0.06***
D married	0.11***	0.07***	0.04***	0.04***	0.06***	0.10***	0.13***
D church	-0.31***	-0.28***	-0.26***	-0.24***	-0.25***	-0.27***	-0.18***
Age	0.04***	0.03***	0.03***	0.03***	0.03***	0.02***	0.01***
Age^2	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D limit	3.30***	3.20***	3.08***	2.92***	2.72***	2.37***	1.89***
Base year income	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D West Germany	0.18***	0.15***	0.13***	0.11***	0.08***	0.05***	-0.01
D $year_1$	-0.05***	-0.05***	-0.05***	-0.05***	-0.05***	-0.07***	-0.08***
D $year_2$	-0.18***	-0.16***	-0.15***	-0.14***	-0.12***	-0.12***	-0.10***
D $year_3$	-0.06***	-0.06***	-0.05***	-0.05***	-0.05***	-0.05***	-0.04***
Main $income_1$	0.12***	0.09***	0.07***	0.05***	0.07***	0.05***	-0.02*
Main $income_2$	-0.26***	-0.28***	-0.30***	-0.30***	-0.26***	-0.19***	-0.07***
Number of observations	2189841	2189869	2189875	2189879	2189882	2189883	2189883

Note: Three-step censored quantile regression parameters estimates. Standard errors are bootstrapped with 200 replications, asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). Number of observations vary due to the selection process accounting for the censoring.

Source: Own computation based on TPP 2001-2006.

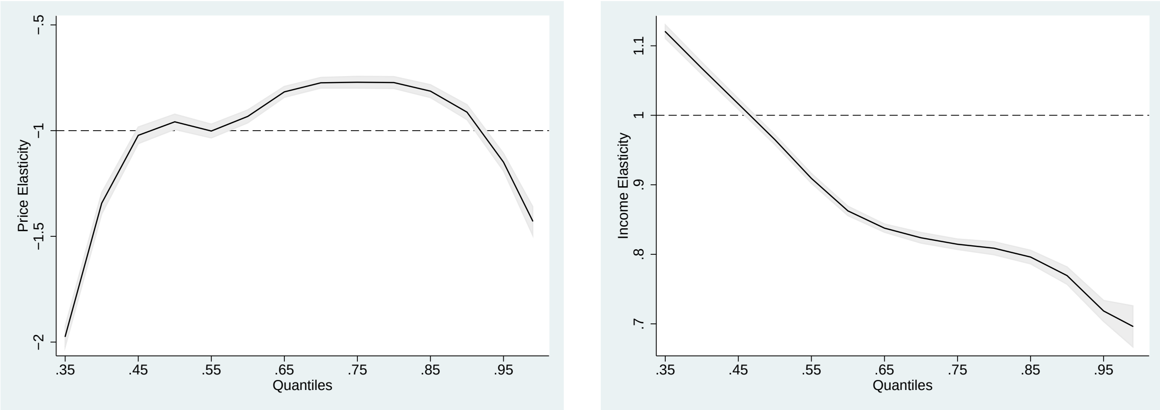
Second, in late 2004 the tsunami hitting East Asia, causing donation to peek afterwards in 2004 and especially 2005. In sum, we find that our estimation yields similar results regarding socio-demographic characteristics to previous studies (e.g. Bönke et al. 2013).

Estimates for income and price elasticities, y_{it} and p_{it}, pose the central results. Again, we find estimates to vary across quantiles in a pattern reassembling Bönke et al. (2013) in general, who found price elasticities between -1.44 and -0.45 and income elasticities 1.49 and 0.78. However, results differ in magnitude, especially regarding the price elasticity of giving. This finding is important as Bönke et al. (2013) use different data. Unlike our data, they draw on three cross sections which are representative for the whole population of German taxpayers below incomes of 153,000 Euro. As mentioned above, the data we use might not be representative due to the balanced panel design and in addition highly over-samples taxpayers with high incomes. Finding similar patterns to Bönke et al. (2013) therefore suggests that we may draw valid general conclusions from our empirical exercise for giving behavior in Germany.[24]

In order to present our central results in a more convenient manner, estimations displayed in Table 3.3 for the elasticities of prices and incomes are rehashed in Figure 3.2 where the quantile specific point estimates are represented by the solid lines and the grey shaded areas denote the according confidence interval. We comment on the price elasticity pictured in the left panel first. As mentioned above, results confirm the heterogenous behavior following an inverse u-shaped pattern. This allows us to categorize taxpayers into three different groups. (1) Price elastic contributors with estimates ranging from minus two to close to minus one and comparably low donations (35^{th} until 55^{th} quantile); (2) price inelastic taxpayers with contributions between the 60^{th} and the 95^{th} quantile; and (3) price elastic taxpayers with contributions close to minus one and high contributions above the 95^{th} quantile of the distribution of charitable giving. Hence, we find the price elasticity to exceed one in absolute value at the tails of the distribution. In sum, taxpayers with high amounts of charitable giving confirm the prominent interpretations to be more sensitive to tax incentives as itemizing their donations potentially results in a considerable tax relief and, hence, tax planning pays off. In contrast, the behavior in the middle of the distribution of giving is rather price inelastic with price elasticities below .8 in absolute values and tax incentives are not treasure efficient (Feldstein 1975) to boost giving. Those medium donors are driven rather by income than by tax incentives. The very price and income elastic behavior at the lower tail of the distribution may reflect purposely decisions in case of rather small donations. According to theory, here the marginal utility pay off is very high and thus prone to be elastic to changes in prices, tax reliefs and income.

[24]Our data originates from the same source Bönke et al. (2013) use. However, the panel is designed to be balanced per construction. Thus we are missing taxpayers with irregular income tax reports in our sample.

Figure 3.2: Price and Income Elasticities from the non-dynamic specification



Source: Own calculations based on TPP. Solid lines denote point estimates for the respective quantile; grey areas denote the 95th confidence interval computed by bootstrap.

The income elasticities pictured in the right panel of Figure 3.2 show heterogenous behavior as well. Income elasticities are strictly downward sloping from an income elastic range (35^{th} until 45^{th} quantile) with estimates exceeding one, a semi elastic range estimates where after an initial steep decrease oscillate around .8 for medium to up to high donors. The income effect on all is positive and high for all quantiles. Estimates for income elasticities are in line with the theoretical assumption classifying giving as a normal good with decreasing marginal utility, along the distribution of donors.

However, this non-dynamic approach does not exploit the panel structure of our data and does not allow to disentangle persistent and transitory behavior from changes in prices or incomes (e.g. transitory income shocks could be exceptional high (low) incomes through short periods of unemployment or capital gains, transitory price shocks arise from temporary law changes affecting the taxable income composition.)

3.5.2 Exploiting the Panel Structure

The indications from the non-dynamic specification are plausible and confirm previous findings. However, only in a more dynamic set up one can validate, if the elasticities are indeed linked to permanent responses and not biased from transitory effects. Indeed, to correctly judge the treasure efficiency of tax incentives, the evaluation of the persistence effect is needed and therefore, a more dynamic framework.

Table 3.4: Quantile regression results: quasi-dynamic model with perfect foresight

Parameter	$Q = 0.35$	$Q = 0.4$	$Q = 0.45$	$Q = 0.5$	$Q = 0.55$	$Q = 0.60$	$Q = 0.65$
C	-13.80***	-12.75***	-11.84***	-10.91***	-9.71***	-8.19***	-7.03***
y_{it}	1.16***	1.12***	1.06***	1.00***	0.94***	0.90***	0.87***
Δy_{it}	-0.20***	-0.21***	-0.20***	-0.20***	-0.22***	-0.24***	-0.24***
Δy_{it+1}	0.45***	0.43***	0.40***	0.36***	0.32***	0.28***	0.25***
y_{it} *transitory*	0.52***	0.52***	0.47***	0.44***	0.41***	0.38***	0.38***
p_{it}	-2.16***	-1.44***	-1.06***	-1.00***	-1.07***	-1.00***	-0.88***
Δp_{it}	0.92***	0.54***	0.41***	0.46***	0.64***	0.58***	0.47***
Δp_{it+1}	-0.58***	-0.43***	-0.31***	-0.29***	-0.25***	-0.27***	-0.29***
p_{it} *transitory*	-0.67***	0.52***	-0.33***	-0.25***	-0.17***	-0.15 ***	-0.11***
D child	0.18***	0.22***	0.27***	0.30***	0.28***	0.22***	0.16***
D married	0.31***	0.53***	0.60***	0.56***	0.46***	0.30***	0.18***
D church	-0.59***	-0.58***	-0.56***	-0.55***	-0.52***	-0.44***	-0.36***
Age	0.06***	0.06***	0.06***	0.06***	0.06***	0.05***	0.04***
Age^2	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D limit	4.19***	3.89***	3.71***	3.58***	3.48***	3.40***	3.33***
Base year income	0.00***	0.00***	0.00***	0.00***	0.00***	0.00	0.00***
D West Germany	0.62***	0.52***	0.40***	0.32***	0.29***	0.24***	0.20***
D $year_1$	-0.20***	-0.12***	-0.06***	-0.05***	-0.06***	-0.06***	-0.05***
D $year_2$	-0.44***	-0.35***	-0.28***	-0.25***	-0.25***	-0.23***	-0.19***
D $year_3$	-0.19***	-0.13***	-0.10***	-0.10***	-0.10***	-0.09***	-0.08***
Main $income_1$	-0.07***	-0.04***	0.05***	0.12***	0.15***	0.13***	0.11***
Main $income_2$	-0.86***	-0.69***	-0.51***	-0.39***	-0.33***	-0.28***	-0.27***
Number of observations	2149437	2176035	2184801	2187896	2189129	2189594	2189789

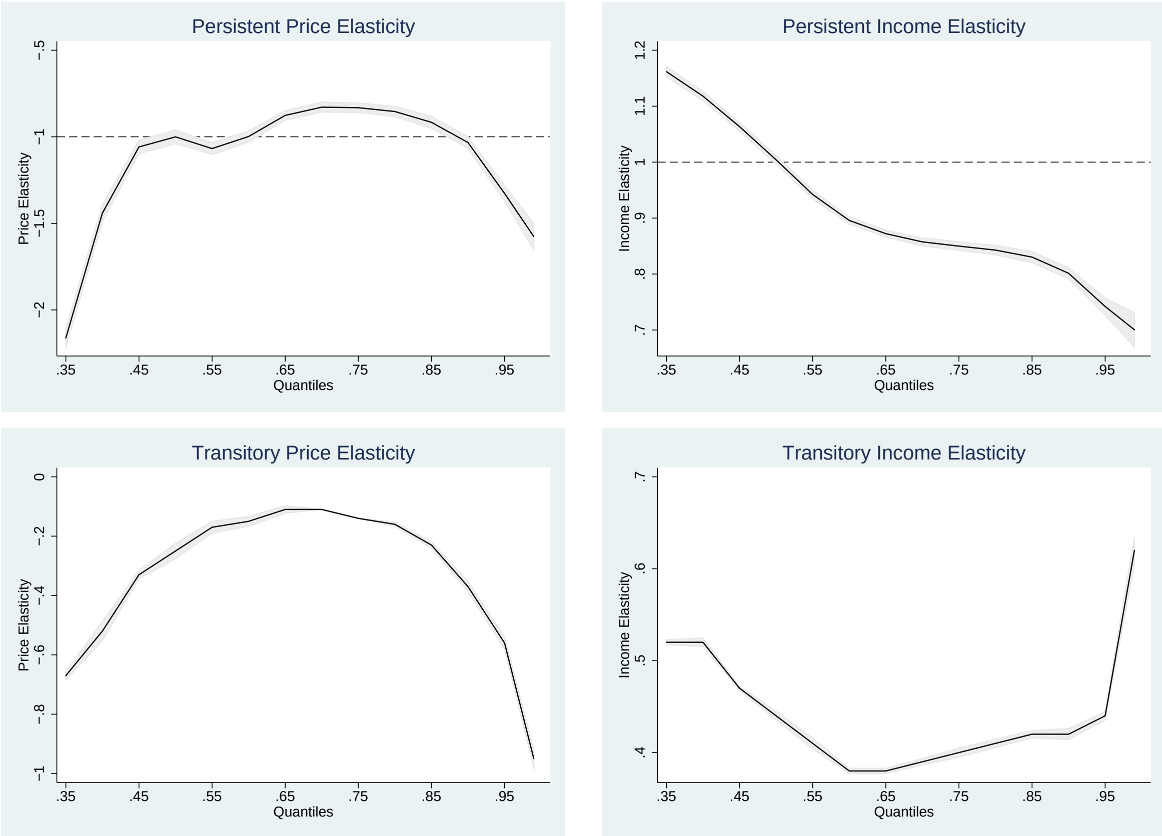
Parameter	$Q = 0.70$	$Q = 0.75$	$Q = 0.8$	$Q = 0.85$	$Q = 0.9$	$Q = 0.95$	$Q = 0.99$
C	-6.24***	-5.67***	-5.16***	-4.65***	-3.97***	-2.73***	-0.75***
y_{it}	0.86***	0.85***	0.84***	0.83***	0.80***	0.74***	0.70***
Δy_{it}	-0.23***	-0.23***	-0.22***	-0.22***	-0.20***	-0.17***	-0.05***
Δy_{it+1}	0.24***	0.23***	0.22***	0.20***	0.18***	0.13***	0.03***
y_{it} *transitory*	0.39***	0.40***	0.41***	0.42***	0.42***	0.44***	0.62***
p_{it}	-0.83***	-0.83***	-0.85***	-0.92***	-1.03***	-1.33***	-1.58***
Δp_{it}	0.42***	0.39***	0.38***	0.34***	0.29***	0.34***	0.28***
Δp_{it+1}	-0.29***	-0.30***	-0.31***	-0.34***	-0.37***	-0.43***	-0.34***
p_{it} *transitory*	-0.11***	-0.14***	-0.16 ***	-0.23***	-0.37***	-0.56***	-0.95***
D child	0.13***	0.11***	0.09***	0.08***	0.08***	0.09***	0.05***
D married	0.10***	0.06***	0.03***	0.02***	0.04***	0.09***	0.13***
D church	-0.32***	-0.28***	-0.26***	-0.25***	-0.25***	-0.29***	-0.19***
Age	0.04***	0.03***	0.03***	0.03***	0.03***	0.02***	0.01***
Age^2	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D limit	3.25***	3.16***	3.05***	2.92***	2.71***	2.38***	1.89***
Base year income	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D West Germany	0.16***	0.14***	0.11***	0.09***	0.07***	0.04***	-0.02*
D $year_1$	-0.05***	-0.05***	-0.04***	-0.05***	-0.06***	-0.08***	-0.09***
D $year_2$	-0.17***	-0.16***	-0.14***	-0.13***	-0.12***	-0.12***	-0.10***
D $year_3$	-0.07***	-0.06***	-0.06***	-0.06***	-0.05***	-0.05***	-0.04***
Main $income_1$	0.09***	0.06***	0.03***	0.02**	0.02***	0.01	-0.04***
Main $income_2$	-0.27***	-0.29***	-0.31***	-0.31***	-0.27***	-0.20***	-0.07***
Number of observations	2189861	2189876	2189879	2189882	2189883	2189883	2189883

Note: Three-step censored quantile regression parameters estimates. Standard errors are bootstrapped with 200 replications, asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). Number of observations vary due to the selection process accounting for the censoring.

Source: Own computation based on TPP 2001-2006.

In the model specification in equation (3.5), the panel structure is exploited by integrating lagged and future first differences for the price and the income elasticity and results are presented in Table 3.4. With this approach we are able to disentangle giving behavior into reactions to persistent and transitory changes of income and prices. Thereby, responses to transitory changes may include consumption smoothing, short-run timing, learning and tax-planning behavior (Bakija and Heim, 2011). First difference including future prices and incomes build on the assumption of perfect foresight, which implies that taxpayers know their income and tax price of giving in the year following the donation. In this specification, p_{it} and y_{it} denote the persistent price, respectively the persistent income elasticity, the responses to transitory changes in income and prices are calculated as $p_{it} + \Delta p_{it} - \Delta p_{it+1}$ and $y_{it} + \Delta y_{it} - \Delta y_{it+1}$. The according sums are displayed in the respective lines *transitory*. Else, socio-economic and time co-variates have a similar influence like in the non-dynamic set up. Accordingly, we solely focus on the analysis of price and income elasticities. Again, we plot the main results from our estimation to visualize the pattern over the quantiles which are provided in Figure 3.3. The two upper graphs show results for p_{it} and y_{it} and are directly comparable to Figure 3.2. However, we interpret them in this econometric setting as persistent income and persistent price elasticities. Overall, the patterns for the persistent elasticities reassemble the findings reported for the non-dynamic approach with price elastic behavior at the tails of the distribution but price inelastic behavior for medium donors. The persistent income elasticity shows again a downward sloping curve with elasticities exceeding one for the lowest quantiles and elasticities below .8 for the top quantiles. The transitory elasticities are depicted in the two lower panels of Figure 3.3. The estimates for the transitory price elasticity are in absolute value (much) smaller than the permanent price elasticities. Furthermore, the transitory price elasticity resembles the same inverse u-shaped pattern of their permanent counterparts over the distribution of quantiles. The magnitude however differs substantially, estimates are close to zero in absolute value for all quantiles but for the highest donors. The transitory income elasticities are presented in the right lower panel of Figure 3.3. Showing a reversed pattern to their permanent counterparts, they are all positive with values around .4 for lower quantiles and increasing in the amount given. Estimates for the highest quantile amount to .7. In sum, we find transitory income elasticities to be all well below one, with the high donors to be relative more elastic than lower donors.

Figure 3.3: Price and Income Elasticities from the quasi-dynamic specification



Source: Own calculations based on TPP. Solid lines denote point estimates for the respective quantile; grey areas denote the 95th confidence interval computed by bootstrap.

