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# Distributional and Welfare Effects of Germany's Year 2000 Tax Reform *

Richard Ochmann†

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**Abstract**

This paper empirically investigates distributional and welfare effects of Germany's year 2000 income tax reform. The reform is simulated in an ex-ante behavioral microsimulation approach. Dead weight loss of changes in capital income taxation is estimated in a structural model for household savings and asset demand applied to German survey data. Significant reductions in tax rates result in income gains for most of the households. Gains are found greater for households in higher tax brackets, whereby income inequality increases, slightly greater in East- than in West-Germany. Moreover, households increase savings and alter the structure of asset demand as a result of shifts in relative asset prices. As a consequence, utility losses reduce welfare effects for almost all households.

**Keywords:** Capital income taxation, household savings, asset demand, welfare effects.
**JEL Classification: C35, G11, H31**

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# 1 Introduction

At the turn of the century, a governmental coalition of the green party and the social democrats enforced the greatest tax reform of post-war Germany, measured by tax relief. The main intention was to bring forward employment and economic growth by lowering tax burdens and distorting effects of taxation for corporates, entrepreneurs, and other private households. The reform, on the one hand, significantly altered the tax tariff, and on the other hand largely broadened the tax base. The income tax tariff was generally shifted downwards, and taxation schemes as well as allowances for capital income were adjusted. According to Germany's federal ministry of finance, the reform had a total annual tax relief of 32 bn. euros, of which about 27 bn. euros are related to changes in personal income taxation (Bundesministerium der Finanzen, 2004). As a result, families, employees, and non-incorporated medium-sized enterprises were meant to benefit the greatest from the reform. These aggregate numbers do though not tell the whole story, as nothing is said yet about the distribution of the gains and about welfare effects regarding savings and asset demand.

There are a couple of studies that analyze distributional effects of Germany's year 2000 tax reform in various contexts: some comparing them to other reform proposals (Merz and Zwick, 2002; Bönke and Corneo, 2006) or to alternative methods of measurement (Maiterth and Müller, 2009), some in the context of tax avoidance (Corneo, 2005), others putting them in an intergenerational perspective (Krimmer and Raffelhüschen, 2003), and again others explicitly accounting for labor supply reactions and estimating welfare effects (Haan and Steiner, 2005; Wagenhals, 2001). However, there is no empirical evidence yet on welfare effects of this reform that are related to adjustments of the consumption-savings behavior and the structure of asset demand. The reform is though likely to affect aggregate savings of private households as well as the allocation of savings between various available asset types, as the relative prices of consumption and savings as well as the relative after-tax returns of related assets are altered. This analysis intends to investigate distributional and welfare effects of Germany's year 2000 tax reform that are related to households' savings as well as asset allocation behavior.

There is a vast literature of studies that empirically identify effects of differential income taxation in general on asset allocation.[1] These studies generally find significant effects of differential income taxation on asset allocation, though of varying size: demand for tax-privileged assets is lowered and demand for less privileged assets is increased if marginal tax rates are

[1] Among these studies, the most influential are Feldstein (1976); Hubbard (1985); King and Leape (1998); Poterba and Samwick (2002); Dicks-Mireaux and King (1983); Hochguertel, Alessie, and van Soest (1997); Agell and Edin (1990). For Germany, only Lang (1998) conducts a comparable analysis. A comprehensive overview on relevant issues in the field of taxation effects on household asset allocation, such as differential income taxation, is provided by Poterba (2002).

shifted downwards. Hausman and Poterba (1987) analyze effects of the 1986 tax reform act in the US on labor supply as well as effects on household savings. They find that aggregate savings are slightly reduced by the reform. An increase in savings due to rising net returns resulting from massive reductions of marginal tax rates is offset by a decrease due to falling gross returns as a result of heavier taxation of corporate capital. The recent literature in this field finds stronger effects of the rate of return on single assets than for savings in general (see Attanasio and Wakefield, 2010, for a survey). For a study on the distributional effects of a value-added tax reform for Germany using the same micro data that are used here, see Bach, Haan, Hoffmeister, and Steiner (2006).

This brief literature review suggests on the one hand that there were significant income gains to be distributed from Germany's year 2000 income tax reform and on the other hand that changes in the tax schedule play a relevant role for households' savings behavior and asset choice. However, there is by now only very scarce empirical literature on the quantification of welfare effects related to capital income taxation that result from tax-induced distortions in portfolio structure, primarily due to a lack of structural modeling of the portfolio choice.[2] Poterba and Samwick (2002) e.g., delegate this issue to one of the most important concerns for future research, and even in the most recent literature in this field, the estimation of deadweight loss in a structural portfolio model is still on top of the agenda for future research (Alan, Atalay, Crossley, and Jeon, 2010).

The analysis at hand extends the literature by quantifying distributional and welfare effects of the reform that are related to savings and asset demand. The focus is on that part of the tax reform that affects private households. For analyses of the effects of the tax reform on incorporated companies, see Homburg (2000); Schreiber (2000); Keen (2002), or for a general equilibrium approach, Sørensen (2002). The reform is evaluated in an ex-ante analysis and simulated in an income taxation module in the framework of a static behavioral microsimulation model of household savings and asset demand. The model is estimated using the 1998 cross section from official survey data on income and consumption in Germany. Behavioral responses are derived from demand elasticities estimated in a microeconomic model of asset demand.

In line with the literature, income gains are found for most of the households through substantial reductions of marginal tax rates. Income inequality is found to increase, slightly stronger in East- than in West-Germany, as the gains are greater for households in higher tax brackets. Moreover, households are induced to increase savings and alter the structure of asset demand as a result of the income gains as well as shifts in relative asset prices. This substitution causes

[2]While there is extensive literature on theoretical aspects of optimal taxation of capital income (see Sandmo, 1985; Bernheim, 2002, for surveys), empirical evidence is basically limited to a couple of studies on effects of capital gains taxation mainly for the U.S., surveyed in Poterba and Samwick (2002).

deadweight loss, so that welfare effects are lower than income gains for most of the households. Utility losses are found to be significantly greater for households with relatively high savings ratios and great asset demand. In the next section, the major changes from the reform are briefly introduced. Section 3 presents the data applied and the methodology for evaluating the tax reform. In Section 4, results for distributional and welfare effects are discussed, and Section 5 concludes.