To ensure robustness, we compare the estimates for price and income elasticities derived from the quasi-dynamic specification with perfect foresight with three alternative approaches: the non-dynamic specification presented above, a quasi-dynamic approach controlling for permanent and transitory incomes (Table 3.A.2) and a quasi-dynamic specification with imperfect foresight (Table 3.A.1). Comparing the estimates to our non-dynamic model first, we find, both the permanent income and price elasticity show the same pattern and confirm results from equation (3.4). While price elasticities tend to be slightly higher (in absolute value) in this quasi-dynamic model, income elasticities are very similar. Overall, the patterns for the persistence elasticities reassemble the findings reported for the non-dynamic approach. This complements the hypothesis that high donors are more responsive to tax incentives than medium donors and supports the usage of quantile regression. Although differences between the models are marginal, the transitory component should not be neglected and especially high donors tend to react more elastic with regard to transitory changes in prices and incomes. The second test of sensitivity is the inclusion of a permanent and transitory income component. Following standard approaches in the literature (e.g. Gottschalk and Moffitt 1994), permanent income is computed as the individual average over the whole panel length and transitory incomes are the respective yearly deviations. Decomposing income into this two components leaves the estimates for the permanent income elasticities and price elasticities virtually unchanged, hence resembling the same pattern across quantiles and confirming our preferred specification. Results and an detailed description of the empirical approach are presented in Table 3.A.2 in the appendix.

Comparing the preferred model to the third specification aims at testing the assumption of perfect foresight. As mentioned above, results in Table 3.4 assume that taxpayers have complete knowledge of future prices and incomes. To relax that somewhat strong assumption, we perform an alternative scenario following Bakjia and Heim (2012), called *imperfect foresight*, in which taxpayers know only on average their incomes and according prices in the future. Estimates based on the imperfect foresight assumption are listed in Table 3.A.1 and confirm results from Table 3.4 with virtually unchanged permanent price and income elasticities for most of the distribution. Only transitory income and price elasticities at the lower tail increase in absolute value significantly and are greater than one in absolute values. Another study based on the same data but relying on a different econometric modeling of donations to charity is Adena (2014). Here, individual fixed effects estimation is employed. Estimating the conditional mean of price and income elasticities, Adena's (2014) results are unbiased in case of no censoring. Then again, her results are robust against individual fixed effects, while the interpretation of quantile regressions is hard once fixed effects are eliminated.[25] In short, Adena's (2014) results complement our findings and imply that the price elasticity of giving is heterogenous along the income distribution: low incomes are not price elastic with relative small elasticities

[25] We believe that our results confirm that donations to charity are not strongly driven by individual fixed effects. If taxpayers donations follow a fixed effect, those fixed effects are likely to be larger for high donors than for small donors. That would contradict our inverse u-shaped pattern of the permanent price elasticity.

but medium and high incomes have a price elasticity greater one (in absolute value). The income elasticity is rather constant for the income classes around .2 which is however, significantly smaller than our estimates. Adena's (2014) results have direct implications for the optimal design of the tax subsidization of donations within the German tax code: the tax favoring of donations should depend on the income level of the taxpayer. Only donations of taxpayers with incomes above 30,000 Euro should have lower prices than one and receive a tax subsidy. Our results have different implications for the optimal design of the tax subsidizes: the tax induced price of giving should hinge upon the amount given rather than the tax rate which in turn is a progressive function of total income. Moreover, our results confirm the consumption character of donations as normal good.

3.5.3 New donors

To close the circle, we now look how tax incentives are suited to activate new donors and concentrate on the heterogeneity of donations at the extensive margin. This is especially important if policy makers desire to broaden the base of donors.[26] Therefore, we select a sample of 640,134 observations (compared to about 2.2 million in the quasi-dynamic case) consisting only of non-donors in a given year and re-estimate equation (3.4) for the subsequent year. The results for the new donors are displayed in Table 3.5. Roughly 20% of taxpayers who did not donate in a given year change their status from non-donors to donors in the subsequent year, thus estimates start at the 80th quantile and go up to the 99th quantile (for the quasi-dynamic model, the lowest quantile is the 35th). Comparing the results for these new donors with the overall population of taxpayers reveals several differences. Comparing the results of the control variables with estimation results from the quasi-dynamic model, coefficients for socio-demographic characteristics (age, children, married, etc.) and assessment years exceed the results from the quasi-dynamic case but exhibit the same sign. Again, we are most interested in income and price elasticities. Estimates for price elasticities for the new donors are all well below the absolute value of one and even insignificant for the 95th and 99th quantile. The downward sloping pattern for income elasticities slightly mirrors the previous findings: at the lower tale, donors

[26]Unlike in the US where most taxpayers donate, German taxpayers are less likely to donate. Our estimation sample consists of 67.7% donors, which corresponds only to 55% of the weighted observations. This is in line with Bönke et. al (2013) have 55% of donors in their representative sample.

exhibit income elastic behavior with estimates between 1.27 to 0.95 for quantiles .8 to .9 and semi elastic behavior at the very top. Hence it shows clearly, that the propensity to become a donor is mostly income related. Thus, the policy maker needs to consider that tax incentives are not suited to activate donors but only the taxpayers income is. Winning taxpayers over to become donors obviously calls for other instruments than price subsidization.

Table 3.5: Quantile regression results: new donors

Parameter	$Q = 0.8$	$Q = 0.85$	$Q = 0.9$	$Q = 0.95$	$Q = 0.99$
C	-11.22***	-9.95***	-6.27***	-4.65***	-3.34***
y_{it}	1.27***	1.15***	0.95***	0.93***	0.91***
p_{it}	-0.51***	-0.86***	-0.47***	-0.07	-0.18
D child	0.19***	0.23***	0.10***	0.06***	0.10***
D married	0.56***	0.69***	0.11***	-0.10***	-0.14***
D church	-0.28***	-0.35***	-0.24***	-0.22***	-0.31***
Age	0.00	0.02***	0.01***	0.00***	0.00***
Age^2	0.00	0.00***	0.00***	0.00***	0.00***
D limit	6.40***	5.93***	4.63***	4.05***	3.48
Base year income	0.00	0.00	0.00	0.00**	0.00**
D West Germany	-0.10***	-0.02	-0.01	-0.01	-0.01
D $year_1$	-0.09***	-0.10***	-0.06***	-0.02	0.03
D $year_2$	-0.36***	-0.68***	-0.49***	-0.23***	-0.06*
D $year_3$	-0.10***	-0.13***	-0.09***	-0.07***	-0.03
Main $income_1$	0.61***	0.39***	0.37***	0.33***	0.27***
Main $income_2$	-0.82***	-0.79***	-0.43***	-0.38***	-0.44***
Number of observations	638536	639527	640110	640131	640134

Note: Three-step censored quantile regression parameters estimates. Standard errors are bootstrapped with 200 replications, asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). Number of observations vary due to the selection process accounting for the censoring.

Source: Own computation based on TPP 2001-2006.

3.6 Conclusion

We apply the fairly new estimation technique of censored quantile regressions for the first time in a balanced panel setting to investigate donation behavior with administrative income tax data. The German taxpayer panel (TPP) itself is only recently available to researchers, heavily over-samples high incomes and provides rich demographic information on nearly one million taxpayers for six consecutive years. In addition and contrary to the bulk of previous empirical studies on giving, censored quantile regressions allow to assume non-constant price and income elasticities along the distribution of donors. Moreover, the panel setting enables us to disentangle persistent from transitory effects. Altogether, we present estimates for five specifications and perform in addition several tests of robustness. Based on the whole population of donors, the preferred specification represents the quasi-dynamic approach assuming perfect foresight regarding future prices and incomes. This quasi-dynamic model is complemented by three alternative specifications: First, a non-dynamic approach which does not utilize the panel structure but mirrors the procedure and data limitations of previous studies. Second, a quasi-dynamic approach with imperfect foresight shedding some light on the sensitivity of results with respect to the perfect foresight assumption. Third, a quasi-dynamic approach which includes a transitory and permanent income component and thus serves as a robustness exercise for permanent and transitory responses. Last, the results derived for the whole distribution of donors are complemented with estimates for new donors by restricting the sample. All our modeling builds on the underlying theoretical assumption that giving is a function of prices and income. Hence, a full dynamic approach which includes giving as an autocorrelated process is not considered.

Our main results are derived from the quasi-dynamic specification with perfect foresight. Estimates reveal giving behavior to be very heterogenous with coefficient estimates varying substantially across the conditional distribution of donors. Hence, the adoption of censored quantile regressions in this kind of econometric setting is justified and confirms previous works that model giving behavior as heterogenous (e.g. Bönke et al. 2013, Fack and Landaise 2011). In case of persistent income elasticities, taxpayers in the lower conditional distribution of donors show relatively high values in excision of one, while donors in the upper part of the distribution qualify as inelastic. Thus, the downward sloping pattern of income elasticities suggests that donations can be categorized as a normal consumption good, a finding which is also supported by the transitory income elasticity oscillating around .4 for all quantiles. Consequently, donations do not hinge on one-time income fluctuations but rather permanent income changes. Of particular interest due to the direct policy implication for the design of tax incentives are the price elasticities. Across the whole distribution of donors, the permanent price elasticities imply only in parts an elastic behavior: tax incentives matter at the very top and lower tail of the whole distribution of donors. Turning to Feldstein's (1975) rule of treasure efficiency, tax incentives are not efficient to boost giving behavior for a substantial portion of donors in the middle of the distribution. For the new donors, we can establish giving behavior not to be price elastic at all. All of the results above are robust against alternative specifications, including the relaxation of taxpayers foresight on future income and prices or the splitting income into a permanent and transitory component.

We complement the findings and policy recommendation of previous studies in several ways. Amongst others, we extant the previous work by Bönke et al. (2013) and Fack and Landaise (2011) and close a research gap by providing estimates for income and price elasticities in a dynamic set up allowing for heterogonous responses. Of special interest in this matter is the comparison between the quasi-dynamic approaches and the non-dynamic specification which confirms, that estimates provided by previous cross-sectional studies not utilizing panel information due to data limitations are not overly distorted. Then again, some recent panel studies estimate average responses to tax incentives (e.g. Adena 2014, Bakija and Heim 2011). Following our findings, average price elasticities for the whole distribution give a rather inaccurate picture. For example, estimators that provide average elasticities may be driven by behavioral responses of small parts in the distribution and may imply inaccurate measure of treasure efficiency and optimality of tax incentive design. Confirming Bönke et al. (2013) that giving behavior in Germany is price elastic at both tails of the distribution of donors, tax incentives to boost giving behavior have to vary with the amount given and not, as it is currently designed, with income. Hence, more ideal tax incentives have to take the actual amount given into account. In addition, we provide estimates that show that the current design of tax incentives is not likely to activate new donors. The propensity to give is for new donors solely depending on income.

3.7 Appendix

Table 3.A.2 and Table 3.A.2 provide alternative specifications and serve as robustness check for quasi-dynamic approache. Results in Table 3.4 are based on perfect foresight, i.e. taxpayers know their future income and their future price when itemizing their donating. To relax that somewhat strong assumption, results in Table 3.A.1 are based on imperfect foresight. As a sensitivity analysis, taxpayers are only assumed to know their future income and price on average. Following Bakija and Heim (2011), we predict the future income and price using lagged incomes and prices as explanatory variables. Both these estimations have very strong explanatory power with R^2s above .9.

Results with impeferct foresight in Table 3.A.1 strongly resemble results from perfect foresight presented in Table 3.4. The estimates for the permanent income and the permanent price elasticities remain virtually unchanged, so is the lagged income growth, the lagged price growth and the control variables. The only noticeable difference are the estimated elasticities of the future income and future price growth rate. The elasticities of the future income growth are significantly smaller for the model with imperfect foresight for all quantiles. Moreover, all quantiles but the first (.35) have negative elasticities of future income growth, which increases the transitory income elasticity for the medium quantiles above one. The elasticity of the future price growth is significantly larger for the model of imperfect foresight for all quantiles. Estimates are now large and positive, especially for the lower tail resulting into transitory price elasticities exceeding one in absolute value for quantiles between .35 and .5. All in all, results for imperfect foresight appear much less smooth and transitory price elasticities are unreasonable high at the lower tail. This could arise from the estimation process of the future income and price, which might have low explanatory power at the lower tail.

Table 3.A.1: Quantile regression results from the dynamic model with imperfect foresight

Parameter	$Q = 0.35$	$Q = 0.4$	$Q = 0.45$	$Q = 0.5$	$Q = 0.55$	$Q = 0.60$	$Q = 0.65$
C	-13.58***	-12.44***	-11.50***	-10.54***	-9.36***	-8.02***	-6.90***
y_{it}	1.13***	1.09***	1.04***	0.99***	0.94***	0.89***	0.87***
Δy_{it}	-0.28***	-0.30***	-0.29***	-0.29***	-0.29***	-0.31***	-0.30***
Δy_{it+1}	0.15***	-0.02	-0.27***	-0.45***	-0.58***	-0.54***	-0.37***
y_{it} *transitory*	0.71***	0.81***	1.02***	1.15***	1.22***	1.12***	0.94***
p_{it}	-2.07***	-1.37***	-1.10***	-1.10***	-1.21***	-1.17***	-0.99***
Δp_{it}	1.14***	0.65***	0.46***	0.44***	0.59***	0.59***	0.49***
Δp_{it+1}	2.18***	2.58***	1.69***	0.90***	0.11	-0.33***	-0.17 **
p_{it} *transitory*	-3.11***	-3.31***	-2.32***	-1.55***	-0.72***	-0.26***	-0.33***
D child	0.20***	0.23***	0.27***	0.29***	0.27***	0.22***	0.16***
D married	0.33***	0.54***	0.60***	0.56***	0.46***	0.31***	0.19***
D church	-0.59***	-0.58***	-0.56***	-0.55***	-0.52***	-0.45***	-0.37***
Age	0.06***	0.06***	0.06***	0.06***	0.05***	0.05***	0.04***
Age^2	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D limit	4.25***	3.95***	3.75***	3.62***	3.51***	3.42***	3.35***
Base year income	0.00***	0.00***	0.00***	0.00***	0.00**	0.00	0.00***
D West Germany	0.64***	0.54***	0.40***	0.31***	0.28***	0.24***	0.20***
D $year_1$	-0.15***	-0.12***	-0.14***	-0.17***	-0.21***	-0.21***	-0.16***
D $year_2$	-0.48***	-0.38***	-0.30***	-0.26***	-0.25***	-0.23***	-0.19***
D $year_3$	-0.23***	-0.15***	-0.09***	-0.07***	-0.06***	-0.05***	-0.05***
Main $income_1$	-0.06***	-0.04***	0.06***	0.13***	0.15***	0.14***	0.12***
Main $income_2$	-0.87***	-0.71***	-0.51***	-0.38***	-0.31***	-0.27***	-0.26***
Number of observations	2132841	2165267	2175345	2179841	2181960	2182821	2183158

Parameter	$Q = 0.70$	$Q = 0.75$	$Q = 0.8$	$Q = 0.85$	$Q = 0.9$	$Q = 0.95$	$Q = 0.99$
C	-6.09***	-5.52***	-5.04***	-4.52***	-3.88***	-2.64***	-0.70***
y_{it}	0.85***	0.84***	0.84***	0.82***	0.80***	0.74***	0.70***
Δy_{it}	-0.29***	-0.28***	-0.26***	-0.26***	-0.24***	-0.20***	-0.07***
Δy_{it+1}	-0.24***	-0.15***	-0.09***	-0.07***	-0.08***	-0.15***	-0.14***
y_{it} *transitory*	0.81***	0.71***	0.66***	0.64***	0.64***	0.70***	0.78***
p_{it}	-0.89***	-0.85***	-0.83***	-0.87***	-0.97***	-1.27***	-1.55***
Δp_{it}	0.46***	0.45***	0.44***	0.40***	0.38***	0.42***	0.33***
Δp_{it+1}	-0.02	0.12*	0.18**	0.18***	0.09	-0.06	-0.64***
p_{it} *transitory*	-0.41***	-0.52***	-0.57***	-0.65***	-0.68***	-0.79***	-0.58***
D child	0.13***	0.11***	0.09***	0.08***	0.08***	0.09***	0.05***
D married	0.11***	0.06***	0.03***	0.02***	0.04***	0.08***	0.13***
D church	-0.32***	-0.28***	-0.26***	-0.25***	-0.26***	-0.29***	-0.20***
Age	0.03***	0.03***	0.03***	0.03***	0.03***	0.02***	0.01***
Age^2	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D limit	3.27***	3.18***	3.07***	2.92***	2.72***	2.37***	1.88***
Base year income	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D West Germany	0.16***	0.14***	0.12***	0.10***	0.07***	0.04***	-0.01*
D $year_1$	-0.12***	-0.09***	-0.07***	-0.07***	-0.08***	-0.11***	-0.13***
D $year_2$	-0.17***	-0.16***	-0.15***	-0.14***	-0.12***	-0.12***	-0.10***
D $year_3$	-0.05***	-0.05***	-0.05***	-0.05***	-0.05***	-0.04***	-0.03***
Main $income_1$	0.09***	0.06***	0.04***	0.02***	0.03***	0.02**	-0.04***
Main $income_2$	-0.27***	-0.29***	-0.31***	-0.31***	-0.28***	-0.20***	-0.07***
Number of observations	2183294	2183354	2189879	2189882	2189883	2189883	2189883

Note: Three-step censored quantile regression parameters estimates. Standard errors are bootstrapped with 200 replications, asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). Number of observations vary due to the selection process, accounting for censoring.

Source: Own computation based on TPP 2001-2006.

Results in Table 3.A.2 employ an alternative strategy for identifying the persistent and transitory income elasticity. Following Gottschalk and Moffitt (1994), we compute a permanent income as the average income over our panel data with transitory income as the annual deviation from the permanent income.[27] Then, the permanent income $\overline{Y_i}$ for taxpayer i is:

$$\overline{Y_i} = ln(\frac{1}{6}\sum_{t=1}^{6} Y_{it})$$

Accordingly, the transitory income $\widetilde{Y_{it}}$ for taxpayer i in period t is the yearly deviation from the average income:

$$\widetilde{Y_{it}} = ln(Y_{it}) - \overline{Y_i}$$

Results from Table 3.A.2 are remarkable similar to the results from the preferred specification in Table 3.4. Estimates for the permanent income elasticity $\overline{Y_i}$ are only somewhat larger than the estimates for the persistent income elasticities y_{it} in Table 3.4 and show the same downward sloping trend. Transitory income elasticities $\widetilde{Y_{it}}$ in Table 3.A.2 also follow the same pattern like the transitory income elasticities in Table 3.4.
Results for the price elasticity are somewhat smaller in magnitude than from the preferred specification and resemble the price elasticities from the non-dynamic model.

[27]Note that our data contain six straight years. However, results are not sensitive when estimating the permanent income on basis of less years.

Table 3.A.2: Quantile regression results from model with permanent and transitory income

Parameter	$Q = 0.35$	$Q = 0.40$	$Q = 0.45$	$Q = 0.5$	$Q = 0.55$	$Q = 0.6$	$Q = 0.65$
C	-14.46***	-13.17***	-12.20***	-11.34***	-10.26***	-8.58***	-7.39***
$\overline{Y_i}$	1.22***	1.16***	1.10***	1.04***	0.99***	0.93***	0.90***
$\widetilde{Y_{it}}$	0.40***	0.40***	0.38***	0.32***	0.28***	0.29***	0.29***
p_{it}	-1.85***	-1.24***	-0.92***	-0.84***	-0.90***	-0.83***	-0.72***
D child	0.19***	0.22***	0.27***	0.30***	0.29***	0.22***	0.16***
D married	0.31***	0.53***	0.60***	0.56***	0.46***	0.30***	0.17***
D church	-0.58***	-0.57***	-0.55***	-0.53***	-0.51***	-0.43***	-0.35***
Age	0.06***	0.06***	0.06***	0.06***	0.06***	0.05***	0.04***
Age^2	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D limit	4.17***	3.87***	3.70***	3.58***	3.48***	3.40***	3.32***
Base year income	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00
D West Germany	0.62***	0.52***	0.39***	0.30***	0.28***	0.23***	0.19***
D $year_1$	-0.01	0.05***	0.10***	0.12***	0.11***	0.10***	0.11***
D $year_2$	-0.35***	-0.26***	-0.19***	-0.16***	-0.16***	-0.14***	-0.11***
D $year_3$	-0.12***	-0.08***	-0.05***	-0.04***	-0.04***	-0.03***	-0.02***
Main $income_1$	-0.07***	-0.05***	0.04***	0.12***	0.15***	0.14***	0.12***
Main $income_2$	-0.81***	-0.67***	-0.49***	-0.37***	-0.30***	-0.25***	-0.23***
Number of observations	2146623	2176918	2185852	2188547	2189451	2189738	2189832

Parameter	$Q = 0.70$	$Q = 0.75$	$Q = 0.8$	$Q = 0.85$	$Q = 0.9$	$Q = 0.95$	$Q = 0.99$
C	-6.61***	-6.06***	-5.59***	-5.12***	-4.46***	-3.27***	-1.03***
$\overline{Y_i}$	0.89***	0.88***	0.88***	0.87***	0.85***	0.79***	0.73***
$\widetilde{Y_{it}}$	0.29***	0.28***	0.28***	0.28***	0.27***	0.28***	0.55***
p_{it}	-0.68***	-0.68***	-0.70***	-0.75***	-0.87***	-1.14***	-1.42***
D child	0.13***	0.11***	0.09***	0.08***	0.08***	0.10***	0.05***
D married	0.10***	0.05***	0.02***	0.01***	0.03***	0.08***	0.12***
D church	-0.30***	-0.27***	-0.25***	-0.24***	-0.24***	-0.27***	-0.19***
Age	0.04***	0.03***	0.03***	0.03***	0.03***	0.02***	0.01***
Age^2	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D limit	3.24***	3.15***	3.05***	2.91***	2.71***	2.38***	1.87***
Base year income	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
D West Germany	0.16***	0.13***	0.11***	0.08***	0.06***	0.03***	-0.01*
D $year_1$	0.10***	0.11***	0.11***	0.10***	0.09***	0.06***	-0.03***
D $year_2$	-0.09***	-0.07***	-0.06***	-0.05***	-0.04***	-0.05***	-0.07***
D $year_3$	-0.02***	-0.02***	-0.01***	-0.01**	-0.01	-0.01*	-0.02***
Main $income_1$	0.09***	0.06***	0.03***	0.01*	0.02**	0.01	-0.03***
Main $income_2$	-0.24***	-0.26***	-0.28***	-0.28***	-0.25***	-0.17***	-0.06***
N	2189872	2189882	2189883	2189883	2189883	2189883	2189883

Note: Three-step censored quantile regression parameters estimates. Standard errors are bootstrapped with 200 replications, asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). Number of observations vary due to the selection process, accounting for censoring.

Source: Own computation based on TPP 2001-2006.

Table 3.A.3: Net income

Income from business activity
(including income from agriculture and forestry, from unincorporated business enterprise and from self-employed activities)
+ wage income, income from renting and leasing and other income
+ earnings from capital investments (imputation of missing data on an average level)
+ all tax reliefs and tax allowances for income from business activity as far as identifiable
+ allowable expenses for wage and other income (consumptive character)
+ age relief
+ tax-exempted income from foreign countries
+ loan and income indemnification
+ life annuity income less income component (flat 70% of life annuity income)
+ tax shelters: losses from equity holdings
+ losses from business activity income and renting and leasing income, if the modified income class and the sum of income until this point is still negative (negative consumption is not possible)
- fixed income tax and solidarity surcharge
- alimony / child support
+ child benefit
= Net Income (net-of-tax adjusted gross income)

Chapter 4

What Drives Tax Refund Maximization from Inter-temporal Loss Usage? Evidence from the German Taxpayer Panel

4.1 Introduction

The usage of losses is widely recognized as a tax planning tool to reduce tax burden.[1] The German income tax code provides substantial insurance against negative incomes in two ways: (1) negative incomes from one income source can be offset against positive incomes from other income sources from the same year. (2) if the negative incomes exceed positive incomes from the same year, those negative incomes, hence called losses, can be offset against positive incomes from the adjacent years. Incomes from renting and leasing are a prominent example of loss offsetting within a year in Germany and recent results suggest a negative correlation between total income and income from renting and leasing.[2] Losses from business income are the main source for inter-temporal loss usage, which plays a considerable role in the federal German budget and reduces the tax revenue 1.2% annually.[3] Tax units are free to chose the allocation[4] of the losses as a carry-back to

[1]See for instance Bach et al. (2009) who disregard losses from renting and leasing exceeding 5000 Euros for the calculation of individual economic income.

[2]See Müller (2006) for more details on the size and distribution of losses from renting and leasing.

[3]See Bach and Buslei (2009) for an extensive depiction of the influence of losses on the tax budget.

[4]There is a limit on the carry-back for a single tax unit of 500,000 Euros. Carry-forwards are unrestricted until 1,000,000 Euros, and losses exceeding that amount can be still used with 60%. Unused

the year before the loss or as a carry-forward to the year following the loss in the income and tax declaration.[5] This paper calculates if tax units use a tax refund maximizing allocation of losses and estimates what drives that maximizing allocation. Using micro-simulation methods show that only 59% of tax units choose an allocation that maximizes their tax refund from losses, which are hence called refund maximizer. The share of the refund maximizer increases between 8% to 15% when tax units are allowed to have small deviations from the tax refund maximizing loss allocation.

The recent release of administrative micro panel-data from 2001 to 2006 on income tax returns, supplied by the German Federal Statistical Office, opens new possibilities to investigate the inter-temporal loss usage. During that period, the biggest German tax reform in recent history was implemented. The reform lowered tax rates between 2003 and 2005 in two steps and increased incentives to use losses as carry-backs.[6]

Literature on losses can be divided into two branches, individual loss usage and companies loss usage. A milestone in the literature on company losses is the paper by Auerbach and Poterba (1987). Their results suggest that companies losses play a key role for profit strategy and in tax planning. Dwenger (2008) shows for Germany how potential restrictions on inter-temporal loss usage of companies could substantially increase tax revenue.[7] So far, there is only little empirical evidence on the individual loss usage for Germany. Müller (2006) describes contemporary loss offsetting between 1989 and 2001 with five cross sections of tax income returns. He finds a negative correlation between total income and the two main loss sources, income from renting and leasing, and business income. While more than 40% of the aggregated losses from renting and leasing are held by the 10% richest tax units, about 70% of the business losses are obtained by the lowest 10% of the income distribution.[8] Another example by Bach and Buslei (2009) relies on microsim-

losses can be only carry-forwarded but do not expire and must be used once income in the subsequent years is positive.

[5]Tax units are able to delay their income declaration to the end of the following year when the tax unit has knowledge of the incomes from both adjacent years. The declaration asks the tax unit whether she wants to restrict the amount of carry-back and if so by how much. If a tax unit does not report anything, losses will be carried back.

[6]The tax rate in the year the loss is used determines the tax refund. Assuming income from adjacent years being equal and a tax reform lowering tax rates in future years, one would expect tax units to use more losses as carry-back to maximize tax refund.

[7]While only a small share of companies would be affected from the restriction, tax revenue would increase over 1 billion Euros.

[8]Wegener (2014) confirms that the two main individual loss sources are renting and leasing, and

ulation for assessing the impact of losses on effective tax rates on income sources. They compute effective tax rates with and without loss usage and find that effective tax rates significantly increase for most types of incomes when losses are included. Moreover, they show how the loss offsetting regulations decrease tax revenue by 1.2% annually. Lang et. al (1997) find that tax revenue in 1983 is reduced by 33.6% of total tax revenue due to legal and illegal tax avoidance. Estimated effective marginal and average tax rates are as much as sixteen percentage points lower than legislated tax rates and mainly come from tax avoidance through under-reporting of interest income and deductions from real estate.[9]

Inter-temporal loss usage possesses integral features of tax avoidance that allows to complement Lang et al.'s (2013) results: loss usage creates a tax refund in the used year, but costs a reduced tax refund from loss usage in alternative years. This is in line with Slemrod's (2001) model of tax avoidance which derives tax avoidance as a function of the income tax and avoidance costs. Slemrod (1995, 2001) shows that tax avoidance is individually optimal when marginal costs of avoidance equal its individual benefit. Furthermore, inter-temporal loss usage contains features of tax avoidance such as tax planning, renaming or re-timing activities aiming to reduce tax liability.
This chapter contributes to the literature on tax avoidance and individual loss usage with a special case of tax avoidance for Germany. To the best of my knowledge, it is the first paper to measure tax avoidance in the special context of inter-temporal loss usage. Incentives for tax avoidance depend on the individual income and the associated tax refund. The particular inter-temporal loss offset feature of the German income tax code can be used to maximize the inter-temporal tax refund by choosing the right allocation of carry-back and carry-forward.

Applying the popular Probit model shows that tax refund maximization highly depends on the difference between the tax rates from the loss adjacent years. A tax rate difference of 10 percentage points between the years prior to the loss and subsequent to the

business income, and finds that the majority of losses are contemporary offset with positive incomes. This is especially true for losses from renting and leasing where 96% of all losses are contemporary offsets. About 84% of losses from business income are contemporary offset.

[9] Bach et al. (2013) remark that those numbers are based on survey data that do not include the richest two percent of German tax units, and do not allow to draw conclusions about taxation of the top.

loss increases the probability of refund maximization by 24.5 percentage points.[10] This is in line with the result from Alstadsaeter and Jacob (2012) who find that tax incentives have a particular high impact on tax avoidance.[11] The results for the tax rate difference are robust against the inclusion of control variables for incomes and losses. Somewhat surprising are results that tax consultants do not have a significant influence on the probability of refund maximization. By contrast, the size of the loss can have an impact on the probability of refund maximization.[12]

This chapter proceeds as follows: Section 4.2 describes the German tax system, recent tax reforms and the mechanics of loss usage. Section 4.3 presents some descriptive results and Section 4.4 shows regression results and section 4.5 concludes.

4.2 The German Income Tax System and Reforms

The German income tax schedule is progressive, taxable income above the basic allowance is divided into three brackets with increasing marginal tax rates within the two lower brackets and a constant marginal tax rate in the top bracket. Moreover, it discriminates substantially between single and married tax units.[13]

Further, the German tax code allows tax units to delay their income declaration until the end of the subsequent year. Thus, tax units are able to know their taxable incomes from the years surrounding a loss before they have to choose a loss allocation.[14] The

[10] Using 10 percentage points is a conservative number for the tax rate difference. Tax units with losses in a year have high income variance and accordingly high tax rate variance. Tax refund maximizer have a high mean of tax rate difference with 20.6 percentage points.

[11] Alstadsaeter and Jacob (2012) classify tax avoidance into three categories: incentive, access and awareness. Using a regression discontinuity design to investigate income shifting from personal income to corporation income induced by the Swedish capital taxation reform 2006, the authors find that tax minimization activities increase significantly with increasing tax rates and awareness of the tax code.

[12] Losses increase the probability of tax refund maximizing in the benchmark specification but reduce the probability in alternative specifications.

[13] Married taxpayers can opt for the splitting tax schedule to decrease their joint taxation and marginal tax rates. Marginal tax rates for married couples are determined as if one single taxpayer would earn the average taxpayers income. Accordingly, the tax burden is calculated as twice as much the single taxpayer with the average income would have to pay.

[14] The data deliver detailed information on the usage of losses. I.e. it is possible to identify the amount of carry-back and carry-forward. Furthermore, it is possible to determine the income source with the loss.

German Income Tax code allows several tax reliefs on total income reducing the basis for the taxable income. Losses from other years need to be used primarily before other reliefs can be employed. However, only if total income is negative, tax units can use their negative income as a loss in other years. A negative taxable income or a taxable income below the basic allowance is not sufficient to claim inter-temporal loss usage.[15] Once tax units declare a loss, they can use the loss as a carry-back in the year prior to the loss, or as carry-forward in the year(s) after the loss in any arbitrary composition of carry-back and carry-forward. The income declaration asks to limit the amount of carry-back. If the tax unit does not choose an amount, the loss will be carried back until total income from the prior year is either zero or the losses are all carried back. Losses which are not used as carry-back need to be used as carry-forward once the total income from the subsequent year is positive.[16] Unfortunately, the data do not allow to use losses from earlier years than 2004 due to other reforms on the loss offset law.[17]

Marginal tax rates from the loss adjacent years determine the tax refund from the loss usage. The most prominent income tax reform in recent German history had an impact on marginal tax rates and was passed in 2000. The reform consisted of a gradual reduction of the personal income tax schedule, accompanied by modest tax base broadening and combined several steps which lowered the whole income tax schedule from 2003 to 2004 and from 2004 to 2005.[18] Figure 4.1 demonstrates the effect of the reform on marginal tax rates for an individually taxed tax unit.

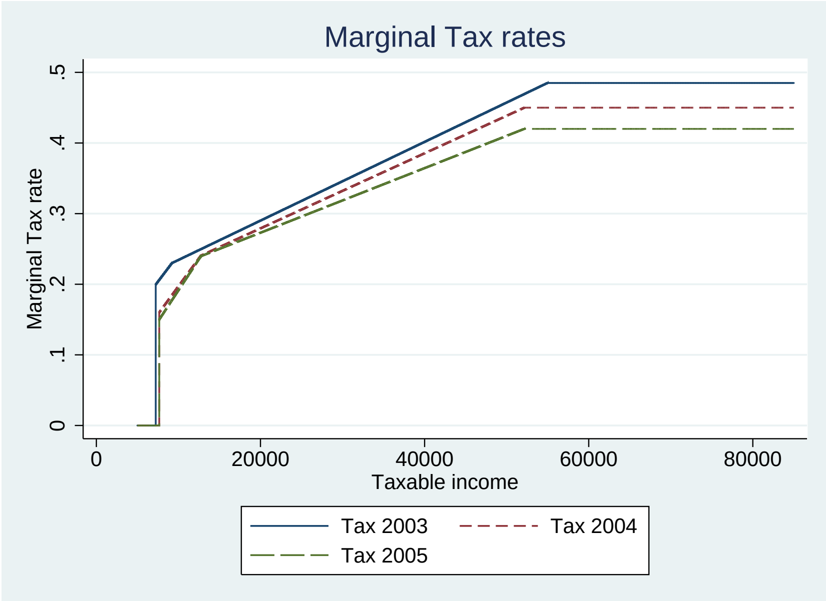
[15] Note that other tax reliefs lose their tax saving potential, once used losses reduce total income below the basic allowance in the employed year.

[16] However, there are restrictions on the maximum amount of loss usage. Carry-back cannot exceed 500,000 Euros (1,000,000 Euros) for single (married) tax units. Carry-forward is unrestricted until 1,000,000 Euro (2,000,000 Euro) for single (married) tax units, and restricted to 60% for losses exceeding 1,000,000 Euro (2,000,000 Euro). Remaining losses can be used in the following years.

[17] The usage of losses between 2001 and 2003 was primarily restricted to usage within income sources. A complex deduction system also allowed to offset a limited amount of high losses with positive incomes from other sources. However, the data is not providing conclusive identification to connect losses and their usage in other years.

[18] Besides the reduction of all marginal tax rates, the basic tax allowance was slightly increased from 7,206 Euro in 2003 to 7,664 Euro in 2005.

Figure 4.1: Marginal tax rates for an individually tax unit



Note that the tax reform decreased the tax refund from carry-forward and increased incentives for loss usage as carry-back. Equation (4.1) illustrates an example of incentives for loss usage for the first loss Euro, with $\Delta\tau$ as the difference of tax refund when one Euro loss is used as carry-back or as carry-forward. $\tau_{t-1}(Z_{t-1})$ $(\tau_{t+1}(Z_{t-1}))$ denotes the marginal tax rate from the year prior to (following) the loss and Z_{t-1} (Z_{t+1}) is taxable income from the year prior to (following) the loss.

$$\Delta\tau = |\tau_{t-1}(Z_{t-1}) - \tau_{t+1}(Z_{t+1})| \tag{4.1}$$

The tax rate difference for the first loss Euro shows the additional tax saving from choosing the loss usage as carry-back in contrast to the loss usage as carry-forward. In the case that tax rates equal each other, the tax unit cannot create a bigger tax refund from choosing more carry-back over carry-forward and vice versa.
Thus, the first loss Euro tax refund difference demonstrates incentives for the tax planing of the loss: the higher the tax rate difference the higher the corresponding tax refund.
Accordingly, only the first loss Euro tax difference can be used for the further analysis because the maximization the tax refund from a considerable loss implies that the marginal tax rates from the adjacent years are equal after loss usage.[19] This implies that

[19] This is true unless the refund is maximized by using losses only in one year. That could be in the

maximizing the tax refund from losses underlies the same optimization process than tax avoidance does: individual tax avoidance is maximal when marginal avoidance costs equal the marginal tax saving. To avoid an endogeneity problem when estimating the probability of tax refund maximization, only the tax rate difference of the first loss Euro is used in the further analysis.[20]

The refund is maximized when losses are used in the year with the higher marginal tax rate. Thus, tax units that are not able to increase their tax refund from a reallocation of loss usage can be defined as tax refund maximizer.[21]

4.3 Descriptive Results

This section displays some descriptive results of German tax units with losses. Starting with simple descriptive results, the section continues with an analysis of the distribution of refund maximizers and the distribution of deviating losses from the refund maximizing allocation. Subsequently, the section shows at which positions of the income distribution tax units with losses are, and finishes with more detailed descriptive statistics.