## 2 Germany's Year 2000 Income Tax Reform

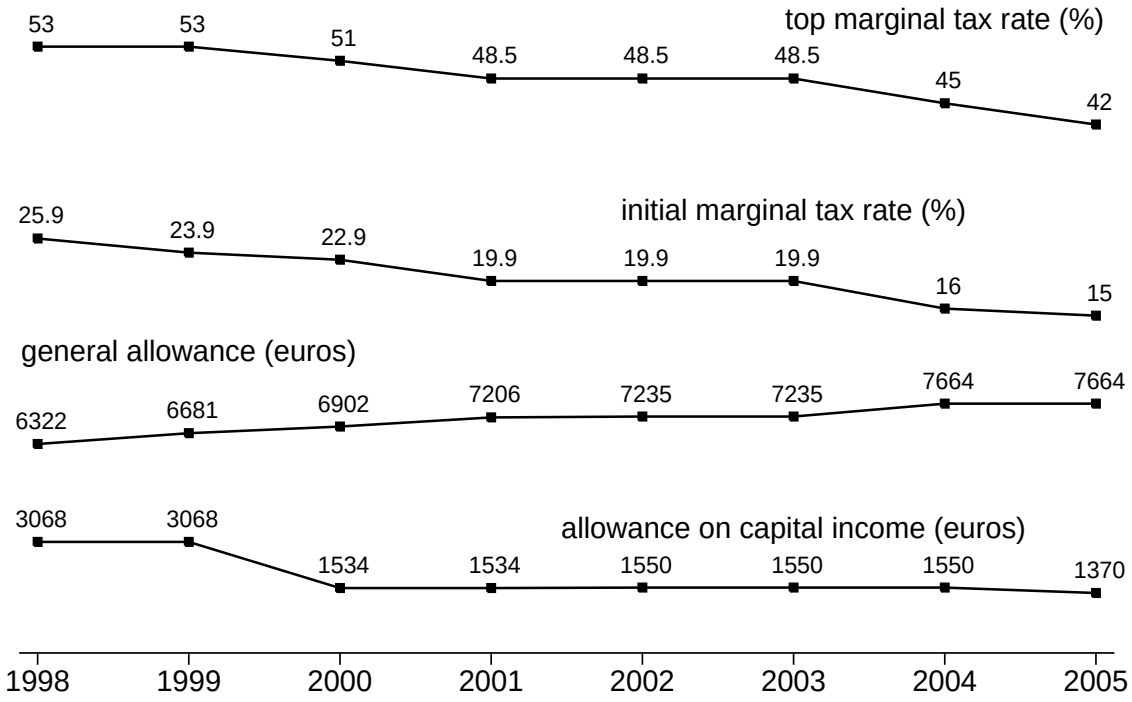
Germany's year 2000 income tax reform was implemented in three steps: the first step was initiated at the beginning of the year 2001. The second step was postponed to the beginning of the year 2004 due to excessive costs resulting from a flood in 2002. Finally, the third step of the reform was implemented at the beginning of the year 2005. The year 2000 tax reform, as it shall be subject to analysis, consists of three single laws: the "Steuersenkungsgesetz" (StSenkG), the "Steuersenkungsergänzungsgesetz" (StSenkErgG), and the "Steuerentlastungsgesetz 1999/2000/2002", see Bach, Corneo, and Steiner (2008), for an overview. Generally, changes from all three laws shall be considered here.

However, as this analysis shall focus only on that part of the reform that affected private households, changes at the taxation of corporate profit are only considered as far as they directly affect the after-tax return of shareholders, in this case through a change in the taxation scheme for dividends. Changes related to the income tax also affect income of entrepreneurs and proprietors from non-incorporated business partnerships ("Personengesellschaften"), as such income is subject to personal income tax (PIT). The focus shall be on the shifts in the tariff of the PIT as well as on a couple of reform components related to the taxation of capital income that are targeted to broaden the tax base and that may affect households' consumption-savings decision as well as asset demand through variation in the net asset returns. The components of the reform that are considered in this analysis shall be briefly described in the following.

On the one hand, the reform generally shifted the PIT tariff by gradually lowering the rates and at the same time, increasing the general tax-free allowance. The development of the PIT rates for the top and the initial rate as well as the general allowance and the allowance on capital income is plotted in Figure 1 over the time frame of the reform. By the reform, the PIT tariff was generally shifted downwards. The top marginal tax rate, excluding solidarity surcharge of 5.5%, was lowered from 53.0% in 1998 to 51.0% in 2000, to 48.5% in 2001, then to 45.0% in 2004, and finally to 42.0% in 2005. Meanwhile, the initial rate was also lowered from 25.9% in 1998 to 23.9% in 1999, to 22.9% in 2000, to 19.9% in 2001, then to 16.0% in 2004, and finally to 15.0% in 2005. At the same time, the tax-free allowance was increased

from 6,322 euros in 1998 to 6,681 euros in 1999, to 6,902 euros in 2000, to 7,206 euros in 2001, to 7,235 euros in 2002, and then to 7,664 euros in 2004, whereupon it stayed constant in 2005 (Bundesministerium der Finanzen, 2004).

**Figure 1:** Personal Income Tax Rates and Allowances over the Time Frame of the Reform




Notes: Tax rates exclude solidarity surcharge of 5.5%.
Source: Own illustration.

On the other hand, the reform broadened the tax base by altering the taxation schemes and allowances for income from the investment of capital.[3] The tax-free allowance on income from financial capital was gradually reduced, as plotted in Figure 1: for singles, from 3,068 euros in 1998 to 1,534 euros in 2000, then slightly increased to 1,550 euros in 2002, and then again reduced to 1,370 euros in 2005. The taxation of dividends was changed from the imputation scheme (*"Anrechnungsverfahren"*) to the half-dividend scheme (*"Halbeinkünfteverfahren"*). Before the reform, *gross* dividends at the shareholder level were subject to PIT, and there was a withholding tax (KEST) prepayment of 25%, while the corporate tax payment (30% for distributed profits) was considered as a tax credit. After the reform, *net* dividends ("Bardividende")[4] were subject to PIT, with only 50% of the net dividend taxable, and the KEST was

[3] These changes are mostly based on the "Steuerentlastungsgesetz 1999/2000/2002".
[4] Net dividends are net of corparate taxes and net of KEST at the shareholder level.

reduced to 20%. The tax credit of corporate taxes (reduced to 25%) was abolished.

Moreover, allowances for purchasing expenses related to owner-occupied housing were adjusted. If construction of the house was started between 01.01.1996 and 01.01.1999, expenses could be deducted as initial costs according to § 10i EStG in line with the home-building allowance ("Eigenheimzulage"), see Ochmann (2010) for more details. Also, time frames for tax exemption of price arbitrage sales of several asset types were altered. This time frame was increased from six months to twelve months for sales of equities, i.e. stocks and bonds. It was increased from two to ten years for non-owner-occupied housing assets, while for owner-occupied housing assets, the time frame of two years was abolished, so that income from such sales is generally tax exempt after the reform.[5]

It is assumed in this analysis that the tax reform is financed, apart from the self-financing effects through the broadening of the tax base, by deficit spending. Thus, there are no immediate cuts in any transfer payments to households, so that there will result a non-negative income gain for almost every household through the reform.[6] These income gains and their distribution by taxable income shall be subject to analysis in the following. In addition, the income gain is expected to affect the households' consumption-savings behavior as well as asset demand, from which welfare effects shall be derived. Firstly, the data used and the methodology for the reform evaluation are presented in the next section.

# 3 Data and Methodology

## 3.1 Data

The data applied in this analysis stem from the Income and Consumption Survey for Germany ("Einkommens- und Verbrauchsstichprobe", EVS). The EVS is maintained by the German Federal Statistical Office ("Statistisches Bundesamt", StaBu). Households are recruited voluntarily for reports every five years, according to stratified quota samples from Germany's current population census ("Mikrozensus"). They are aggregated to the population according to a marginal distribution of demographic characteristics. The entire population covered by the EVS is re-

[5] Moreover, the tax-free allowance for income from agriculture and forestry (§ 13 Abs.3 EStG) was reduced from 1,023 euros in 1998 to 670 euros in 2005. Simultaneously to the year 2000 tax reform, adjustments at the child benefit and the child allowance ("Familienleistungsausgleich") were undertaken. In 2005, a reform of the taxation of old-age pension income was undertaken ("Alterseinkünftegesetz"). These adjustments shall not be considered in the analysis at hand.

[6] This implies that the fiscal budget is unbalanced in the short run through the reform. For the long run, it can be assumed that the fiscal budget is to be balanced so that the income gains through the reform could be partly (or entirely) drawn back from the households, also see the discussion in Section 4. In fact, the major financing elements of the reform were meant to be adjustments of depreciation rules for companies' assets, which are though not considered here (Bundesministerium der Finanzen, 2004).

stricted, as there are groups that are not covered: institutionalized people (i.e. military people in caserns, students in dormitories, elderly and disabled people in nursery homes or hospitals, nurses or migrant workers in residences, people in jails), homeless people, and households with monthly net household income greater than 35,000 DM (i.e. about 18,000 euros). For the 1998 cross section applied here, the scientific use file (80% samples) contains 49,720 households (42,744 for 2003). For details on how the data set has been manipulated, see Ochmann (2010).