Simple descriptive results are presented in Table 4.1. The Table contains the tax rate difference $\Delta\tau$ for tax refund maximizer and for non-maximizer, the loss and the adjacent incomes Z_{t-1} and Z_{t+1}. Table 4.1 shows that $\Delta\tau$ is 58% higher for refund maximizer than for non-maximizer. Losses and incomes Z_{t-1} and Z_{t+1} are high on average with very high variation. Moreover the mean-median ratio shows that incomes and losses are highly skewed with mean-median ratios exceeding 3. The size of the individual maximal tax refund is a combination of the loss and the corresponding tax rates from the adjacent years. Accordingly, one would expect that incentives to maximize the refund show positive correlation with increasing adjacent incomes and with increasing size of the loss. Further, one would expect that the probability of refund maximization particularly correlates with

case of a small loss or comparable high income in one year and comparable low income in the other year.

[20] In the case that the tax refund is maximal through loss usage with both carry-forward and carry-back, the tax rate differences for the last Euro is zero.

[21] Alternatively, one can allow tax units to differ from this strict definition of tax refund. One alternative definition allows tax units to deviate with up to 200 Euros from their maximal tax refund, another definition allows tax units to deviate up to 5% of losses weighted by average income. In addition another definition tax units can deviate up to 2% of the potential maximum of tax refund.

a combination of losses and adjacent income: the loss income ratio.

Table 4.1: Descriptive statistics for selected variables

	Mean	Median	Mean-Median Ratio	Std.	N. Obs.
$\Delta\tau$, RM	.208	.207	1.005	.13	5227
$\Delta\tau$, NRM	.132	.084	1.57	.12	3604
Losses	-111871	-16388	6.83	479753	8831
Z_{t-1}	126940	33909	3.74	550264	8831
Z_{t+1}	136334	28984	4.70	560245	8831

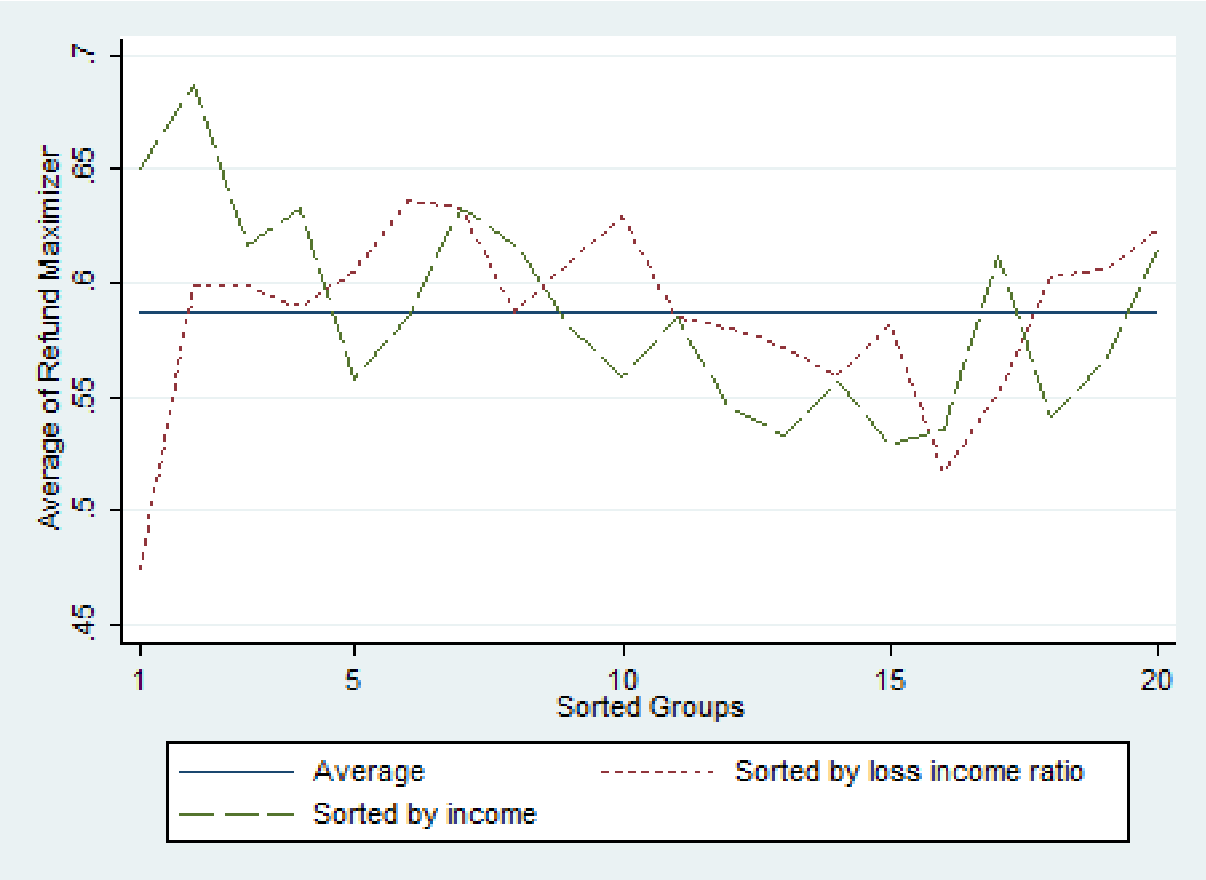
Notes: RM denotes tax units that maximize the tax refund, NRM denotes tax units that do not maximize the tax refund. Z_{t-1} denotes the total income from the year prior to the loss, Z_{t+1} denotes total income from the year subsequent to the loss, N. Obs. is the number of observations with losses from either 2004 or 2005 with incomes in the adjacent years exceeding the basic allowance.

Source: Own computation based on German Taxpayer Panel 2001-2006.

Figure 4.2 illustrates shares of tax units that maximize their tax refund. Tax units are sorted into 20 equally sized groups and average shares of refund maximizer are computed for every group. The long dashed line presents the groups average shares sorted by increasing income from adjacent years, the dashed line presents the groups average shares sorted by the increasing ratio of losses to income from adjacent years, using that loss income ratio as an indicator for the relevance of the losses to the tax units. The solid line is the overall average share of tax refund maximizer with 59%. The figure displays that there is no clear pattern for refund maximization with either increasing income or increasing loss income ratio. Shares of refund maximizer differ only little per group from the overall mean. Only the lowest two groups of the income sorted tax units have substantially higher refund maximization rates and only the lowest group of the losses weighted by income has a substantially lower rate of maximization rate.[22] The message of Figure 4.2, though, is limited to the correlation between shares of tax refund maximizer and two variables: income and the loss income ratio. However, the figure is not able to reveal the magnitude of the deviations from the refund maximizing loss allocations.

[22] Sorting tax units by losses looks very similar to the sorting by income.

Figure 4.2: Distribution of shares of refund maximizer



To complement Figure 4.2, Figure 4.3 depicts how much tax units deviate from the refund maximizing loss allocation. Average shares of deviating losses are computed and ordered into 20 equally sized groups and sorted by adjacent income (solid line) or the losses income ratio (dotted line). Sorting tax units according to income shows a very robust share of deviating losses for all 20 groups. Sorting according to the loss income ratio however, highlights a strong decline for deviating loss from an increasing ratio.[23]

[23] Appendix (4.6.2) shows very similar results for further tax refunds weighted by the losses in Figure 4.5.

Figure 4.3: Share of deviating losses

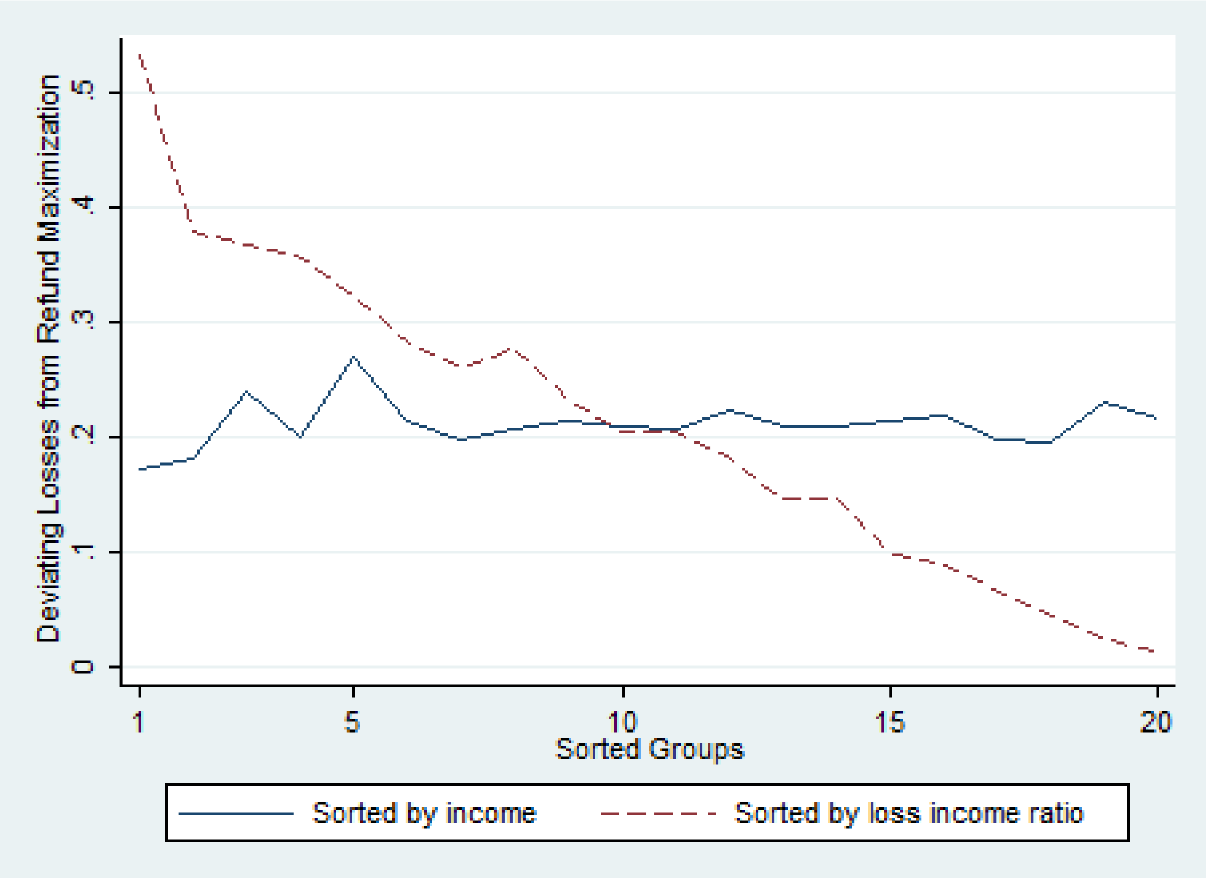


Figure 4.2 and Figure 4.3 provide three insights. (1) Adjacent income neither drives the probability of refund maximization nor deviating losses from the refund maximizing loss allocation. (2) The loss income ratio does not drive the probability of refund maximization but shows strong correlation to the deviating losses. (3) With increasing loss income ratio, i.e. relevance of losses to the tax units, deviating losses from refund maximization decrease.

Figure 4.4 shows that inter-temporal loss usage is not concentrated on one section of the income distribution and matters to the whole income distribution. However, the size of the losses along the distribution increase exponentially with the income decile.[24] The solid blue line in Figure 4.4 is the relative share of all tax units with losses in the decile. The dotted red line is the average loss in a decile divided by overall average loss.[25] Figure

[24] The position in the income distribution is defined on the average income in all years but the year of the loss and expressed with 10 deciles.

[25] The average loss is the mean loss of all tax units with losses.

4.2 shows that the majority of tax units with losses are located in the second and third decile. Losses below the sixth decile are small compared to the average loss, but increase exponentially with the deciles. Losses are highest in the top decile and about 23 times higher than the average loss.

Figure 4.4: Distribution of losses

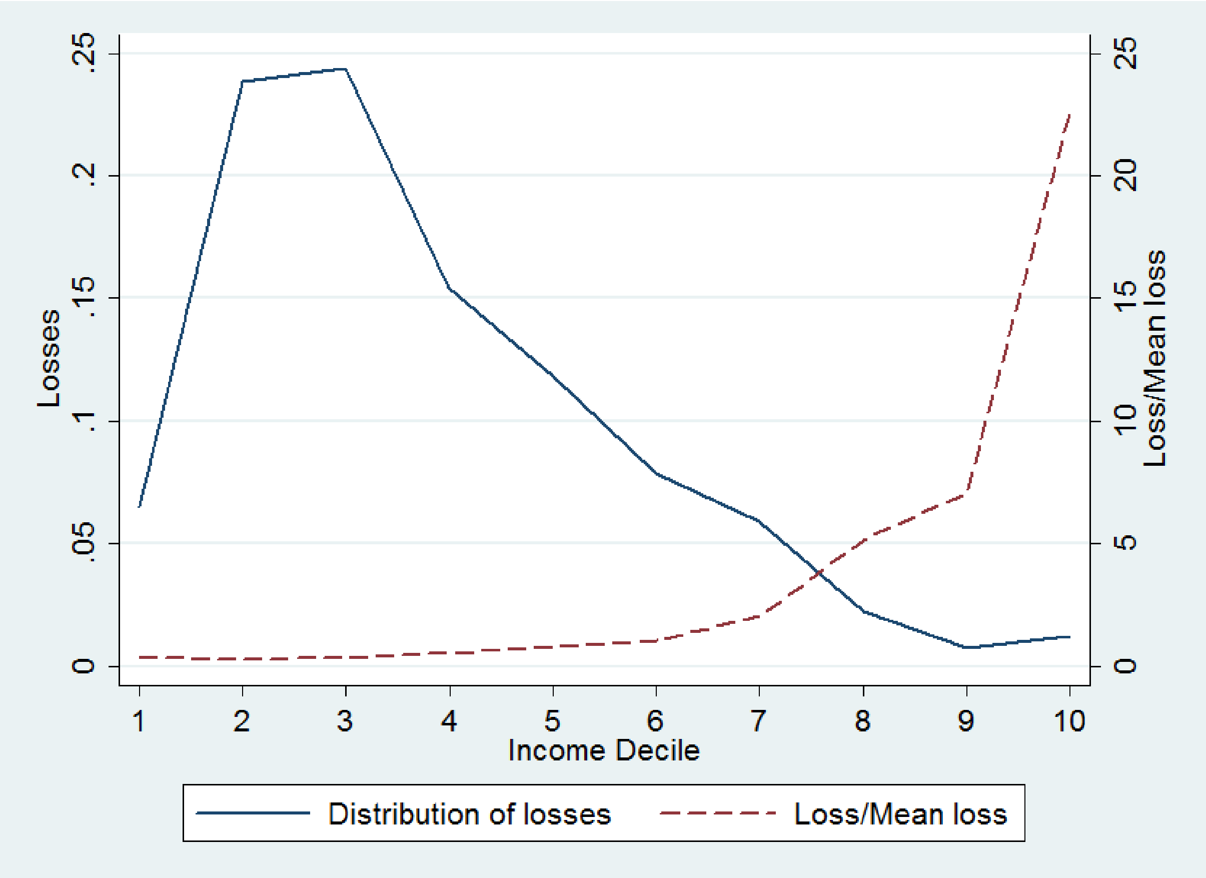


Table 4.2 continues with descriptive results that is better able to show incentives for the loss usage as carry-forward or carry-back. Even if the tax reform, depicted in Figure 4.1 lowered the tax refund from carry-forward for losses from 2004 or 2005, a refund from carry-forward could still be higher than from carry-back, depending on the tax units income distribution. Table 4.2 illustrates incentives for particular loss usage by sorting tax units with different income distributions into different groups. The left panel shows descriptive results for tax units with higher income in the year prior to the loss than following the loss ($Z_{t-1}>Z_{t+1}$), the right panel shows descriptive results for tax units with

higher incomes in the year following the loss ($Z_{t-1}<Z_{t+1}$). In both panels are tax units separated into refund maximizing (RM) and non-maximizing (NRM) observations. Table 4.2 confirms for both panels that refund maximizing tax units have higher averages of tax rate differences than non-maximizing tax units. There are two further points about the descriptive results for the tax rate differences worth noting. First, the gap between the tax rate differences between refund maximizing and non-maximizing is particularly huge in the right panel with higher income in the following year. Second, due to the tax reform that lowered tax rates in years following the loss, tax units that do not maximize the tax refund would have a 17.4 percentage points higher tax refund from using the first loss Euro as carry-back than from carry-forward.

Table 4.2: Mean and standard deviation sorted after adjacent incomes

	$Z_{t-1}>Z_{t+1}$		$Z_{t-1}<Z_{t+1}$	
	NRM	RM	NRM	RM
$\Delta\tau$	.174	.22	.072	.197
	(.12)	(.13)	(.07)	(.12)
	Carry-Forward			
$\frac{Forward}{Z_{t+1}}$	.518	.20	.389	.398
	(.41)	(.38)	(.40)	(.37)
$\frac{Forward}{Losses}$	.618	.077	.549	.781
	(.42)	(.20)	(.44)	(.34)
$\frac{Forward}{Used\ Losses}$	.884	.128	.676	.900
	(.32)	(.27)	(.46)	(.27)
	Carry-Back			
$\frac{Back}{Z_{t-1}}$	.065	.291	.147	.082
	(.20)	(.29)	(.28)	(.23)
$\frac{Back}{Losses}$	.113	.810	.316	.09
	(.31)	(.34)	(.45)	(.26)
$\frac{Back}{Used\ Losses}$	.116	.872	.324	.10
	(.32)	(.27)	(.46)	(.27)
Number of Observation	2136	2515	1468	2712

Notes: RM denotes tax units that maximize the tax refund, NRM denotes tax units that do not maximize the tax refund. Z_{t-1} is total income from the year prior to the loss, Z_{t+1} income from the year following the loss. Observations are taxpayers with losses from either 2004 or 2005 and with incomes exceeding the basic allowance in the adjacent years.

Source: Own computation based on German Taxpayer Panel 2001-2006.

Table 4.2 also displays the distribution of loss usage in greater detail. Three ratios show different aspects of loss usage: the first ratio compares carry-forward (carry-back) to income of the following year (income of the prior year), the second carry-forward (carry-back) to the total losses and the third carry-forward (carry-back) to all used losses.[26] The three measures confirm that non-maximizing tax units do not use their losses according to their income and tax rate distribution. The sub-group of non-maximizing tax units with higher incomes in the year prior to the loss, use only 12% of carry-back of their used losses while using 62% of total losses as carry-forward. Those tax units use excessive carry-forward even when the refund from carry-back would be higher.[27] This is particularly interesting since the German income tax code would automatically assign losses as carry-back if not chosen differently by the tax unit. Also, carry-backs offer other potential advantages: the tax refund is one year earlier than a refund from the subsequent year and higher tax rates in the year prior to the loss offer higher tax refunds. In contrast, tax refund maximizing tax units with higher income in the year prior to the loss use 87% of their used losses as carry-back and only 8% of total losses as carry-forward. Non-maximizing loss users in the right panel have a low average of tax rate difference and use excessive carry-back. However, differences between refund maximizing and non-maximizing tax units are not as striking for tax units with higher incomes in the year following the loss. Refund maximizing tax units use 90% of their losses as carry-forward, while non-maximizing tax units only 68%. However note that differences between groups are not statistically significant in this descriptive analysis.

4.4 Regression Analysis

This section presents results from the regression analysis. Section 4.4.1 starts with results from the Probit model in Table 4.3. Results are based on a strong criterion for tax refund maximization: every tax unit that could have an increased tax refund from an alternative loss allocation is denoted as non-maximizing. A sensitivity analysis, relaxing this strong requirement on refund maximization is presented in in Table 4.4.
All results from Table 4.3 and Table 4.4 are drawn from a selective sub-sample with tax

[26] Total losses can exceed the used losses if total losses are bigger than the adjacent income.
[27] About 60% of all tax units use only carry-forward, 29% use only carry-back and only 11% use both carry-back and carry-forward.

units that face a decision of their loss usage between carry-back and carry-forward.[28] This induces a potential selection problem and section 4.4.2 presents results in Table 4.5 based Probit model which controls for the selective nature of the data following Heckman (1979).

4.4.1 Probit model

The Probit model estimates the tax refund maximizing loss usage y_i of tax unit i equaling 1 if the tax unit maximizes the tax refund, and 0 if not. The model includes a constant, the individual difference of the tax rates $\Delta\tau_i$ and two types of control variables X_i and Z_i. $\Delta\tau_i$ is allowed to have a non-linear relationship, measured by α_1 and α_2, X_i contains characteristics of the tax unit which could have an influence on loss usage, measured by column vector β_1 and Z_i includes the adjacent incomes and the absolute value of the loss in logs, measured by column vector β_2.[29] To control for the influence of the variables contained in Z_i, regressions are also performed using only a subset of the controls of Z_i. u_i is the error term and is assumed to follow the standard normal distribution.[30] Since tax units can file the income report at the end of the year following the loss, I assume that all incomes from loss adjacent years and the loss are exogenous to usage of the loss.[31]

$$y_i = c + \alpha_1\Delta\tau_i + \alpha_2(\Delta\tau_i)^2 + \beta_1' X_i + \beta_2' Z_i + u_i \tag{4.2}$$

Column I of Table 4.3 shows marginal effects for the Probit model of equation(4.2) without controls for adjacent income and loss. The tax rate difference has a significant, high and concave effect on the likelihood of tax refund maximization. Higher tax rate differences have a strong impact on the probability of tax refund maximization. A tax rate difference of 10 percentage points increases the probability of tax refund maximization by 20.8 percentage points. Most of the control variables including the tax consultant dummy are insignificant, which is surprising.[32]

[28] Only tax units with income above the basic allowance in the years adjacent to the loss can reduce tax burden in both years with the usage of carry-back or carry-forward.

[29] Table 4.A.4 in the appendix describes the control variables in greater detail.

[30] To check that assumption, results for the Logit model, assuming a standard logistic error distribution and the linear probability model, assuming a uniform distribution, are presented in the appendix.

[31] This is equivalent to assuming that tax units do not produce a loss in a year on purpose.

[32] The data provide information about expenses for conducting the income report. Tax units that

Tax units with higher incomes are likely to have a higher variation in income, and be able to profit from experience with tax minimizing strategies.

Table 4.3: Probit model with different specification

	I	II	III	IV
$\Delta\tau$	2.378***	2.382***	2.426***	2.459***
	(0.122)	(0.123)	(0.126)	(0.126)
$\Delta\tau^2$	-3.033***	-3.045***	-2.448***	-2.509***
	(0.286)	(0.288)	(0.294)	(0.294)
$ln(Z_{t-1})$			-0.057***	-0.049***
			(0.005)	(0.005)
$ln(Z_{t+1})$			0.074***	0.080***
			(0.004)	(0.004)
ln(loss)		0.064***		0.087***
		(0.016)		(0.016)
ln(loss)^2		-0.003***		-0.005***
		(0.001)		(0.001)
D tax consultant	0.015	0.011	0.010	0.007
	(0.011)	(0.011)	(0.010)	(0.010)
D business	-0.037*	-0.030*	-0.028	-0.023
	(0.015)	(0.015)	(0.015)	(0.015)
D business, high	0.038**	0.021	0.010	0.007
	(0.013)	(0.014)	(0.013)	(0.014)
D rent	0.009	0.008	0.013	0.010
	(0.015)	(0.015)	(0.015)	(0.015)
D rent, high	0.005	-0.006	-0.008	-0.013
	(0.015)	(0.015)	(0.015)	(0.015)
D year	-0.022*	-0.023*	-0.021*	-0.021
	(0.010)	(0.010)	(0.010)	(0.010)
D prior losses	-0.045***	-0.046***	-0.059***	-0.057***
	(0.012)	(0.012)	(0.012)	(0.012)
Pseudo-R^2	.090	.091	.126	.128
Number of Observations	8831	8831	8831	8831
Share of RM	.592	.592	.592	.592

Notes: Regressions also include a constant, a marriage dummy and a dummy for losses bigger than income from adjacent years. Asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). $ln(Z_{t-1})$ is the logarithm of the total income from the year prior to the loss, $ln(Z_{t+1})$ is accordingly the income from the year following the loss. Share of RM is the relative share of refund maximizing tax units.
Source: Own computation based on German Taxpayer Panel 2001-2006.

Also, tax units with higher losses might substantially differ from tax units with lower losses but could have the same tax rate difference. For instance, they could have more

exceed a lower threshold of expenses are assumed to have a tax consultant. However, results are robust against any probability level.

resources at their disposal to plan their income declaration, have higher education or experience the loss with a different background.
To control for influence of potential heterogeneity between tax units with the same tax rate difference, results in column III and IV include the losses and column II and IV include the adjacent incomes. Adding the losses in column II has no effect on the coefficients of the tax rate differences. However, the probability of tax refund maximization increases with increasing losses, also with a concave effect.
Including incomes from the adjacent years in column III leaves the marginal effects of the tax rates virtually unchanged. The marginal effect of income from the year before the loss is negative, the marginal effect from income from the year following the loss is positive. This is connected to the tendency of a large group of tax units to use losses preferably in the following than the prior year.

Adding both the incomes and losses in column IV does not affect the tax rate difference significantly, but slightly increases its effect. Now, a 10 percentage point tax rate difference increases the probability of tax refund maximization by 22 percentage points.
First robustness checks are performed in Table 4.4 which presents a variation in the criterion of of tax refund maximization. Column I is a reproduction of column IV of Table 4.3 and is based on the strong refund maximization criterion.

To control for this strong requirement of refund maximization, three alternative definitions are applied and compared to the benchmark results from column I. Results in column II are produced based on the first alternative refund maximization definition: tax units can deviate up to 200 Euros of tax refund from the strong criterion. This criteria does not penalize minor deviations from strict refund maximization.[33] This increases the share of refund maximizing tax units by 7.6 percentage points. The second alternative in column III allows tax units to deviate up to 5% of the loss income ratio. This is my preferred specification because it allows relative small deviations from the strong criterion and redefines only tax units with their majored of losses used for refund maximization.

This is my preferred specification because it allows relative small deviations from the strong criterion and redefines only tax units that use their majority of losses for refund

[33]Note that this criteria changes the sorting of the tax units asymmetrically and is likely to redefine non-maximizing tax units with small losses more often into the refund maximization category than tax units with bigger losses.

maximization.[34] Compared to the benchmark, the share of refund maximizer increases by 11.5 percentage points. Column IV shows results based on the third alternative: tax units can deviate up to 2% of the potential maximum of tax refund, which increases the share by 14.8 percentage points to 74%.

Table 4.4: Probit for different criteria of refund maximization

	I	II	III	IV
	No Deviation allowed	200 Euro Deviation	Loss weighted Deviation(5%)	Tax-Refund weighted Deviation(2%)
$\Delta\tau$	2.459***	2.155***	1.801***	1.633***
	0.126	0.120	0.120	0.115
$\Delta\tau^2$	-2.509***	-2.525***	-1.436***	-1.509***
	0.294	0.278	0.284	0.269
$ln(Z_{t-1})$	-0.049***	-0.052***	-0.014**	-0.023***
	0.005	0.005	0.005	0.005
$ln(Z_{t+1})$	0.080***	0.040***	0.064***	0.049***
	0.004	0.004	0.004	0.004
ln(loss)	0.087***	-0.201***	-0.219***	-0.301***
	0.016	0.020	0.021	0.023
ln(loss)^2	-0.005***	0.009***	0.008***	0.012***
	0.001	0.001	0.001	0.001
D tax consultant	0.007	0.005	0.012	0.014
	0.010	0.010	0.010	0.009
D business	-0.023	-0.038**	-0.059***	-0.052***
	0.015	0.015	0.014	0.014
D business, high	0.007	0.028*	0.042**	0.053***
	0.014	0.013	0.013	0.013
D rent	0.010	0.011	0.002	0.004
	0.015	0.014	0.014	0.013
D rent, high	-0.013	0.007	0.003	0.013
	0.015	0.014	0.014	0.013
D year	-0.021*	0.003	0.007	0.011
	0.010	0.009	0.009	0.009
D prior losses	-0.057***	-0.048***	-0.029**	-0.029**
	0.012	0.011	0.011	0.010
Pseudo-R^2	.128	.14	.128	.123
Number of Observations	8831	8831	8831	8831
Share of RM	.592	.668	.707	.740

Notes: Regressions also include a constant, a marriage dummy and a dummy for losses bigger than income from adjacent years. Asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). $ln(Z_{t-1})$ is the logarithm of the total income from the year prior to the loss, $ln(Z_{t+1})$ is accordingly the income from the year following the loss. Share of RM is the relative share of refund maximizing tax units.

Source: Own computation based on German Taxpayer Panel 2001-2006.

[34]Noe, that this alternative does not assign tax units with small losses automatically to the tax refund maximizing category.

A tax rate difference of 10 percentage points increases the likelihood of refund maximization by 19 percentage points in column II, by 16.6 percentage points in column III and by 14.8 percentage points in column IV. However, while the marginal effect of the tax rate difference decreases, it remains significant and has a high influence on the likelihood of refund maximization.

Results for the tax rate difference suggest that the increasing share of refund maximizer reduces the differences between the refund maximizer and the non refund maximizing tax units. Changing the definition of refund maximization induces only one noticeable difference for the control variables with the coefficients for the loss. The coefficient changes from 0.09 in column I to -0.20 in column II and remains that high and negative for the alternative specifications in column III and IV. This indicates that tax units with smaller losses change disproportionally more from the non-maximizing to the refund maximizing group. Moreover, this implies the surprising result that following column II to IV, the higher the loss of the tax unit, the lower the probability of refund maximization.

4.4.2 Probit model including a selection control

Results so far can be driven by a potential selection bias through non-random selection which would not allow to interpret the marginal effects as causal effects.[35] To control for the selection, results in Table 4.5 are based on the Probit model including a Heckman (1978) selection control.[36]

Results in Table 4.5 are produced analogously to results in Table 4.4 with varying refund maximization criteria. The selection parameter, the inverse Mills ratio λ is significant for all specifications with little variation between the optimality definitions and a mean of 0.1Again, most marginal effects of the control variables are not sensitive to the criterion of refund maximization. A 10 percentage point tax rate difference in my favored specification in column III increases the probability of refund maximization by 24.5 percentage points. The effect of the loss is negative for all specifications but the benchmark criteria, with smaller marginal effects (in absolute value) in column II to IV.

[35] Results from Table 4.3 and Table 4.4 are based on a heavy selective sample: only tax units with losses and adjacent incomes exceeding the basic allowance have the necessary loss usage circumstances.

[36] The exclusion restriction for the Heckit is the number of children, age of the tax units and information about losses from earlier years.

Results from these estimations confirm that tax incentives determine loss usage. High tax incentives increase the likelihood of refund maximization, thus driving tax avoidance.

Table 4.5: Probit model including selection control for different criteria of refund maximization

	I	II	III	IV
	No Deviation allowed	200 Euro Deviation	Loss weighted Deviation(5%)	Tax-Refund weighted Deviation(2%)
$\Delta\tau$	3.100***	2.930***	2.800***	2.617***
	(0.201)	(0.194)	(0.192)	(0.186)
$\Delta\tau^2$	-3.858***	-4.155***	-3.536***	-3.577***
	(0.444)	(0.426)	(0.426)	(0.410)
$ln(Z_{t-1})$	-0.029***	-0.028***	0.016*	0.006
	(0.007)	(0.007)	(0.007)	(0.007)
$ln(Z_{t+1})$	0.098***	0.061***	0.091***	0.076***
	(0.006)	(0.006)	(0.006)	(0.006)
ln(loss)	0.173***	-0.105***	-0.098**	-0.185***
	(0.027)	(0.028)	(0.028)	(0.029)
$\ln(\text{loss})^2$	-0.010***	0.004*	0.001	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
D tax consultant	0.003	0.000	0.006	0.008
	(0.011)	(0.010)	(0.010)	(0.009)
D business	-0.015	-0.029*	-0.048**	-0.041**
	(0.015)	(0.015)	(0.014)	(0.014)
D business, high	-0.001	0.019	0.031*	0.042**
	(0.014)	(0.014)	(0.013)	(0.013)
D rent	0.015	0.017	0.010	0.012
	(0.015)	(0.014)	(0.014)	(0.013)
D rent, high	-0.018	0.001	-0.003	0.007
	(0.015)	(0.014)	(0.014)	(0.013)
D year	-0.036***	-0.015	-0.016	-0.012
	(0.011)	(0.010)	(0.010)	(0.009)
D prior losses	-0.084***	-0.081***	-0.072***	-0.070***
	(0.014)	(0.013)	(0.013)	(0.012)
λ	0.112***	0.138***	0.176***	0.175***
	(0.028)	(0.028)	(0.027)	(0.026)
N_1	8831	8831	8831	8831
N_2	1849155	1849155	1849155	1849155
Share of RM	.592	.668	.707	.740

Notes: Regressions also include a constant, a marriage dummy and a dummy for losses bigger than income from adjacent years. Asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). $log(Z_{t-1})$ is the logarithm of the total income from the year prior to the loss, $log(Z_{t+1})$ is accordingly the income from the year following the loss. λ denotes the inverse Mills ratio from Heckmans sample selection model. N_1 is the number of observations used in the second stage of the model, N_2 the number of observations that are not included in the second stage of the model but in the first stage of the Heckman model. Share of RM is the relative share of refund maximizing tax units.

Source: Own computation based on German Taxpayer Panel 2001-2006.

Moreover, tax units with low tax rate differences do not use losses to maximize tax refunds because incentives are not high enough.

4.5 Conclusion

This paper uses a substantial insurance component of the German income tax code to study opportunities of tax avoidance. German tax units with severe income shocks who experience a loss in a year can offset that loss with positive incomes from adjacent years. Tax avoidance is maximized if the offset losses are used according to tax rates from the loss adjacent years.

The paper uses a unique German tax return panel data that comprise six straight years, from 2001 to 2006, and three different tax rate schedules. That data connects exhaustive individual information about incomes, socio-demographic characteristics and losses. Moreover, it allows to connect the losses from one year with its usage in the surrounding years. Micro simulation provides tax rates and the computation of the potential tax refund from the loss usage, and the computation of the refund maximizing loss usage. The progressive German tax schedule and two steps of a recent income tax reform provide strong exogenous variation of tax refund and promote to use losses in the year before the loss.

Results show that only about 59% of tax units maximize their tax refund. Non-refund maximizing tax units belong mainly to two groups: tax units with low increase of tax refund from an alternative loss allocation, or tax units that prefer future tax refund over current tax refund.[37] However, the share of 59% refund maximization is based on a strong criterion for tax refund maximization: the tax unit needs to use all losses according the refund maximization loss allocation. Relaxing that somewhat strong criterion by allowing minor deviations increases the share up to 67% or 74% depending on the deviation concept.