### 3.2 Reform Evaluation

The first aim of this analysis is to evaluate distributional effects of Germany's year 2000 tax reform. Distributional effects may occur because households' incomes are affected to a varying degree by the reform depending on taxable income. In order to quantify these effects, households' disposable equivalent income before and after the reform shall be compared, where the modified OECD equivalence scale and a size-adjusting function are applied.[7] As households are observed in the data only for the pre-reform year, 1998, and not for the post-reform year, 2005, the changes in the tax function related to the reform need to be simulated.

The reform is thus evaluated in an ex-ante analysis. The tax reform was implemented between the years 1998 and 2005, but data are currently available only for the years 1998 and 2003.[8] Pre-reform tax law is simulated as of the time of 1998, and post-reform tax law is simulated as of the time of 2005. The simulations are undertaken with the help of an income taxation module, which is briefly introduced in the following. Thereafter, a model for household asset demand is described, which is then applied to estimate welfare effects.

[7] The modified OECD equivalence scale attaches a weight of 1.0 to the household head, a weight of 0.5 to every other household member older than 14, and a weight of 0.3 to every remaining household member younger than 14. It determines the equivalent income function applied. In addition, the size-adjusting function specifies the weight attached to each household according to its composition. Here, size adjustment by needs is applied, i.e. technically, incomes are divided by the equivalence scale and resulting equivalent incomes are in turn weighted by the equivalence scale. See Ebert and Moyes (2003) for the concept of needs-adjusted equivalence scaling and Bönke and Schröder (2010) for an application to country inequality rankings. It is moreover debatable if other income concepts are more appropriate in the context of this analysis. Alternatively, the income concept that underlies the consumption-savings decision could be applied here. Further research shall investigate sensitivity of the results w.r.t. alternative income concepts.

[8] As households are also observed for the in-between-reform year, 2003, in another cross-section, a mixture of ex-ante and ex-post analysis would be possible. The 2003 data could be used for an ex-post evaluation of the first step of the reform, which was implemented in 2001. This shall be undertaken in future research together with an ex-post evaluation of the entire reform once micro data from the 2008 cross-section are available.

## Simulation

In order to evaluate distributional effects of the reform, income taxation is simulated for the pre-reform year as well as for the post-reform year based on the income taxation module that is described in Ochmann (2010). In the module, the changes at the tax function that are related to the reform, as described in Section 2, are implemented. It is set up in the framework of a classical static microsimulation model of household savings and asset demand, either including or excluding behavioral responses.[9] Behavioral responses related to savings and asset demand are derived from estimated asset demand elasticities.

At the simulation, the commonly observed effect of "bracket creep" (see e.g. Saez, 2003), that is related to inflation and progressive elements in the tariff, is accounted for. The tax tariff in German income tax law is related to incomes in nominal terms and not indexed to inflation. Thus, taxpayers that are close to the upper bound of a tax bracket may creep up to a higher bracket in case of rising *nominal* incomes, while their *real* incomes may stay constant if the increase barely compensates inflation. They then face a higher marginal tax rate, while their incomes in real terms are constant. In order to account for the effect of "bracket creep", it is assumed that gross incomes in *real* terms are constant between 1998 and 2005, i.e. real gross wages are also constant. Increases in nominal incomes thus barely compensate inflation.[10] Technically, taxable incomes in 1998 prices are inflated by the CPI[11] to 2005 prices for the simulation of the post-reform tariff and then deflated back to 1998 prices when comparing pre-reform incomes to post-reform incomes for the evaluation of distributional income effects.[12]

Following the basic set up of a static microsimulation model, the analysis is conducted in a partial equilibrium framework of comparative statics. It is assumed that pre-tax asset market prices are in equilibrium and thus are not affected by demand changes. This implies that asset supply is perfectly elastic, so that the only effects considered result from demand shifts that are related to changes in taxation of asset returns. Moreover, effects on other markets than

[9] For a survey on behavioral microsimulation models in the context of public redistribution policies, see Bourguignon and Spadaro (2006).

[10] Real gross wages were largely constant over the period of 1998 to 2005 in East- as well as West-Germany, see Brenke (2009).

[11] Compound inflation measured by CPI differentials amounts to 10.5% for West-Germany and 9.2% for East-Germany in the post-reform year 2005 compared to the pre-reform year 1998.

[12] It is generally debatable if it is appropriate to account for the effect of "bracket creep" here. The idea of this approach is to measure the reform-related reduction of the tax burden in real terms. The assumptions made for this approach appear to be reasonable. It could, however, also be argued that there is more heterogeneity in the inflation effects over this time frame, e.g. in wages over the industries, that remains uncaptured, or that the households will have to be compensated for the effect of "bracket creep" in the long run and thus the tax tariff be adjusted. This would rather speak for neglecting its effects in this analysis. First-round effects are found to be 45% greater for this alternative approach, see Section 4.

the asset market are not considered here.[13] Thus, also labor supply effects are not considered here. In Section 4, it is discussed how this might affect the results. In the following, a model for household asset demand will be briefly introduced.

### A Model for Household Asset Demand

Another aim of this analysis is to evaluate welfare effects of Germany's year 2000 tax reform that are related to household reactions concerning savings behavior and asset demand. Households may be induced by the reform to adjust intertemporal consumption decisions as well as decisions to allocate given savings to various types of assets. These demand effects are twofold. On the one hand, there is an income effect, as the reform affects disposable household income through the tariff shift. On the other hand, there is a substitution effect, as the reform alters relative asset prices by the shift and additionally by changes in taxation schemes and allowances related to capital income. In order to determine whether households, in addition to the income effect, gain or lose utility by substituting relatively more expensive assets for relatively less expensive ones, household preferences for assets shall be estimated.

In order to estimate households' preferences for consumption and savings as well as for allocation of savings to types of assets, household asset demand is modeled in a structural system for asset demand. For that purpose, asset demand is embedded in a two-stage budgeting model (2SBM) and modeled in a linearized quadratic almost ideal demand system (QUAIDS), as it is described in detail in Ochmann (2010) and shall thus be introduced here only briefly. In that model, households maximize utility that is generated from a stream of service flows provided by the assets.[14] The budget is allocated to assets in clusters at two stages. Let $s_{ij}$ denote the share from the respective budget in cluster $l$ that household $i$ invests in asset $j$. Then asset demand in the QUAIDS is represented by the following system of $j = 1, \ldots, J$ demand share equations, where $J$ denotes the number of all asset types available to the household:

$$s_{ij} = \alpha_{0j} + \beta_{1j} \ln(A_{il}/P^*) + \beta_{2j} \ln(A_{il}/P^*)^2 + \sum_{k=1}^{J} \gamma_{jk} \ln(p_{ik}) \tag{1}$$

for households $i = 1, \ldots, N$, assets $j = 1, \ldots, J$ and clusters $l = 1, \ldots, L$. $A_{il}$ is household $i$'s budget for cluster $l$, $p_{ik}$ the price of asset $k$ for household $i$, and $\alpha_{0j}$ an asset-specific constant. $\beta_{1j}$ and $\beta_{2j}$ denote parameters of the budget effects and $\gamma_{jk}$ a parameter of relative price changes. $\ln(P^*)$ is the translog price index, which is approximated by a linear price index, the

[13] For a study of effects of tax reforms on asset prices and other markets in a general equilibrium framework, see inter alia Hall (1996).