To investigate determinants that drive tax refund maximization, this chapter further em-

[37] That is particular interesting since the German income tax code would automatically assign losses as carry-back if not chosen differently by the tax unit. Moreover, carry-backs offer other potential advantages: the tax refund is one year earlier than a refund from the subsequent year and higher tax rates in the year prior to the loss offer higher tax refunds.

ploys the Probit model to estimate determinants of the probability of tax refund maximization. The preferred model includes several socio-demographic control variables, incomes from loss adjacent years and the loss. Further, the model includes the variable of interest, the tax rate difference from the loss adjacent years. That variable illustrates the difference of the tax refund potential from the loss adjacent years. Results from sensitivity analysis show that the marginal effects of the tax rate difference is robust against the inclusion of incomes from adjacent years and the loss. Further, results imply that tax consultants have no significant positive impact on the probability of tax refund maximization. Main results are drawn from the Probit model including a selection control following Heckman (1978). That selection control counteracts the selective nature of the estimation sample: only tax units that experience an aggregated loss in one year and have incomes above the basic allowance in the loss adjacent years have incentives for inter-temporal loss usage. The first requirement is an obvious necessity for studying inter-temporal loss usage, the second requirement ensures that the tax units have incentives for loss usage in both years and need to decide where to use it. In order to control for the selective nature of the estimation sample and to interpret marginal effects as partial effects, the Heckman model includes a selection control from a first step estimation. Indeed results from the Heckman model confirm the necessity of the selection control.

Results from the preferred model are obtained for four different definitions of tax refund maximization. Most reasonable results are obtained from allowing minor deviations of 200 Euro from the strong criterion. Estimations suggest that a tax rate difference of 10 percentage points increases the probability of tax refund maximization by 24.5 percentage points.

That result is robust for alternative definitions of tax refund maximization including relative deviations from the strong criterion. Estimation results from the strong criterion however propose a stronger impact from the tax rate difference. A 10 percentage points tax rate difference increases then the probability of tax refund maximization by 27.1 percentage points.

Results from this chapter suggest that tax avoidance is especially large when tax incentives have a considerable size. Further, that tax incentives of small size are less likely to induce tax units to maximize their tax refund and to exercise tax avoidance.

This result is in line with Lang et. al (1997) who find that tax avoidance in Germany increases with increasing tax rates and is of significant size and confirms theoretical results that tax avoidance is very responsive to taxation (Slemrod 1995, 2001). Moreover, results imply that tax avoidance is non-constant, increases with tax rates and is stronger than income reactions to taxation.[38] Following Chetty (2009), this provides further evidence that the elasticity of taxable income is inappropriate for welfare analysis of income taxation.

[38]See Chapter 2 for estimations of the taxable income to tax rate changes.

4.6 Appendix

4.6.1 Data and data processing[39]

Relevant information generated in the process of taxation is documented in the income tax return: information on the family situation, declaration of income from different sources, granted deductions and exemptions, calculation of taxable income, and personal income tax payment. The German Federal Statistical Office collects the official income tax returns electronically as Income Tax Statistics, providing the basis for a balanced panel, the German Taxpayer Panel. Individual taxpayers IDs are used to link annual cross section income tax returns over time to create the panel. However, this procedure might be problematic. In cases of marriage, divorce or moving to another federal state, individual tax ID will be given up, created new or changed. Additionally, German wage earners are not forced to file a tax return unless they have other sources of income. Moreover, the incentive for wage earners of filing a tax return depends on the expectation of a possible tax refund. The German Taxpayer Panel does not include tax returns which are only available for a subset of years and not consistently linkable. It contains income tax returns of approximately 19 million observations out of possible 31 million taxpayers included in the Income Tax Statistics. Several socio-economic characteristics of taxpayers such as age, number of children, church membership and marital status are observable. Tax units with losses are very likely to file income reports since they have a potential tax saving ability. Furthermore, tax units with atypical income structure need to file a tax report anyway.

On basis of five stratification criteria, i.e. federal state, assessment type, main type of income, level of total income and variation of the total income, a 5% sample is drawn and made available for scientific purposes. The stratification procedure aims to optimize the sample with regard to standard errors of total income over time. Observation weights are generated accordingly. Tax units with high positive income are highly over-sampled in our sample. However, losses of tax units are not over sampled and I assume that they

[39] The first half of this section is taken from an earlier working paper with Nima Massarrat-Mashhadi (see Massarrat-Mashhadi (2012)).

are only randomly drawn and are representative for tax units with losses in Germany.

4.6.2 Further Descriptive Statistics

Figure 4.5: Distribution of further tax refunds

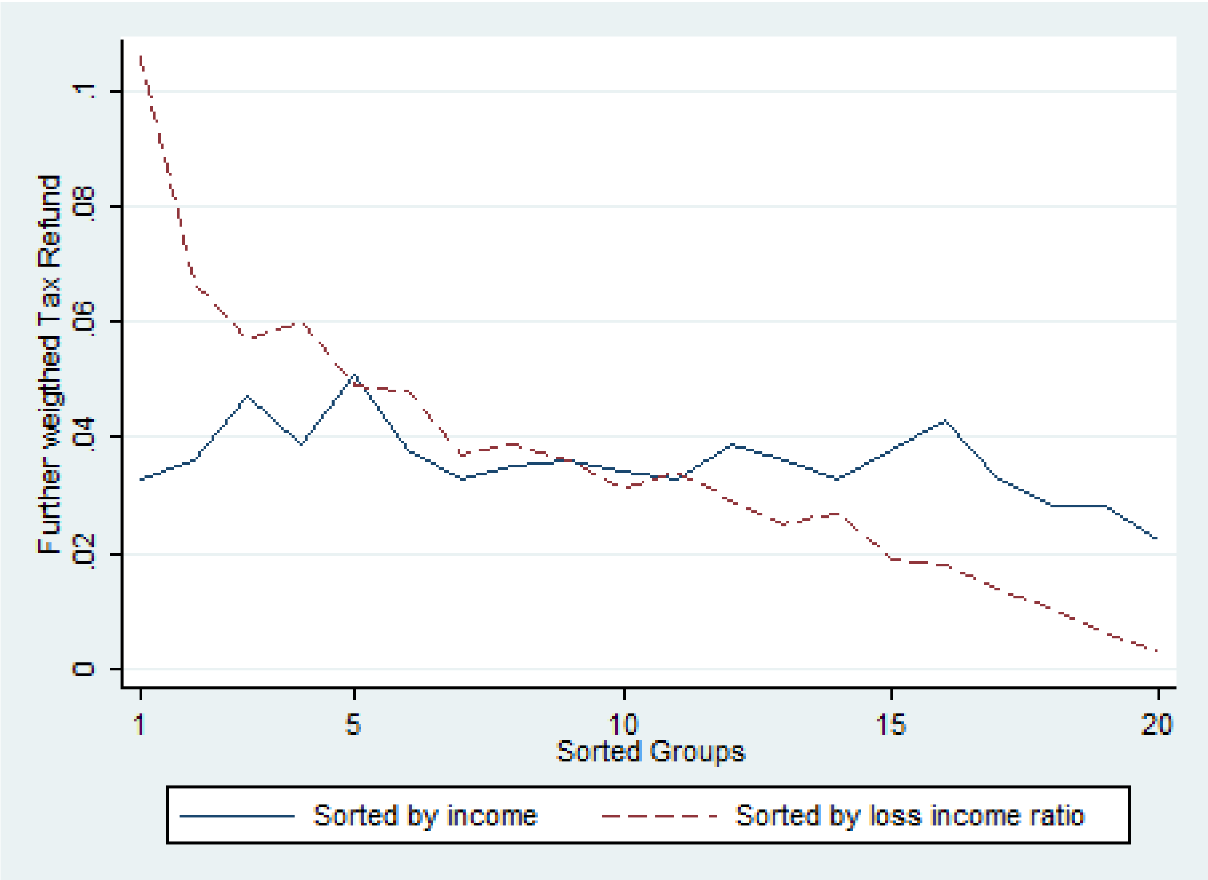


Figure 4.5 is a reproduction of Figure 4.3 and shows the ratio of further tax refunds to the size of the loss if tax units would have used all losses according to refund maximizing. Average shares of the ratio are computed and ordered into 20 equally sized groups and sorted by adjacent income (solid line) or the losses income ratio (dotted line). The ratio can be understood as a weighted result of the deviating losses: deviating losses are weighted by the individual tax rates and the loss. If tax rates are different along the sorting, the average shares of the refund ratio should show a varying pattern. Sorting tax units according to income shows a robust share of refund ratio for all 20 groups. Sorting

according to the loss income ratio, however, highlights a strong decline for refund ratio for increasing loss income ratio. These patterns are very similar to the patterns in Figure 4.3 which suggests that further refund follows a similar distribution to the deviating losses.

4.6.3 Results from the Logit model

Results in Table 4.A.1 and Table 4.A.2 show marginal effects from the Logit model for different criteria of redund maximization. Table 4.A.1 shows results for the model without the selection control from the two step Heckman approach, and Table 4.A.2 including the selection control.

All in all, marginal effects from the Logit model resemble the marginal effects from the Probit model remarkably well. The marginal effects of the tax rate difference in Table 4.A.2 have the same size and are not statistically different from the marginal effects from the Probit model in Table 4.4. Results in Table 4.A.2 also resemble results from the Probit model in Table 4.5 remarkably well and are statistically not distinguishable.

Table 4.A.1: Logit for different criteria of refund maximization

	I	II	III	IV
	No Deviation allowed	200 Euro Deviation	Loss weighted Deviation(5%)	Tax-Refund weighted Deviation(2%)
$\Delta\tau$	2.442***	2.133***	1.775***	1.627***
	(0.126)	(0.119)	(0.120)	(0.115)
$\Delta\tau^2$	-2.457***	-2.478***	-1.324***	-1.463***
	(0.300)	(0.281)	(0.297)	(0.277)
$ln(Z_{t-1})$	-0.048***	-0.048***	-0.012**	-0.020***
	(0.005)	(0.005)	(0.005)	(0.005)
$ln(Z_{t+1})$	0.082***	0.040***	0.064***	0.048***
	(0.004)	(0.004)	(0.004)	(0.004)
ln(loss)	0.089***	-0.204***	-0.223***	-0.308***
	(0.016)	(0.020)	(0.022)	(0.024)
ln(loss)^2	-0.005***	0.009***	0.008***	0.012***
	(0.001)	(0.001)	(0.001)	(0.001)
D tax consultant	0.007	0.005	0.011	0.014
	(0.010)	(0.010)	(0.010)	(0.009)
D business	-0.023	-0.038**	-0.060***	-0.054***
	(0.015)	(0.015)	(0.014)	(0.014)
D business, high	0.008	0.027*	0.041**	0.051***
	(0.014)	(0.013)	(0.013)	(0.012)
D rent	0.010	0.011	0.001	0.003
	(0.015)	(0.014)	(0.014)	(0.013)
D rent, high	-0.013	0.006	0.003	0.013
	(0.015)	(0.014)	(0.014)	(0.013)
D year	-0.022*	0.002	0.006	0.010
	(0.010)	(0.010)	(0.009)	(0.009)
D prior losses	-0.056***	-0.047***	-0.028**	-0.028**
	(0.012)	(0.011)	(0.011)	(0.010)
Pseudo-R^2	.127	.139	.128	.122
Number of Observations	8831	8831	8831	8831
Share of RM	.592	.668	.707	.740

Notes: Regression includes a constant, a marriage dummy and a dummy for losses bigger than income from adjacent years. Asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). $ln(Z_{t-1})$ is the logarithm of the total income from the year prior to the loss, $ln(Z_{t+1})$ is accordingly the income from the year following the loss. Share of RM is the relative share of refund maximizing tax units.

Source: Own computation based on German Taxpayer Panel 2001-2006.

Table 4.A.2: Logit model including selection control for different criteria of refund maximization

	I	II	III	IV
	No Deviation allowed	200 Euro Deviation	Loss weighted Deviation(5%)	Tax-Refund weighted Deviation(2%)
$\Delta\tau$	3.051***	2.905***	2.767***	2.607***
	(0.202)	(0.196)	(0.195)	(0.189)
$\Delta\tau^2$	-3.744***	-4.103***	-3.418***	-3.529***
	(0.449)	(0.432)	(0.441)	(0.422)
$ln(Z_{t-1})$	-0.029***	-0.025***	0.018**	0.009
	(0.007)	(0.007)	(0.007)	(0.007)
$ln(Z_{t+1})$	0.099***	0.061***	0.091***	0.074***
	(0.006)	(0.006)	(0.006)	(0.006)
ln(loss)	0.171***	-0.109***	-0.103 ***	-0.194***
	(0.027)	(0.028)	(0.029)	(0.030)
$\ln(\text{loss})^2$	-0.010***	0.004*	0.001	0.006***
	(0.001)	(0.002)	(0.002)	(0.002)
D tax consultant	0.003	0.001	0.005	0.008
	(0.011)	(0.010)	(0.010)	(0.009)
D business	-0.015	-0.029	-0.048**	-0.043**
	(0.015)	(0.015)	(0.014)	(0.014)
D business, high	0.000	0.018	0.030*	0.041**
	(0.014)	(0.014)	(0.013)	(0.013)
D rent	0.015	0.017	0.008	0.010***
	(0.015)	(0.014)	(0.014)	(0.013)
D rent, high	-0.018	0.001	-0.003	0.007
	(0.015)	(0.014)	(0.014)	(0.013)
D year	-0.037***	-0.016	-0.018	-0.012
	(0.011)	(0.010)	(0.010)	(0.009)
D prior losses	-0.082***	-0.080***	-0.070***	-0.069***
	(0.014)	(0.013)	(0.012)	(0.012)
λ	0.108***	0.138***	0.176***	0.174***
	(0.028)	(0.028)	(0.028)	(0.027)
N_1	8831	8831	8831	8831
N_2	1849155	1849155	1849155	1849155
Share of RM	.592	.668	.707	.740

Notes: Regressions also include a constant, a marriage dummy and a dummy for losses bigger than income from adjacent years. Asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). $log(Z_{t-1})$ is the logarithm of the total income from the year prior to the loss, $log(Z_{t+1})$ is accordingly the income from the year following the loss. λ denotes the inverse Mills ratio from Heckmans sample selection model. N_1 is the number of observations used in the second stage of the model, N_2 the number of observations that are not included in the second stage of the model but in the first stage of the Heckman model. Share of RM is the relative share of refund maximizing tax units.

Source: Own computation based on German Taxpayer Panel 2001-2006.

4.6.4 Results from the linear probability model

Table 4.A.3: Probit model including selection control for different criteria of refund maximization

	I	II	III	IV
	No Deviation allowed	200 Euro Deviation	Loss weighted Deviation(5%)	Tax-Refund weighted Deviation(2%)
$\Delta\tau$	3.349***	3.051***	2.971***	2.639***
	(0.21)	(0.20)	(0.19)	(0.19)
$\Delta\tau^2$	-4.489***	-4.428***	-4.046***	-3.719***
	(0.45)	(0.43)	(0.42)	(0.40)
$ln(Z_{t-1})$	-0.019**	-0.021**	0.022***	0.010
	(0.01)	(0.01)	(0.01)	(0.01)
$ln(Z_{t+1})$	0.091***	0.051***	0.080***	0.062***
	(0.01)	(0.01)	(0.01)	(0.01)
ln(loss)	0.173***	-0.054*	-0.008	-0.037
	(0.03)	(0.03)	(0.03)	(0.02)
$\ln(\text{loss})^2$	-0.010***	0.001	-0.003*	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
D tax consultant	0.004	-0.000	0.003	0.006
	(0.01)	(0.01)	(0.01)	(0.01)
D business	-0.014	-0.024	-0.038**	-0.026
	(0.02)	(0.01)	(0.01)	(0.01)
D business, high	0.001	0.014	0.023	0.029*
	(0.01)	(0.01)	(0.01)	(0.01)
D rent	0.014	0.014	0.006	0.008
	(0.01)	(0.01)	(0.01)	(0.01)
D rent, high	-0.016	-0.004	-0.011	-0.005
	(0.02)	(0.01)	(0.01)	(0.01)
D year	-0.040***	-0.016	-0.017	-0.010
	(0.01)	(0.01)	(0.01)	(0.01)
D prior losses	-0.082***	-0.075***	-0.062***	-0.058***
	(0.01)	(0.01)	(0.01)	(0.01)
λ	0.105***	0.112***	0.139***	0.125***
	(0.03)	(0.03)	(0.03)	(0.03)
N_1	8831	8831	8831	8831
N_2	1849155	1849155	1849155	1849155
Share of RM	.592	.668	.707	.740

Notes: Regressions also include a constant, a marriage dummy and a dummy for losses bigger than income from adjacent years. Asterisks denote the respective significance level at 95% (*), 99% (**), and 99.9% (***). $log(Z_{t-1})$ is the logarithm of the total income from the year prior to the loss, $log(Z_{t+1})$ is accordingly the income from the year following the loss. λ denotes the inverse Mills ratio from Heckmans sample selection model. N_1 is the number of observations used in the linear probability model, N_2 the number of observations that are not included in the linear probability model but in the first stage of the Heckman model. Share of RM is the relative share of refund maximizing tax units.

Source: Own computation based on German Taxpayer Panel 2001-2006.

Results for the Probit model are very similar to the results from the linear probability model in Table 4.A.3. A 10 percent tax rate difference for the benchmark specification for the linear probability model increases the probability of refund maximization by 29 percentage points. Allowing for minor deviations from refund maximization delivered for the 10 percent tax rate difference effects of 26.1 in column II, 25.7 in column III and 22.7 in column IV. These effects are slightly higher than the marginal effects from the Probit model which estimates from a 10 percent tax rate difference an increase in the probability of refund maximization by 27.1 percentage points in the benchmark specification in column I, by 25.1 in column II, by 24.5 in column III and by 22.5 in column IV.