[14] Service flows of an asset may involve the return to investment, risk-related attributes, transaction-related characteristics, and other asset-specific services.

log-linear Laspeyres index ($\ln(P^*) = \sum_j \bar{s}_j \ln(\bar{p}_j)$), resulting in the linearized QUAIDS.

In the linearized QUAIDS, the budget elasticity for asset $j$ demand *level* follows from Eq. (1):

$$\eta_{ij} \equiv \frac{\partial A_{ij}}{\partial A_{il}} \frac{A_{il}}{A_{ij}} = 1 + \left(\beta_{1j} + 2\beta_{2j} \ln(A_{il}/P^*)\right)/s_{ij} \tag{2}$$

The uncompensated price elasticity for the demand level of asset $j$ w.r.t. price of good $k$ is:

$$\varepsilon^u_{ijk} \equiv \frac{\partial A_{ij}}{\partial p_{jk}} \frac{p_{jk}}{A_{ij}} = -\delta_{jk} + \gamma_{jk}/s_{ij} - \left(\beta_{1j} + 2\beta_{2j} \ln(A_{il}/P^*)\right) \bar{s}_k/s_{ij} \tag{3}$$

where $\bar{s}_k$ is the average share of asset $k$ and $\delta_{jk}$ is the Kronecker delta, i.e. $\delta_{jk} = 1$ if $j = k$ and $\delta_{jk} = 0$ if $j \neq k$. By the Slutsky equation, the compensated price elasticity follows as:

$$\varepsilon^c_{ijk} \equiv \varepsilon^u_{ijk} + s_{ik}\eta_{ij} = -\delta_{jk} + \gamma_{jk}/s_{ij} + s_{ik} + \left(\beta_{1j} + 2\beta_{2j} \ln(A_{il}/P^*)\right)(s_{ik} - \bar{s}_k)/s_{ij} \tag{4}$$

For the sake of interpretation, compensated (after-tax) rate-of-return elasticities rather than price elasticities will be presented. They follow from the price elasticities as:

$$\varepsilon^{(r)\,c}_{ijk} = -\varepsilon^c_{ijk} \frac{\widetilde{r}^{net}_j}{1 + \widetilde{r}^{net}_j} \tag{5}$$

where $\widetilde{r}^{net}_j = r^{gro}_j(1 - t_{ij}) - \pi_i$ is the after-tax real rate of return to asset $j$, $r^{gro}_j$ the respective pre-tax return, $\pi_i$ is the inflation rate relevant for household $i$, and $t_{ij}$ the marginal tax rate on capital income from asset $j$ that is simulated in the income taxation module described in the previous subsection. The uncompensated rate-of-return elasticity follows accordingly from Eq. (3). Total asset demand in this model is defined as the sum of accumulations of each asset. This definition for total demand excludes asset liquidations in order to define asset shares consistently in Eq. (1). Thus, total asset demand can be interpreted as *gross* savings, in terms of expenditures for asset accumulations.[15] For more details on the model, see Ochmann (2010).

### Measuring Distributional and Welfare Effects

If the tax reform induces households to reallocate their assets due to an income effect and shifts in relative asset prices, there may occur changes in household utility additionally to the distributional effects of income gains or losses. In order to quantify the excess burden of distortionary taxation of asset accumulation following the concept of consumer surplus, an estimate

[15] When estimated effects are summed up to aggregate asset demand in Section 4, effects on asset liquidations are inferred from simplifying assumptions, so that conclusions can also be drawn on *net* savings. Liquidations are though not integrated into the model.

for households' preferences concerning consumption and savings as well as the allocation of savings to asset types is required. In the analysis at hand, the underlying preferences are inferred from estimates for asset demand functions from the microeconomic model. Differences in utility are approximated by areas under the compensated (Hicksian) demand functions from the asset demand model, which is in line with the concept of consumer surplus.[16] The structural demand system in Eq. (1) allows for between-asset substitution, so that compensated price (or rate-of-return) elasticities can be estimated.

Following the concept of consumer surplus, welfare effects of distortionary taxation can be quantified by a popular welfare measure, the compensating variation ($CV$). The compensating variation is a money-metric measure that yields welfare effects in actual cash sums. It is defined by the integral under the Hicksian demand curve, for a constant *pre*-reform utility level. The compensating variation can thus be interpreted as the cash sum by which a household would have to be compensated for a price increase – after the reform, i.e. at post-reform prices – in order to gain a constant pre-reform utility level.[17] Following the welfare-concept definition, the compensating variation is defined as (see Deaton and Muellbauer, 1980, pp. 184-190):

$$CV_i \;=\; c(u_i^1, p_i^1) \;-\; c(u_i^0, p_i^1) \tag{6}$$

where $c(u_i^1, p_i^1)$ is the cost function for expenditures of household $i$ to gain the post-reform utility level at post-reform prices, and $c(u_i^0, p_i^1)$ the respective cost function to gain the pre-reform utility level at post-reform prices. If this difference is strictly greater than zero, the household is better off after the reform in money-metric welfare terms.

As differences in utility are not observed, the $CV$ needs to be approximated with the help of estimates for the compensated price elasticities in Eq. (4).[18] A second-order Taylor expansion of $c(u^0, p^1)$ around $(u^0, p^0)$ yields, omitting household indices for simplicity (see Deaton and Muellbauer (1980), p. 174 or an application in Banks, Blundell, and Lewbel (1996)):

$$c(u^0, p^1) \;\approx\; c(u^0, p^0) \;+\; \sum_j \frac{\partial c(u^0, p^0)}{\partial p_j^0}(p_j^1 - p_j^0) \;+\; \frac{1}{2}\sum_j \sum_k \frac{\partial^2 c(u^0, p^0)}{\partial p_j^0 \partial p_k^0}(p_j^1 - p_j^0)(p_k^1 - p_k^0) \tag{7}$$

where $c(u^0, p^0)$ is the cost function for the pre-reform utility level at pre-reform prices.

[16] As Hicksian demand functions are first derivatives of the cost function, integration over the interval of a price change yields differences in costs of reaching the same indifference curve at two distinct price vectors (see Deaton and Muellbauer, 1980, pp. 184-186).

[17] However, the equivalent variation is the cash sum a household would be willing to pay in order to avoid the price increase – before the reform, i.e. at pre-reform prices – to gain a constant post-reform utility level. For a comparison to other welfare measures in the context of tax reforms and an application to a specific reform of the subsidization of housing assets in the UK, see e.g. King (1983).

[18] Note that here *price* elasticities must be applied to approximate the expenditures in Eq. (6).

Rewriting the definition of the $CV$ in Eq. (6) and using Eq. (7), the $CV$ of a combined price and income change can be approximated by estimates for the compensated price elasticities (see Appendix A for a detailed derivation):[19]

$$\widehat{CV} \approx y^1 - y^0 - \sum_j p_j^0 q_j^0 \left( \frac{p_j^1 - p_j^0}{p_j^0} \right) \left( 1 + \frac{1}{2} \sum_k \widehat{\varepsilon}_{jk}^c \frac{p_k^1 - p_k^0}{p_k^0} \right) \tag{8}$$

where $\widehat{\varepsilon}_{jk}^c$ is an estimate for the compensated price elasticity of asset $j$ w.r.t. price of asset $k$.[20] Eq. (8) contains only variables that are observed or that have been estimated, while all utility terms have been replaced. In case demand is completely inelastic for all assets, there are no distortionary effects, i.e. $\widehat{\varepsilon}_{jk}^c = 0 \; \forall \, j,k = 1,...,J$, and the $CV$ reduces to the income changes added to the changes in expenditures for constant demand resulting from the price shifts: $\widetilde{CV} \approx y^1 - y^0 - \sum_j p_j^0 q_j^0 \left( \frac{p_j^1 - p_j^0}{p_j^0} \right)$. This is denoted in the literature as first-order approximation to the welfare measure (Banks et al., 1996).[21]

If the single utility changes are accumulated to an aggregate welfare measure, a normative assumption concerning the relative valuation of the individual households is required. One normative assumption is implied here by weighting the welfare effects with the modified OECD equivalence scale, i.e. accounting for effects of household composition and adjusting for differences in needs. Apart from that, it is assumed that the social welfare function is utilitarian, i.e. all households get the same social utility weight, so that the welfare effects in *equivalent* money-metric terms are effectively added up over all households and average effects are evaluated.[22] Results on estimated elasticities and welfare effects together with distributional income effects are presented in the next section.

[19] In simulations with log-linear utility, this approximation performed accurately in case the differentials in pre- and post-reform prices are of similar size and the same sign for all assets. In case, the variation in the differentials is not too large, the approximation error appeared to be acceptable. For further simulations on the approximation error, also see Banks et al. (1996).

[20] Note that these are average elasticities over all households. Their application in the welfare measure implies the assumption of equal social utility weights for all households (see Banks et al., 1996).

[21] Generally, there is a trade off regarding accuracy between such a first-order approximation and a second-order approximation of the form in Eq. (8). The latter is on the one hand found to produce lower approximation error in specific empirical applications (Banks et al., 1996). On the other hand, it gives rise to potential imprecision or even bias from the estimation of substitution elasticities in demand, which is not needed for first-order approximations. In Section 5, implications for further research are directed to the investigation which approximation is the most appropriate for the application at hand.

[22] Alternatively, social utility weights could vary over the households, and inequality aversion could be introduced. This would put a higher weight on households with relatively lower income and a lower weight on households with relatively higher income. The results in Section 4 indicate that such weighting would reduce the aggregate welfare effects of the reform, as welfare effects increase by income and they are even slightly negative in the lower income deciles. The results found for the utilitarian welfare function shall be compared to welfare effects for an income-weighted welfare function in future research. The weights applied shall be made consistent with the applied income concept, as discussed earlier.

# 4 Results

This section is partitioned into four parts. Firstly, first-round distributional effects of the reform are presented. They refer solely to the income effects and neglect any household behavioral response. Secondly, effects of households' demand reactions on savings and asset demand are featured.[23] From all these effects, resulting second-round distributional effects are derived. Finally, utility losses resulting from behavioral adjustments are quantified and evaluated in terms of welfare effects.

## 4.1 First-Round Distributional Effects

Distributional effects are related to cash gains (or losses) that result from the tax reform. They are relevant if the gains are distributed unequally over the households, e.g. if disposable income increases relatively stronger through the reform for households in higher tax brackets than for households in lower brackets. This is the case here, primarily because the tax function is progressive, so that the gains will have an effect on inequality in the income distribution. Distributional effects shall be decomposed into first-round and second-round effects depending on whether behavioral adjustment of savings and asset demand is taken into account or not. While first-round effects consist only of immediate income changes for fixed demand, second-round effects additionally consider income changes in the form of capital income differentials resulting from demand adjustments. Income changes are evaluated for pre-reform and post-reform differentials in disposable equivalent household income.

Changes in the income distribution shall be evaluated with several popular inequality measures. The general entropy index, GE(-1), is relatively more sensitive to changes at the lower end of the income distribution. The Gini coefficient is sensitive to income changes in the middle of the distribution. The Theil index, GE(1), is more than average sensitive to income shifts at the top of the distribution (see e.g. Ochmann and Peichl, 2006). Definitions of the indices are relegated to Appendix A.

Germany's year 2000 tax reform affects the distribution of disposable household income directly by shifting the tax tariff and broadening the tax base. These effects shall be measured by comparing the distribution of pre-reform equivalent income with the distribution of simulated post-reform equivalent income. Table 1 presents results for first-round distributional effects of the tax reform, where the effects of "bracket creep" are accounted for. Pre-reform and post-reform disposable equivalent household incomes in pre-reform prices and absolute as well as relative income differentials are displayed in the upper panel of Table 1. First-round

[23] However, by the partial equilibrium assumption, there are no third-round effects of changes in market prices on asset demand analyzed here, as pre-tax asset prices are assumed unaffected by the reform.

income gains, defined by differentials in pre-reform and post-reform income, are reported for equivalent as well as non-equivalent incomes – i.e. the latter are not adjusted for differences in needs – while relative gains are reported only for the former.

**Table 1:** First-Round Distributional Effects by Taxable Income (in euros per year)

| | Upper Dec. Bound | Pre-Reform Eqv. Income | Post-Reform Eqv. Income | Δ (eqv.) | Δ (non-eqv.) | Δ (%) |
|---|---|---|---|---|---|---|
| **Deciles of Tax. Inc.** | | | | | | |
| 1 | 675 | 13,548 | 13,548 | 0 | 0 | 0.00 |
| 2 | 1,585 | 13,961 | 13,962 | 1 | 2 | 0.01 |
| 3 | 2,808 | 16,144 | 16,148 | 4 | 5 | 0.03 |
| 4 | 7,084 | 17,149 | 17,202 | 53 | 75 | 0.31 |
| 5 | 11,376 | 17,012 | 17,352 | 340 | 556 | 2.00 |
| 6 | 14,758 | 17,925 | 18,420 | 495 | 872 | 2.76 |
| 7 | 18,509 | 20,009 | 20,607 | 598 | 1,049 | 2.99 |
| 8 | 22,782 | 22,847 | 23,550 | 703 | 1,151 | 3.08 |
| 9 | 29,465 | 26,169 | 26,963 | 794 | 1,234 | 3.03 |
| 10 | 191,714 | 39,006 | 40,371 | 1,365 | 2,037 | 3.50 |
| **Region** | | | | | | |
| West-Germany | | 21,586 | 22,079 | 493 | 745 | 2.28 |
| East-Germany | | 16,237 | 16,559 | 322 | 495 | 1.99 |
| **Average Household** | | 20,576 | 21,037 | 461 | 698 | 2.24 |
| Gini | | 0.2704 | 0.2728 | 0.0024 | | 0.90 |
| $\text{Gini}_{west}$ | | 0.2717 | 0.2739 | 0.0022 | | 0.82 |
| $\text{Gini}_{east}$ | | 0.2206 | 0.2239 | 0.0033 | | 1.48 |
| GE(-1) | | 0.1285 | 0.1319 | 0.0034 | | 2.59 |
| $\text{GE(-1)}_{west}$ | | 0.1320 | 0.1352 | 0.0032 | | 2.44 |
| $\text{GE(-1)}_{east}$ | | 0.0844 | 0.0874 | 0.0030 | | 3.47 |
| Theil | | 0.1236 | 0.1261 | 0.0025 | | 2.03 |
| $\text{Theil}_{west}$ | | 0.1238 | 0.1262 | 0.0024 | | 1.93 |
| $\text{Theil}_{east}$ | | 0.0852 | 0.0875 | 0.0023 | | 2.78 |

*Notes*: Deciles refer to pre-reform taxable household income. Pre-reform and post-reform disposable incomes are needs adjusted by the modified OECD equivalence scale, see fn. 7 for details. Δ (eqv.) is the differential in pre-reform and post-reform disposable equivalent incomes, Δ (non-eqv.) the respective differential in non-equivalent incomes. Δ (%) denotes the differentials in relative terms and is identical for the two concepts. All incomes are in pre-reform (1998) prices. "Gini" is the Gini coefficient, "GE(-1)" the general entropy index, and "Theil" the Theil index, GE(1), all as defined in Appendix A. Number of observations is $N = 49,484$. Data weighted by population weights (36.5 mn. households in the population).