Table 4.A.4: Dependent variables and covariates

Variable	Description	Coding/construction
y	Tax refund maximization variable	Dummy (1=yes; 0=else)
$\Delta\tau$	Difference between first loss Euro tax rates in prior or following year	Absolute value of difference
	Variables included in X_i	
$log(Z_{t-1})$	Taxable income of year prior to the loss	Log total income
$log(Z_{t+1})$	Taxable income of year following the loss	Log total income
log of loss	Amount of loss in absolute value	Log of the loss
	Variables included in Z_i	
D tax consult.	Taxpayer has expenses for tax consultant	Dummy (1=yes; 0=else)
D business, high	Taxpayer has loss from business more than -10000	Dummy (1=yes; 0=else)
D rent	Taxpayer has loss from rent and lease up till -10000	Dummy (1=yes; 0=else)
D rent, high	Taxpayer has loss from rent and lease more than -10000	Dummy (1=yes; 0=else)
D business	Taxpayer has loss from business up till -10000	Dummy (1=yes; 0=else)
D year	Year of the loss	Dummy (1=2005; 0=2004)
D prior losses	Taxpayer had losses in earlier years of the panel	Dummy (1=yes; 0=else)

Chapter 5

General Conclusion

5.1 Main Results

This cumulative doctoral thesis is a contribution to the empirical literature on behavioral responses to income taxation for Germany. Starting in Chapter 2 with the estimation of the elasticity of taxable income, Chapter 3 provides non-parametric estimates for tax favored donations to charity, and Chapter 4 estimates incentives for tax avoidance. Chapter 2 and 3 estimate parameters that have direct influence on the design of the optimal tax schedule and the treatment of tax favored expenditures. Chapter 4 measures tax avoidance and estimates effects of incentives on tax avoidance that are of particular interest for the assessment of the difference between taxable and disposable income.

Chapter 2 estimates the elasticity of taxable income (ETI) for Germany which is the key parameter for the assessment of tax revenue changes from tax reforms. Estimating income responses to taxation can be challenging due to two technical reasons: (1) controlling for the individual income process and (2) finding valid instruments to control for the endogeneity of the tax rate. Chapter 2 introduces an alternative model estimating the ETI and compares this with the most prominent model in the literature by Gruber and Saez (2002). Results from the alternative model imply rather modest income reactions to taxation with a relative small estimate for the ETI for Germany of .36. Estimates from Gruber and Saez's (2002) model suggest an estimate of .46 which is, with a standard error

of .02, statistically larger than the result from the alternative model. An alternative specification of Gruber and Saez's (2002) model by Weber (2014) finds even higher estimates of .7. However, the results from the models of the literature might suffer from a strong persistence in the residuals which biases results. Results from Chapter 2 are remarkably similar to recent results for Germany by Müller and Schmidt (2012). Although they use the same data, Müller and Schmidt (2012) differ in a wide range of their empirical specification. For instance, Müller and Schmidt (2012) drop taxpayers with low incomes, include potentially problematic instruments and employ potentially endogenous income control variables. Once Chapter 2 replicates one component of their setup, the exclusion of low incomes from the sample, results increase substantially to an estimate of .56. That suggests a potential bias from that selection and demands keeping those observations in the sample. Chapter 2 also provides estimates for separate estimates of the ETI for single and married taxpayers. Estimates for married taxpayers are .44 and exceed significantly the estimates for single taxpayers with .17. This result is in line with findings in the literature of the labor supply elasticity and suggests that income responses might also be driven by reactions of the secondary earner.
Results for the elasticity of taxable income allow the computation of a benchmark of welfare implications, following Feldstein (1999) and Chetty (2009).

Chapter 3 estimates incentives for donations to charity in Germany. The German tax code allows to subtract donations to charity from total income. Thus, the price of donating one Euro is subsidized and reduces to one minus the marginal tax rate. This raises the question of efficiency since the forgone tax revenue could have been also used to fund charities directly. Feldstein's (1975) rule of treasury efficiency implies that only for price elasticities above one, in absolute value, the forgone tax revenue is overcompensated and the tax favoring is efficient.[1]
Chapter 3 assumes that donations to charity are perceived as a consumption good and the true model is determined by income and price. Conducting a censored quantile estimator provides results for the whole distribution of donors. Results are presented for the

[1] Feldstein's (1975) rule is based on the strong assumption of non-asymmetric information, i.e. the social planer knows as well as taxpayers what charities are worth supporting.

preferred quasi-dynamic model including perfect foresight and several alternative models. Estimates of the preferred model imply that incomes and prices have quite heterogenous effects on donations. The income elasticities are downward sloping with elasticities above one for small donations but with relatively small elasticities below one for high donations. Price elasticities are inverse-u shaped and are only above 1 in absolute value at the tails of the donation distribution. Connecting these results to Feldstein's (1975) rule indicates that only taxpayers with relatively high or relatively low donations are treasury efficient. In contrast, medium taxpayers have price elasticities below one in absolute value and are not treasury efficient.

The preferred quasi-dynamic model also allows to compute transitory price and income elasticities. While transitory income elasticities are small in magnitude and show a relatively small variation around .4, the transitory price elasticity shows the same pattern like the permanent price elasticity. However, the transitory elasticities are much smaller and do not exceed one in absolute value. A considerable sensitivity analysis with three alternative models confirms the shape and sizes of the price and income elasticities.

Chapter 3 furthermore provides new insights about the activation of new donors. Reestimating income and price elasticities only for non-donors in the subsequent year suggests that new donors are highly responsive to income but do not react to tax incentives such as the tax defined prices of giving. All in all, results from Chapter 3 are very similar to results from Bönke et. al (2013) and are complementary to results from Adena (2014). Adena (2014) uses fixed effect OLS regressions and presents heterogenous results for price and income elasticities. Her results suggest that prices are only treasury efficient for taxpayers with incomes above 30,000 Euro. However, that might be misleading if donations and prices have a non-linear relationship and outliers might drive results.

Results from Chapter 3 have direct implications for the optimal design of tax incentives for donations. The price of giving should hinge on the amount given instead of the marginal tax rate. Moreover, tax incentives are not able to activate new donors, thus the tax code should include tax subsidy starting conditional on prior donations.

The third contribution of this doctoral thesis, in Chapter 4, uses a substantial insurance component of the German income tax code to study opportunities of tax avoidance.

German tax units with severe income shocks who experience a loss in a year can offset that loss with positive incomes from adjacent years. Tax avoidance is maximized if the offset losses are used accordingly to tax rates from the loss adjacent years.
Results show that only about 59% of tax units maximize their tax refund from loss usage. Moreover, non-refund maximizing tax units belong mainly to two groups: tax units with low increase of tax refund from an alternative loss allocation, or tax units that prefer future tax refund over current tax refund. However, the share of 59% refund maximization is based on a strong criterion for tax refund maximization: the tax unit needs to use all losses according the refund maximization loss allocation. Relaxing that somewhat strong criterion by allowing minor deviations increases the share up to 67% or 74% depending on the deviation concept.
To investigate determinants that drive tax refund maximization, the chapter further employs the Probit model to estimate the probability of tax refund maximization. Main results are drawn from the Probit model including a selection control following Heckman (1978) that controls for the selective nature of the estimation sample. Results are obtained for four different definitions of tax refund maximization and results from the most reasonable concept suggest that a tax rate difference of 10 percentage points increases the probability of tax refund maximization by 24.5 percentage points.
That result is robust for alternative definitions of tax refund maximization including relative deviations from the strong criterion. Results from Chapter 4 suggest that tax avoidance is especially large when tax incentives have a considerable size. And further, that tax incentives of small size are less likely to induce tax units to maximize their tax refund and to exercise tax avoidance.
This result is in line with findings in the literature and suggests that tax avoidance increases with increasing tax rates. Further, Chapter 4 implies that tax avoidance is stronger than income reactions to taxation.

5.2 Future Research

There are several promising extensions to the conducted research of this doctoral thesis. While the elasticity of taxable income in Chapter 2 has been solely estimated by tax rate changes, the incorporation of the German tax-benefit system and social contributions might reveal also very interesting results. Germany, unlike the US, is a country with a pronounced welfare state and especially high transfers at the lower end of the income distribution. Results from a quasi-taxable income elasticity would have implications for both governmental spending and tax revenue. Conducting such a study with panel data including taxpayers with low incomes would also be another promising addition to results from Chapter 2. Moreover, data like SOEP would allow to include more demographic characteristics which might be used to explain further heterogeneity.
Due to data limitations, Chapter 2 was not able to include another obvious target of future research: the German tax reform of 2007 and 2008 which increased the top marginal tax rate to 45% for taxpayers above 250,000 Euro. A considerable literature suggests that top incomes are more responsive to taxation than lower incomes are. Moreover, top incomes pay a large share of the overall tax revenue and possess a greater portfolio of tax planning (e. g. Bach et. al 2013). The employed data in Chapter 2, however, is not able to estimate income responses for top incomes separately since top marginal tax rates already start at an taxable income of 52,000 Euro and needed variation is not available.
Chapter 2 reports only estimates for taxable income but does not provide results for alternative income concepts. Broader income concepts like the aggregated gross income can complement results from the elasticity of taxable income and show results closer to real economic responses.
Finally, studies for other countries estimating the alternative model from Chapter 2 and compare it to Gruber and Saez's (2002) model would be an interesting extension for future research.

Results in Chapter 3 estimate price and income elasticities of donation for the whole distribution of donation. However, results are based on a model without individual fixed

effects. This might be a strong assumption and further research validating or contradicting that assumption would be of great value. Another interesting alternative would be an interaction of income classes with income and price elasticities but estimated with quantile regressions. That would create a combination of Adena's (2014) approach and the model from Chapter 3 and might ease the comparison of the results.
Results in Chapter 3 imply that donations to charity have a non-linear relationship with donations. Thus, incorporating this into linear models like Tobit or OLS would be interesting by including the price squared and the price to the power of three.
Due to data restrictions, Chapter 3 does not include control variables for crowding out, which would be another interesting addition to test sensitivity of the results. Chapter 3 offers first results for the activation of new donors. Further research on that particular group would be worthwhile. For instance, it would be interesting if new donors are more or less likely to keep being donors than the base of donors.

Chapter 4 estimates the probability of tax refund maximization employing the Probit model. However, this assumes some form of homogenous behavior of tax units that do not maximize their tax refund from loss usage. That might be a strong assumption and further research on the non-refund maximizing tax units would be interesting: for instance, estimating the share of refund maximizing losses would be an interesting alternative to the employed linear model and would estimate a more metric variable. Results from Chapter 4 are based on years with tax reforms which created a difference between refund from carry-forward and carry-back. Expanding that analysis to data with more years, possibly without tax reforms, would be promising. It would not be surprising, if results from Chapter 4 would be mitigated once years without tax reforms reduce tax rate differences between the loss adjacent years. Furthermore, it would be interesting to look at other countries which have similar loss usage possibilities and to compare to their reactions to tax avoidance.

Bibliography

Adena, M. (2014). Tax-price elasticity of charitable donations: Evidence from the German taxpayer panel. *Berlin : WZB*

Alstadsaeter, A. and M. Jacob (2012). Who Participates in Income Shifting? *FAccT Center Working Paper* 08, WHU Otto Beisheim School of Management, Vallendar, Germany.

Andreoni, J. (1990). Impure altruism and donations to public goods: a theory of warm-glow giving. *The Economic Journal* 100, 464-477.

Arellano, M. and S. Bond (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations.*The Review of Economic Studies* 58(2), 277-297.

Aucherbach, A. J. and J. M. Poterba (1987). The Effects of Taxation on Capital Accumulation. *Chapter in: The Effects of Taxation on Capital Accumulation*, The University of Chicago Press, 305-342.

von Auer, L., & Kalusche, A. (2010). Steuerliche Spendenanreize: Ein Reformvorschlag. *Research Papers in Economics*, Universität Trier No. 7/10.

Auten, G. and R. Carroll (1999). The Effect of Income Taxes on Household Behavior. *Review of Economics and Statistics* 81(4), 681-693.

Auten, G. E., H. Sieg and C. T. Clotfelter (2002). Charitable giving, income, and taxes: an analysis of panel data. *American Economic Review* 92(1), 371-382.

Bach S., and H. Buslei (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. *Discussion Papers of DIW Berlin*, 950, DIW Berlin, German Institute for Economic Research.

Bach, S., G. Corneo and V. Steiner (2009). From bottom to top: the entire income distribution in Germany, 1992-2003. *Review of Income and Wealth* 55, 303-330.

Bach, S., G. Corneo and V. Steiner (2013). Effective Taxation of Top Incomes in Germany,*German Economic Review* 14(2), 115-137.

Bakija, J. and B. Heim (2011). How does charitable giving respond to incentives and income? New estimates from panel data. *National Tax Journal* 64(2), 615-650.

Bargain, O., K. Orsini and A. Peichl (2012). Labor supply elasticities in Europe and the US. *IZA discussion paper No. 5820.*

Barrett, K. (1991). Panel-data estimates of charitable giving: a synthesis of techniques. *National Tax Journal* 44(3), 365-381.

BMF (2014). Finanzbericht 2015. *Bundesministerium für Finanzen*

Bönke, T., N. Massarrat-Mashhadi and C. Sielaff (2013). Charitable Giving in the German Welfare State: Fiscal Incentives and Crowding Out. *Public Choice* 154(1-2), 39-58.

Bönke, T., F. Neher and C. Schröder (2007). Bestimmung ökonomischer Einkommen und effektiver Einkommensteuerbelastungen mit der Faktisch Anonymisierten Lohn- und Einkommensteuerstatistik. *Schmollers Jahrbuch : Journal of Applied Social Science Studies* 127(4), 585-623.

Boskin, M. J. and M. Feldstein (1977). Effects of the charitable deduction on contributions by low income and middle income households: evidence from the national survey of philanthropy. *Review of Economics and Statistics* 59, 351-354.

Chetty, R. (2009). Is the Taxable Income Elasticity Sufficient to Calculate Deadweight Loss? The Implications of Evasion and Avoidance. *American Economic Journal: Economic Policy* 1(2), 31-52.

Chetty, R. (2012). Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply. *Econometrica* 80(3), 969-1018.

Chetty, R., J. Friedman, T. Olsen and L. Pistaferri (2011). Adjustment Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Danish Tax Records. *Quarterly Journal of Economics* 126(2), 749-804.

Chernozhukov, V. and H. Hong (2002). Three-step censored quantile regression and extramarital affairs. *Journal of American Statistical Association* 97, 872-882.

Clotfelter, C. T. (1980). Tax incentives and charitable giving: evidence from a panel of taxpayers. *Journal of Public Economics* 13, 319-340.

Creedy, J. and N. & Gemmel (2014). Measuring Revenue-Maximising Elasticities of Taxable Income: Evidence for the US Income Tax. *Victoria Business School Working Paper 02.*

Crumpler, H. and P. J. Grossman (2008). An experimental test of warm glow giving. *Journal of Public Economics* 92, 1011-1021.

O'Donoghue, C. and H. Sutherland (1999). Accounting for the family in European income tax systems. *Cambridge Journal of Economics* 23, 565-598.

Dwenger N. (2008). Tax loss offset restrictions: Last resort for the treasury? An empirical evaluation of tax loss offset restrictions based on micro data. *Arqus Discussion Papers in Quantitative Tax Research* 44, arqus - Arbeitskreis Quantitative Steuerlehre.

Fack, G. and C. Landaise (2010). Are tax incentives for charitable giving efficient? Evidence from France. *American Economic Journal: Economic Policy* 2, 117-141.

Feldman, N. and J. Slemrod (2007). Estimating tax noncompliance with evidence from unaudited tax returns. *The Economic Journal* 117, 327-352.

Feldstein, M. (1975). The income tax and charitable contributions, part I: aggregate and distributional effects. *National Tax Journal* 28(1), 81-100.

Feldstein, M. (1980). A contribution to the theory of tax expenditures: the case of charitable giving. In Aaron, H. J. and M. J. Boskin (Eds.), *The economics of taxation* Washington: The Brookings Institution, 99-122.

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), 551-572.

Feldstein, M. (1999). Tax Avoidance and the Deadweight Loss of the Income Tax. *Review of Economics and Statistics* 81(4), 674-680.

Feldstein, M. and C. T. Clotfelter (1976). Tax incentives and charitable contributions in the United States: a microeconometric analysis. *Journal of Public Economics* 5, 1-26.

Feldstein, M. and L. Lindsey (1983). Simulating nonlinear tax rules and nonstandard behavior: an application to the tax treatment of charitable contributions. In M. Feldstein (Ed.), *Behavioral simulation methods in tax policy analysis* University of Chicago Press, 139-172.

Giertz, S. H. (2007). The Elasticity of Taxable Income over the 1980s and 1990s. *National Tax Journal* 60(4), 743-768.

Giertz, S. H. (2010). The Elasticity of Taxable Income during the 1990s: New Estimates and Sensitivity Analyses. *Southern Economic Journal* 77(2), 406-433.

Godfrey, L. G. (1999). Instrument relevance in multivariate linear models. *The Review of Economics and Statistics* 81, 550-552.

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

Gottfried, P. H. Schellhorn (2004). Empirical Evidence on the Effects of Marginal Tax Rates on Income the German Case. IAW Discussion Paper.

Gottschalk, P. and R. Moffitt (1994). The Growth of Earnings Instability in the U.S. Labor Market. *Brookings Papers on Economic Activity*, 217-72.

Gruber, J. and E. Saez (2002). The Elasticity of Taxable Income: Evidence and Implications. *Journal of Public Economics* 84(1), 1-32.

Grüne and SPD (1998). Aufbruch und Erneuerung: Deutschlands Weg ins 21. Jahrhundert, Koalitionsvereinbarung zwischen der Sozialdemokratischen Partei Deutschlands und Bündnis 90/Die Grünen.
https://www.gruene.de/fileadmin/user_upload/Bilder/Redaktion/30_Jahre_-_Serie/Teil_21_Joschka_Fischer/Rot-Gruener_Koalitionsvertrag1998.pdf

Heckman, J. J. (1979). Sample selection as a specification error. *Econometrica* 47(1), 153-161.

Heim, B. T. (2009). The Effect of Recent Tax Changes on Taxable Income. Evidence from a New Panel of Tax Returns. *Journal of Policy Analysis and Management* 28(1), 147-163.

Hengst, B. (2012). Lafontaine besucht Schröder-Auftritt: Zu Gast beim Erzfeind. *Spiegel Online* Montag, 10.09.2012 19:22 Uhr
http://www.spiegel.de/politik/deutschland/agenda-2010-oskar-lafontaine-besucht-vortrag-von-gerhard-schroeder-a-855033.html

Holmlund, B. and M. Söderström (2011). Estimating Dynamic Income Responses to Tax Reform. *The B.E. Journal of Economic Analysis & Policy* 11, 1-36.

Jenderny, K. (2013). Mobility of Top Incomes in Germany. *Free University Berlin Working Paper* 2013/7.

Koenker, R. and G. Bassett (1978). Regression quantiles. *Econometrica* 46(1), 33-50.