*Source*: Own calculations using the EVS data (1998).

An average household gains 461 euros per year in equivalent terms by first-round effects of the reform, which corresponds to 2.24% of pre-reform disposable equivalent household income. This gain corresponds to 698 euros in non-equivalent income. It becomes apparent that this gain is distributed unequally over the deciles of taxable income. While households in the three

lowest deciles gain on average virtually zero by the reform, the gain increases absolutely as well as relatively from, in equivalent terms, 53 euros in the fourth decile to 1,365 euros in the tenth decile (from 0.31% to 3.50%).[24] This finding indicates that the reform has a regressive effect, as high incomes gain relatively more by the reform than low incomes. This effect results primarily from the substantial reduction of marginal tax rates and is apparently not fully compensated by the broadening of the tax base.[25]

As a consequence, income inequality increases by the reform. In the lower panel of Table 1, results for various inequality measures for pre-reform and post-reform incomes are presented, for all households in Germany as well as differentiated by East- and West-Germany. The Gini coefficient of disposable equivalent income for Germany slightly increases by the first-round effects of the reform from 0.2704 to 0.2728 (i.e. by 0.90%). The Gini coefficient is relatively more sensitive in the mid-levels of the income distribution. A stronger increase is found for the general entropy index, which rises for Germany by 2.59%, and for the Theil index, which rises by 2.03%. These results indicate that the increase in income inequality is largely related to the lower end as well as the higher end of the distribution, while leaving mid-level incomes less affected. Higher incomes benefit greatly from the reduction of tax rates, while lower incomes benefit greatly from the increasing tax-exempt allowance. Mid-level incomes are relatively less affected by these two main reform elements.

Generally, first-round income gains are greater in West- than in East-Germany, in absolute as well as in relative terms. While in West-Germany an average household gains 493 euros (which corresponds to 2.28% of pre-reform disposable equivalent household income in West-Germany), an average household in East-Germany gains only 322 euros (1.99%). Moreover, inequality increases more strongly in East-Germany than in West-Germany. While the Gini coefficient increases for West-Germany by 0.82%, it increases for East-Germany slightly stronger by 1.48%. Also the increase in the general entropy index as well as the Theil index is relatively stronger in East-Germany.[26]

[24] While for 69% of the households in the population, first-round effects are positive, for some 8%, they are negative, and some 23% are unaffected, as long as demand adjustments are not considered. Households are unaffected by the reform in the first round if their pre-reform taxable income is below the tax-exempt allowance and no other changes apply. If in addition other changes related to the broadening of the tax base apply or to the effect of "bracket creep", households may actually lose.

[25] The finding of a regressive effect of the reform is in line with Haan and Steiner (2005), Corneo (2005), and Bönke and Corneo (2006). Maiterth and Müller (2009) further qualify this result in the context of tax equity applying a measure for the distribution of the tax burden and find that increasing income inequality does not necessarily allow the conclusion that the reform increased tax inequity.

[26] All results presented refer to the reform simulation accounting for "bracket creep". If "bracket creep" were not accounted for, the income gain for an average household would increase to 669 euros in equivalent terms (3.25% of pre-reform income; 45% greater than under "bracket creep"), and the post-reform Gini coefficient (0.2744) would also be slightly greater compared to the main results. The increase in the income gain through the omission of "bracket creep" is found to be greater in relative terms for low incomes. Moreover,

The results found here are qualitatively and quantitatively similar to what Haan and Steiner (2005) find for distributional effects of the reform in case labor supply adjustment is not accounted for. Haan and Steiner (2005) report a slightly greater Gini coefficient for pre-reform incomes using SOEP data. This is on the one hand due to a different income concept (net income vs. disposable equivalent income), and on the other hand to a different base year (2000 vs. 1998).[27] The average income gain through the reform found by Haan and Steiner (2005) is somewhat greater than found here: 725 euros or 2.80% of net income in case "bracket creep" is accounted for. Due to a different income concept, these results are, if at all, only comparable in relative terms to the results found here. The difference in relative terms is most probably due to the lack of top-incomes in the EVS data; in the SOEP data, these are accounted for by an additional high income sample.[28]

Comparability of the distributional effects found here to results found by Wagenhals (2001) is limited, as Wagenhals (2001) only reports second-round effects considering labor supply reactions. Nevertheless, results for evolution of inequality are similar: the gain of the reform is relatively greater for higher incomes compared to lower incomes and thus inequality increases; the Gini coefficient for disposable household income is found to rise by 2.70% in Wagenhals (2001). The effects also correspond qualitatively to the results from Merz and Zwick (2002). They find an average gain of 6.90% from 1995 disposable household income and an increase in the Gini coefficient of 1.80%. Comparison to their results is though also limited, as Merz and Zwick (2002) additionally consider changes at the local business tax, whereby the gain for entrepreneurs is greater, and they do not account for "bracket creep".

### 4.2 Effects on Asset Demand

The results discussed so far neglect households' responses in savings and asset demand to the reform. Germany's year 2000 tax reform may though induce households to adjust their savings and asset allocation behavior. On the one hand, the increase in disposable income from first-round effects of the reform may be allocated to current and postponed consumption differently

if the shift in the tariff were entirely omitted from the reform, inequality would actually *decrease* solely due to the broadening of the tax base. Thus, the increase in inequality through the entire reform can be traced back to the tariff shift alone.

[27] Generally, income inequality slightly increased during 1998 and 2000 in Germany (Bach, Corneo, and Steiner, 2009). Moreover, as Becker, Frick, Grabka, Hauser, Krause, and Wagner (2003) point out, net incomes on average are slightly greater and income inequality is slightly lower in the EVS data than in the SOEP data. Though, for 1998 data, this result is based on SOEP data that do not include a high income sample, as it is included in Haan and Steiner (2005). A similar Gini coefficient for net equivalent household income in 1998 using EVS data is found by Becker et al. (2003) as well as by Merz (2001).

[28] In order to account for the different distributions of the top incomes in these two micro data sets, the population weights of the EVS data could be regenerated according to the income distribution in the SOEP data. This shall be conducted in future research.

than the pre-reform disposable income is allocated. On the other hand, relative net prices of assets are altered by the reduction of marginal tax rates and the broadening of the tax base, as returns to some assets are taxable while others are tax exempt and as some assets are affected by adjustments of allowances, while others are not. As a consequence, differentials in pre-reform and post-reform net asset prices vary over the assets. While for some assets, the net price falls due to the decreasing tax rates, net prices increase for other assets primarily due to reductions of allowances.

### Differentials in Net Asset Prices

As stated earlier, pre-tax asset market prices are assumed to be unaffected by household asset demand reactions resulting from the reform. Changes in *after-tax* asset prices at the household level are thus directly related to the elements of the reform that affect taxation of asset returns. These changes vary over the households according to the tax bracket as well as over the asset types. Table 2 displays in the third column changes in relative terms in net asset prices related to the reform for an average household.

Net prices fall on average significantly for non-owner-occupied housing assets (by 1.45%) because lower tax rates increase the returns to income from renting and leasing which is fully taxable, offsetting a decrease of returns to speculative trading that results from the fact that the time frame for tax exemption of price arbitrage sales was increased from two to ten years for non-owner-occupied housing assets. Net prices also fall on average slightly for mortgage repayments (0.03%), for bonds (<0.00%), for bank deposits (<0.00%), and for building-society deposits (<0.00%). For all these assets, this is primarily related to the decrease in tax rates which slightly increases net asset returns and offsets the decrease in the tax-exempt allowance on capital income.[29] For bonds, the tax effect additionally offsets a return-diminishing effect from increasing the time frame for tax exemption of price arbitrage sales of equities from six months to twelve months.

Net prices increase, however, on average significantly for stocks (2.31%). Changing the system of taxation of dividends from the imputation scheme to the half-income scheme reduces net stock returns, as corporate taxes can no longer be credited against personal income tax.[30]

[29] Note that mortgage repayments are treated as an asset here. In the German income tax law, they are tax deductible if they are related to non-owner-occupied housing. If marginal tax rates are lowered, deducting such mortgage repayments becomes less attractive and in turn increasing repayments more attractive. For more details on the definition of asset prices in the demand model, see Ochmann (2010).

[30] Deutsches Aktieninstitut (2000) shows that net returns to stocks are lower in the half-income scheme up to a marginal tax rate of 40%. Moreover, they argue that gross returns to stocks are also reduced by the foregone corporate-tax credit. The latter result indicates that the partial equilibrium assumption could be violated here. It suggests that there could be relevant third-round effects of the reform on the demand for stocks that are not subject to analysis in this study.

**Table 2:** Estimated Demand Elasticities and Demand Differentials in Aggregate Sums

| | Elasticities | | Price | Aggregate Demand (bn. euros per year) | | | | |
|---|---|---|---|---|---|---|---|---|
| | Budget $(\widehat{\eta}_{j\|l})$ [a] | Own-Rate $(\widehat{\varepsilon}_{jj}^{(r)u})$ | Delta (%) | Gross (Pre-Ref.) | $\Delta_{gross}$ | % | Net (Pre-Ref.) | $\Delta_{net}$ |
| Savings | 1.84*** | 0.11* | −0.20 | 457.25 | 17.59 | 3.85 | 124.37 | 4.24 |
| Housing Assets | 1.27*** | 1.01*** | −0.12 | 157.65 | 6.65 | 4.22 | 74.97 | 3.19 |
| Financial Assets | 0.94*** | 1.79*** | 0.58 | 299.61 | 10.95 | 3.65 | 52.35 | 1.05 |
| Owner-Occupied | 1.26*** | 1.14*** | 0.02 | 56.38 | 2.84 | 5.03 | 52.10 | 2.62 |
| Non-Owner-Occ. | 1.43*** | 1.20*** | −1.45 | 26.46 | 1.47 | 5.56 | 22.63 | 1.26 |
| Mortgage Rep. | 0.92*** | 1.42*** | −0.03 | 74.81 | 2.34 | 3.12 | −22.13 | −0.69 |
| Bank Deposits | 1.28*** | 1.18*** | −0.00 | 164.30 | 6.85 | 4.17 | −9.61 | −0.40 |
| Building-Soc. D. | 0.82*** | 0.60*** | −0.00 | 36.00 | 0.83 | 2.31 | 19.37 | 0.45 |
| Stocks | 1.62*** | −0.14** | 2.31 | 47.24 | 1.92 | 4.05 | 18.42 | 0.75 |
| Bonds | 1.88*** | −0.61 | −0.00 | 7.18 | 0.34 | 4.67 | −1.70 | −0.08 |
| Insurances | 0.41*** | 1.26*** | 1.03 | 20.25 | 0.36 | 1.78 | 10.19 | 0.18 |
| Credit Rep. | 0.87*** | 0.80*** | 0.00 | 24.63 | 0.65 | 2.65 | 5.81 | 0.15 |

*Notes*: Significance levels based on standard errors computed by the delta method: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Elasticities are computed at the mean of all covariates. $\widehat{\eta}_{j|l}$ is the point estimate for the *conditional* budget elasticity on asset levels. The condition is on the respective cluster budget in the 2SBM, see Ochmann (2010). $\widehat{\varepsilon}_{jj}^{(r)u}$ is the point estimate for the *unconditional* uncompensated own-rate of return elasticity. Price delta (%) is the post-reform to pre-reform relative change in *after-tax* asset prices. Gross aggregate asset demand refers to asset accumulations, whereas net demand is the balance of accumulations and liquidations.

[a]: Null hypothesis for the budget elasticities is $\widehat{\eta}_{j|l} = 1$.

*Source*: Own calculations using the EVS data (1998, 2003).

In addition, the decrease in the tax-exempt allowance on capital income lowers net returns to dividends for the shareholder. These effects largely offset the effects of lower personal tax rates for an average household. Net prices also increase for contributions to capital and private old-age pension insurances (1.03%), as these were still fully tax deductible by the year of 1998, so that their net return decreases if tax rates are lowered. The after-tax price increases only slightly through the reform for owner-occupied housing (0.02%). On the one hand, this price decreases because the time frame for tax exemption of price arbitrage sales for owner-occupied housing assets of two years was abolished, and income from such sales is generally tax exempt after the reform. On the other hand, the net price for owner-occupied housing increases because allowances for deduction of initial costs for buying a house were abolished by the reform, see Section 2. Net prices are invariant for consumer credit repayments as these are not subject to income taxation, meaning in this context, they can not be deducted from taxable income.

As a result, the after-tax price for housing assets in general slightly decreases on average (0.12%), while the price for financial assets in general increases on average (0.58%). Finally,

this lets the net price for savings in general decrease slightly by 0.20%.[31] This price decrease induces households to substitute consumption for savings, as will be derived from the demand model in the following. Moreover, households have incentives to substitute relatively more expensive assets for relatively cheaper assets due to the shifts in relative asset prices.

### Asset Demand Responses

As a consequence of the partial equilibrium assumption, savings and asset demand responses follow directly from the asset demand model presented in Section 3. For methodological issues concerning its estimation, see Ochmann (2010). Estimates for budget and price elasticities determine the effects of the first-round income gains and the relative asset price changes on savings and asset demand. There results post-reform asset demand. Estimates for conditional budget elasticities are compiled in the first column and for uncompensated unconditional own-rate elasticities, in the second column of Table 2, both for demand levels.[32]

As the first column of Table 2 reveals, savings are found to be elastic w.r.t. income ($\widehat{\eta}_{j|l} = 1.84$). Thus, an increase in disposable income of 2.16% by first-round effects of the reform will induce households to increase their savings by about 3.98%, let alone demand reactions that are related to price shifts.[33] As a consequence, an average household increases annual *gross* asset demand by 396 euros if disposable income in non-equivalent terms increases by 698 euros through first-round effects of the reform. If it is further considered that demand for asset liquidations (dissavings) in the data amounts on average to about 73% of the demand for accumulations, there results an increase of annual *net* savings by 107 euros for an average household.[34]

So far, these results relate solely to the income effect. Households moreover increase savings due to a decreasing price for savings in conjunction with a positive estimate for the uncompensated own-rate elasticity (second column of Table 2). Additionally to the 107 euros from the income effect, an average household increases annual net savings by 23 euros due to a decrease

[31] This decrease in the savings price corresponds to an increase in the rate of the return of about 0.20 percentage points, e.g. from 5.0% to 5.2%. Moreover, the prices computed here for the asset clusters are compound price indices, generated as weighted averages over the prices of the underlying asset types, where the weights are sample-average shares of the portfolio of asset holdings which are exogenous to the asset allocation decision. By a composition effect, the decrease in the price for savings is stronger here than the decrease in the price for housing assets. For details, see Ochmann (2010).

[32] The corresponding budget elasticities on the *shares* follow from: $\widehat{\eta}^{share}_{j|l} = \widehat{\eta}^{level}_{j|l} - 1$. More results can be found in Ochmann (2010).