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

Massarrat-Mashhadi, N. and C. Werdt (2012). Estimating dynamic income responses to tax changes: Evidence from Germany. *Free University Berlin Working Paper.*

Mirlees, J. (1971). An exploration in the theory of optimum income taxation. *The Review of Economic Studies* 38, 175-208.

Müller, H. (2006). Ausmaß der einkommensteuerlichen Verlustverrechnung - Eine empirische Analyse der Aufkommens- und Verteilungswirkungen. *Die Betriebswirtschaft* 67(2), 179-200.

Müller, H. and T. P. Schmidt (2012): Die Elastizität des zu versteuernden Einkommens in Deutschland. *ARQUS Discussion Paper No. 132.*

Niemeier, E., S. Bach, J. Geyer, P. Haan, and K. Wrohlich (2012). Die falschen Angriffe auf das Ehegattensplitting. *Wirtschaftsdienst* 92(9), 613-625.

OECD (2011). Taxing Wages 2010, OECD Publishing. `http://dx.doi.org/10.1787/tax_wages-2010-en`

Paqué, K.-H. (1986). The efficiency of tax incentives to private charitable giving-some econometric evidence for the Federal Republic of Germany. *Review of World Economics* 122(4), 690-712.

Peloza, J., and P. Steel (2005). The price elasticities of charitable contributions: a meta-analysis. *Journal of Public Policy and Marketing* 24(2), 260-272.

Randolph, W. C. (1995). Dynamic income, progressive taxes, and the timing of charitable contributions. *Journal of Political Economy* 103(4), 709-738.

Salanie, B. (2003). The Economics of Taxation. MIT Press.

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

Saez, E., J. Slemrod and G. Seth (2009). The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review. *NBER Working Paper No. 15012.*

Saez, E., J. Slemrod and G. Seth (2012). The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review. *Journal of Economic Literature 2012* 50(1), 350.

Samuelson, P. (1954). The pure theory of public expenditure. *Review of Economics and Statistics* 36(4), 387-389.

Shea, J. (1997). Instrument Relevance in Multivariate Linear Models: A Simple Measure.*The Review of Economics and Statistics* 79(2), 348-352.

Slemrod J. (1995). Income creation or Income Shifting Behavioral Responses to the Tax Reform Act of 1986. *American Economic Review* 85(2), 175-180

Slemrod J. (2001). A General Model of the Behavioral Response to Taxation. *International Tax and Public Finance* 8(2), 119-128.

Solon, G., S. J. Haider and J. Wooldridge (2013). What Are We Weighting For? *NBER Working Paper No. 18859.*

Stock, J. H., J. H. Wright and M. Yogo(2002). A survey of weak instruments and weak identification in generalized method of moments. *Journal of Business &*

Economic Statistics 20, 518-529.

Stock, J. H. and M. Yogo (2005). Testing for Weak Instruments in Linear IV Regression. *Andrews DWK Identification and Inference for Econometric Models*, Cambridge University Press, 80-108.

Staiger, D. and J. H. Stock (1997). Instrumental Variables Regression with Weak Instruments. *Econometrica* 65(3), 557-86.

Steiner, V. and K. Wrohlich (2008). Introducing Family Tax Splitting in Germany: How Would It Affect the Income Distribution, Work Incentives and Household Welfare? *Public Finance Analysis* 64(1), 115-142.

Steiner, V., K. Wrohlich, P. Haan and J. Geyer (2012). Documentation of the Tax-Benefit Microsimulation Model STSM: Version 2012. *DIW Data Documentation 63*

Taussig, M. K. (1967). Economic aspects of the personal income tax treatment of charitable contributions. *National Tax Journal* 20(1), 1-19.

Triest, R. K. (1998). Econometric issues in estimating the behavioral response to taxation: a nontechnical introduction. *National Tax Journal* 51(4), 761-772.

Weber, C. (2014). Toward Obtaining a Consistent Estimate of the Elasticity of Taxable Income Using Difference-in-Differences. *Journal of Public Economics* 117, 90-103.

Wegener, L. (2014). Verlusteinkunftsarten und Dynamik der Verlusterzielung im Taxpayer-Panel. *Wirtschaft und Statistik*, Statistisches Bundesamt.

English Summary

This doctoral thesis investigates several aspects of behavioral responses to income taxation. The thesis contains three chapters that estimate empirical parameters of interest for Germany that have direct implications on the optimal design of the German tax code. The first contribution of this dissertation in Chapter 2 estimates the elasticity of taxable income that is the parameter of interest for estimating tax revenue changes from tax reforms. Chapter 3 estimates income and price elasticities of donations for the whole distribution of donors. The price elasticities are of central interest for the assessment of the efficiency of the tax subsidy of donations. Chapter 4 employs an insurance feature of the German tax code to study tax avoidance for German tax units.

The estimation of the elasticity of taxable income (ETI) employs exogenous tax rate changes from a tax reform to measure the effect on the taxpayers income from income taxation. However, in order to assess the impact of the tax rate change one would have to know how the income of the taxpayer would have been without the tax reform. This problem subsumes to two technical challenges: (1) finding a suitable control that is able to depict the individual income process, (2) deriving the individual tax rate in the case that taxpayers would have not reacted to the tax reform.

The chapter derives an alternative model to master those two challenges and compares results to popular model in the literature. All in all, results from the alternative model are small, implying relative modest income reactions to taxation. The result from the preferred specification estimates an ETI of .36 which is significantly lower than results from models of the literature with estimates of .46 and .70. In order to find the appropriate model for German taxpayers, a test of residual autocorrelation is employed confirming the alternative model to fit the best for Germany. Results from estimating separate elasticities

for single and married taxpayers moreover suggest that married taxpayers are significantly more responsive with an ETI of .44 than single taxpayers with an ETI of .17.
However, all these estimates are in the international context comparably small. Recent findings by Weber (2014) suggest an ETI more than twice as large as the German ETI with an estimate of .86 for the US.
The ETI can at least be used as a benchmark for calculating welfare losses from taxation, relying on Feldstein's (1999) and Chetty's (2009) theoretical derivations. Results from Chapter 2 imply that welfare losses from income taxation in Germany are rather small.

Chapter 3 estimates incentives for donations to charity for Germany. Donations to charity are heavily subsidized by the German tax code. By allowing to reduce the total income through charitable giving, the price of giving one Euro is reduced to one minus the tax rate. This raises the question whether that tax subsidy is efficient since the forgone could have been used alternatively to finance the charity directly. Feldstein's (1975) rule implies that price elasticities above or equal one in absolute value are sufficient to compensate the tax revenue reductions from the tax subsidy.
In order to calculate a complete picture of behavioral incentives for donors in Germany, Chapter 3 employs quantile regressions for the whole distribution of donations. Results indeed suggest that behavioral responses to taxation are heterogenous with downward sloping income elasticities and inverse-u shaped price elasticities. Moreover, the results in Chapter 3 from the preferred model suggest that only the tails of the distribution of donors are price elastic with elasticities exceeding one in absolute value. Therefore, this implies that a large share of donors in Germany is price inelastic and treasury efficiency accounts only for parts of the distribution. These results are robust for a large number of sensitivity checks including quasi-dynamic and non-dynamic models. Additionally, Chapter 3 also estimates price and income elasticities for new donors, i.e. calculates effects for the extensive margin. Behavioral responses for that sub-group differ quite substantially with relative high income elasticities but very low price elasticities near zero.
Results from Chapter 3 have direct implications for the design of tax incentives for donations to charity. Tax incentives should depend on the amount given to charity instead of depending on the taxpayers tax rate. Correspondingly, relative small and relative large

donations should receive a high tax subsidy, while medium donations should receive lower tax subsidies. Moreover, since new donors do not respond to tax incentives, tax reliefs could be conditional on donating more years in a row.

Chapter 4 uses a substantial insurance component of the German income tax code to study opportunities of tax avoidance. German tax units with severe income shocks who experience a loss in a year can offset that loss with positive incomes from adjacent years. Tax avoidance is maximized if the offset losses are used according to tax rates from the loss adjacent years.

Results show that, depending on the definition, between 59% and 74% of tax units maximize their tax refund from loss usage. To investigate determinants that drive tax refund maximization, Chapter 4 further employs the Probit model estimating the probability of tax refund maximization. The central parameter for measuring tax avoidance is the tax rate difference of the loss adjacent years. That tax rate difference is the central indicator for the different tax refund potential. Indeed estimation results show that the tax rate differences has a high influence on the probability of tax refund maximization. A 10 percentage point tax rate difference increases the probability of tax refund maximization by 24.5 percentage points. Results are robust against a number of sensitivity checks, including different sets of control variables and different definitions of tax refund maximization. Results from Chapter 4 suggest that tax avoidance is especially large when tax incentives have a considerable size. And further, that tax incentives of small size are less likely to induce tax units to maximize their tax refund and to exercise tax avoidance.

Findings of Chapter 4 are in line with results for Germany from the literature (Lang et. al 1997) and confirm theoretical results of the large behavioral responses of tax avoidance to income taxation (Slemrod 1995, 2001). Further, these results suggest that welfare analysis of income taxation relying on the elasticity of taxable income is not sufficient to study welfare losses, following Chetty (2009).

German Summary

Die vorliegende kumulative Dissertation untersucht verschiedene Aspekte von Verhaltensreaktionen auf Einkommensbesteuerung. Die Arbeit umfasst drei Kapitel, die empirisch wichtige Parameter mit direkten Auswirkungen auf das optimale Design des deutschen Steuersystems haben. Kapitel zwei berechnet die Elastizität des zu versteuernden Einkommens welche die Kernkennzahl für die Berechnung von Steueraufkommen Änderungen durch Steuerreformen ist. Das dritte Kapitel berechnet Preis- und Einkommenselastizitäten für Spenden an wohltätige Zwecke für die gesamte Verteilung von Spendern. Hierbei sind die Preiselastizitäten von zentraler Bedeutung für die Abschätzung der Effizienz von der Steuerbegünstigung von Spenden. Kapitel vier verwendet eine Versicherungsfunktion des deutschen Steuergesetzes zur Analyse von Steuervermeidung in Deutschland.

Die Schätzung der Elastizität des zu versteuernden Einkommens verwendet exogene Steuersatzveränderungen einer Steuerreform um den Effekt von Einkommensbesteuerung auf das zu versteuernde Einkommen zu messen. Hierbei ist es von zentraler Bedeutung, bestimmen zu können wie hoch das Einkommen ohne Steuerreform gewesen wäre und entsprechend wie hoch die Steuersätze ohne Reform gewesen wären.

Für eine konsistente Schätzung ergeben sich zwei technische Herausforderungen: (1) Den Einsatz von exogenen und geeigneten Instrumenten für den endogenen Steuersatz, (2) der Gebrauch von angemessenen individuellen Einkommenskontrollen. Um diese Anforderungen bewältigen zu können, leitet Kapitel zwei zunächst ein alternatives Modell her. Im Anschluss werden die Ergebnisse dieses alternativen Modells mit Ergebnissen etablierter Modelle der Literatur verglichen. Insgesamt lässt sich feststellen, dass die

Schätzergebnisse des alternativen Modells eine relativ kleine Elastizität des zu versteuernden Einkommens in Höhe von 0,36 schätzt. Dieses Ergebnis ist für Deutschland signifikant kleiner als die Ergebnisse von Modellen der Literatur. Um das wahre Modell für die Schätzung der Elastizität des zu versteuernden Einkommens für Deutschland bestimmen zu können, verwendet Kapitel zwei einen Test auf Autokorrelation der Fehler. Dieser Test bestätigt, dass das alternative Modell für Deutschland geeignet ist. Des Weiteren zeigen Ergebnisse des Modells, dass die Elastizität des zu versteuernden Einkommens signifikant höher für Gemeinsam-Veranlager als für Allein-Veranlager ist. Gemeinsam-Veranlager haben eine Elastizität von 0,44 und Allein-Veranlager eine Elastizität von 0,17.
All diese Ergebnisse sind vergleichsweise klein im Vergleich zum internationalen Kontext. Neue Ergebnisse von Weber (2014) weisen auf relativ starke Reaktionen, mit einer Elastizität des zu versteuernden Einkommens, von 0,86 in den USA hin.

Neben der Verwendung von Aufkommens-Schätzungen kann die Elastizität des zu versteuernden Einkommens auch als Grundlage für Wohlfahrtsanalysen gebraucht werden (Feldstein 1999, Chetty 2009). Die Ergebnisse in Kapitel zwei deuten dementsprechend an, dass die Wohlfahrtsverluste in Deutschland durch Einkommensbesteuerung recht klein sind.

Kapitel drei schätzt Spendenanreizwirkungen deutscher Steuerzahler. Spenden an wohltätige Zwecke sind vom deutschen Steuergesetz stark subventioniert. Wobei Spenden verringern nach dem Einkommensteuergesetz den Gesamtbetrag der Einkünfte, wodurch sich der relative Preis einer Spenden auf Eins minus Steuersatz reduziert. Da dieses auch das Steueraufkommen verringert, stellt sich die Frage, ob diese Subvention effizient ist. Feldstein (1975) hat hergeleitet, dass ab einer Preiselastizität von 1 (im Betrag), die Reduktion des Steueraufkommens kompensiert, und die steuerliche Subvention somit effizient ist. Um allerdings mehr als nur einen durchschnittlichen Effekt betrachten zu können und ein komplettes Bild von Spendenverhalten in Deutschland zu erhalten verwendet Kapitel drei Quantilesregressionen. Die Ergebnisse zeigen in der Tat, dass Verhaltensreaktionen auf die steuerlichen Spendenanreize unterschiedlich über die Verteilung sind. Einkommenselastizitäten haben einen fallenden Verlauf mit steigendem Quantil und Preiselastizitäten zeigen einen inversen U-förmigen Verlauf über die Quantile. Des Weiteren zeigen die

Ergebnisse von Kapitel drei, dass lediglich die Ränder der Verteilung von Spenden preiselastisch sind, mit Preiselastizitäten größer als Eins im Betrag. Entsprechend bedeutet dieses, dass ein großer Teil der Bevölkerung nicht preis-elastisch ist und die Effizienz der steuerlichen Subvention nur für Teile der Verteilung gelten. Die Ergebnisse sind robust für eine Vielzahl von Sensitivitätsanalysen einschließlich quasi-dynamische und nicht dynamische Modelle. Zusätzlich berechnet Kapitel drei Preis- und Einkommenselastizitäten für Neu-Spender, das heißt für Spender die in einem Jahr nicht gespendet haben und im folgenden Jahr Spender werden können. Verhaltensanpassungen für diese Untergruppe unterscheiden sich deutlich von Ergebnissen der restlichen Population. Einkommenselastizitäten sind hoch und großteils über Eins, Preiselastizitäten sind jedoch sehr klein und teilweise insignifikant.
Ergebnisse aus Kapitel drei haben direkte Implikationen für das Design von steuerlicher Subvention von Spenden im deutschen Einkommensteuergesetz. Die effiziente steuerliche Subvention sollte, im Gegensatz zum Steuersatz, von der Spendenhöhe abhängen. Entsprechend sollten relativ hohe und relativ kleine Spenden stärker subventioniert werden als mittelmäßig hohe Spenden. Ergebnisse aus Kapitel 3 zeigen weiter, dass durch Steueranreize keine neuen Spenden aktiviert werden können und steuerliche Begünstigung von Spenden erst nach einem längeren Spendenzeitrau erfolgen sollte.

Kapitel vier verwendet eine Versicherungsfunktion des deutschen Steuerrechts um Steuervermeidung zu untersuchen. Deutsche Steuerzahler mit starken Einkommensschocks die in einem Kalenderjahr zu aggregierten Verlusten führen, können diese Verluste mit positiven Einkommen der angrenzenden Kalenderjahren verrechnen. Steuerfälle maximieren ihre Steuererstattung wenn die Verrechnung der Verluste die höchst mögliche Steuererstattung erzeugt. Entsprechend orientiert sich eine solche Verwendung an den Steuersätzen der angrenzenden Jahre. Ergebnisse von Mikrosimulationen zeigen, dass, abhängig von der Definition von maximaler Steuererstattung, zwischen 59% und 74% der Steuerfälle ihre Steuererstattung maximieren. Um Determinanten von maximaler Steuererstattung zu berechnen verwendet das Kapitel das Probit Modell. Hierbei ist besonders der Einfluss von Steuersätzen von zentralem Interesse. Kapitel vier verwendet hier als Instrument die Steuersatzdifferenz der Jahre die an den Verlust angrenzen. Schätzergebnisse bestätigen, dass dieses der Parameter mit große, Gewicht auf die Wahrscheinlichkeit der Steuererstattung ist. Entsprechend bewirkt eine Steuersatzdifferenz von 10 Prozentpunkten eine Erhöhung der Wahrscheinlichkeit der maximalen Steuererstattung von 24,5 Prozentpunkten. Dieses Ergebnis ist robust gegen eine Vielzahl von Sensitivitätsanalysen, einschließlich dem verschiedenen Umfang von Kontrollvariablen und verschiedener Definitionen von maximaler Steuererstattung. Ergebnisse dieses Kapitels deuten darauf hin, dass Steuervermeidung besonders dann ausgeprägt ist, wenn die steuerlichen Anreize hierfür hoch sind. Bei eher moderaten oder geringen steuerlichen Anreizen ist Steuervermeidung nicht stark ausgeprägt. Insgesamt können die Ergebnisse von Kapitel vier die Ergebnisse aus der Literatur für Deutschland (Lang et. al 1997) bestätigen. Weiter bestärken sie die theoretischen Ergebnisse darin, dass Steuervermeidung sehr stark auf steuerliche Anreize reagiert (Slemrod 1995, 2001). Abschließend deuten diese Ergebnisse an, dass für die Berechnung von Wohlfahrtsverlusten durch Besteuerung (Chetty 2009) die Elastizität des zu versteuernden Einkommens nicht ausreicht.

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ETI	Elasticity of taxable income
IV	Instrumental Variable Estimation
2SLS	Two Stage Least Squares
OLS	Ordinary Least Squares
Net-Income	Adjusted Net-of-Tax Gross Income
RM	Refund Maximizing Tax Unit
NRM	Non-refund Maximizing Tax Unit