[33] This budget elasticity is estimated in Beznoska and Ochmann (2010). Its size is almost identical w.r.t. current and permanent income. Thus, the results presented here could be interpreted as valid for the short term as well as for the long term.

[34] This implies the assumption that the relation between asset accumulations and asset liquidations is not affected by the reform. This is probably a strong assumption, and it shall be loosened in future research once the decision to liquidate assets is integrated into the demand model.

in the savings price of about 0.20%, so that altogether, annual net savings are increased by 130 euros if disposable income increases by 698 euros through first-round effects of the reform (Table 1). This implies a marginal savings rate of 18.6% at the household level. Effects on the aggregate savings rate will be analyzed in the next subsection.

These additional savings are then at a first stage further allocated to housing assets and financial assets, where demand for the former is elastic ($\widehat{\eta}_{j|l} = 1.27$, first column of Table 2) and for the latter inelastic (0.94) w.r.t. the budget. Among housing assets, demand is further elastic for owner-occupied (1.26) as well as non-owner-occupied housing (1.43) and inelastic for mortgage repayments (0.92). Among financial assets, demand is elastic for bank deposits (1.28), stocks (1.62), and bonds (1.88), and inelastic for building society deposits (0.82), life and private-pension insurances (0.41), and consumer credit repayments (0.87). Demand for almost all assets increases if the own return increases, which is consistent with a negative semi-definite Slutsky matrix from demand theory. Only for stocks, the estimate for the uncompensated own-rate elasticity is negative and for bonds, it is not significantly different from zero.[35] The estimates for the rate-of-return elasticities are discussed in more detail in Ochmann (2010).

Post-reform budgets together with post-reform prices then determine the allocation of the first-round income gains to the single assets in the demand model, which gives the post-reform asset structure. The latter, together with post-reform real net returns to the single assets, determines post-reform capital income, which in turn is aggregated over all assets at the household level. Comparing post-reform capital income to pre-reform capital income, yields additional income effects of the reform. If these differentials in capital income are distributed unequally over the households, additional distributional effects may occur. These effects added to the first-round effects are compiled as second-round distributional effects in Table 3. Firstly though, effects on aggregate savings, asset demand, and tax revenue shall be presented.

### Effects on Aggregate Asset Demand and on Tax Revenue

If the reactions in savings and asset demand at the household level are grossed up to the population, effects on the aggregate savings rate and on income tax revenue that are related to the reform can be derived. As noted earlier, an average household increases annual net savings by 130 euros if disposable income increases by 698 euros in non-equivalent terms through the reform. In aggregate sums for the population, this corresponds to an increase in annual net savings of private households by 4.24 bn. euros, from a pre-reform level of 124.37 bn. euros, as Table 2 reveals in the last two columns. Relating this increase to the increase in disposable

[35] The negative estimate for the own-rate elasticity of stocks is potentially a problem in this analysis as it drives the demand effects for this asset, and this asset's net price was significantly altered by the reform. The model shall thus be re-estimated in future research putting a constraint on this elasticity.

income through the reform, which results here as 25.51 bn. euros aggregated to the population of private households, the aggregate net savings rate increases by 0.17 percentage points, from 10.92% to 11.09%, by the reform.[36]

Aggregate demand shifts can moreover be analyzed differentiated by the single assets. Given the pre-reform and post-reform price differentials together with the estimated demand elasticities in the first three columns of Table 2, households' cumulated asset demand reactions can be quantified. These aggregate sums in turn are compiled in columns four to eight of Table 2. Columns four to six present the effects on aggregate asset accumulations, i.e. *gross* demand, that can be directly inferred from the estimates for the demand model. It becomes apparent that accumulations increase for each asset due to a dominant budget effect from the first-round income gains. The increase is relatively stronger for assets with a relatively stronger income elasticity or for assets for which relative prices fall by the reform. This is the case for housing assets in general, for non-owner-occupied housing, for bank deposits, and for bonds. Accumulations also increase relatively strongly for owner-occupied housing and for stocks, in spite of rising prices.[37] For all other assets, the increase in accumulations is lower than average.

If it is again assumed that the relation between accumulations and liquidations *for each asset* is not affected by the reform, accumulations can be netted out against liquidations and effects of the reform on *net* asset demand can be quantified. These are presented in the last two columns of Table 2. As a result of the assumption of a constant liquidation rate, demand increases in net terms only for these assets, for which accumulations exceed liquidations already before the reform. However, for mortgage repayments, for bank deposits, and for bonds, net demand is further reduced slightly by the reform. The major loadings of the increase in net savings by 4.24 bn. euros are related to owner-occupied housing assets (2.62 bn. euros) and to non-owner-occupied housing assets (1.26).

The reform moreover results in a reduction in the income tax revenue. Based on the micro data, aggregate income tax revenue from the pre-reform tax function amounts to 172.77 bn. euros per year.[38] This revenue is reduced by the reform, primarily due to the massive cuts in the tax tariff. The simulated post reform income tax revenue amounts to 147.25 bn. euros. The reduction of 25.5 bn. euros per year (14.8% of pre-reform revenue) equals the aggregate income gain for households in non-equivalent terms. It implies the change in the tariff accounting

[36] The pre-reform aggregate net savings rate as well as the pre-reform level of aggregate net savings that are found in the micro data are pretty close to the numbers reported from national accounts, i.e. 10.08% and 127.53 bn. euros, respectively (Statistisches Bundesamt, 2007). However, comparability of the micro with the macro aggregates is limited due to conceptual reasons, also see Beznoska and Ochmann (2010).

[37] Note that for stocks, the effect of an increasing asset price adds to the positive budget effect, due to a negative estimate for the own-rate elasticity.

[38] This aggregate income tax revenue is close to reported revenues from official tax accounts, see Statistisches Bundesamt (2004).

for "bracket creep" and the broadening of the tax base accounting for households' savings and asset demand reactions. This result for the revenue loss comes pretty close to the annual 26.5 bn. euros estimated by the federal ministry of finance for revenue effects of the reform that are related to personal income taxation for the time frame of 1998 until 2005 (see Bundesministerium der Finanzen, 2004; Keen, 2002). Bönke and Corneo (2006) report an annual reduction of about 31 bn. euros for the same time frame. Haan and Steiner (2005) find a reduction of almost 36 bn. euros per year from a year-2000 income tax revenue level of 214 bn. euros in case labor supply reactions are not accounted for. In relative terms, this amounts to a similar reduction (16.8%) as found here.

### 4.3 Second-Round Distributional Effects

If the effects from the demand reactions discussed in the preceding subsection are considered additionally the first-round income gains, second-round income gains can be derived. These gains imply the effects of the increase in savings and the adjusted asset demand structure on capital income – again accounting for the effects of "bracket creep" from the tax tariff. Results for second-round distributional effects are presented in Table 3. They are generally very similar to the results for first-round effects.

An average household gains 458 euros per year in equivalent terms through the reform (2.23% of pre-reform disposable equivalent income) when demand reactions are accounted for. This is less than the first-round income gains, where reactions are neglected, but the difference is with 3 euro per year in equivalent terms negligibly small. On the one hand, households substitute assets that became relatively more expensive through the reform for relatively cheaper assets. On the other hand, a strong income effect dominates the substitution effect for some relatively more expensive assets, or it adds to it which is the case for stocks. The compound effect over all assets slightly reduces aggregate capital income for an average household.

This result holds for households in all upper deciles of the income distribution. While households in the first four deciles are virtually unaffected by demand effects, capital income losses increase slightly in relative terms from the fifth decile upwards. This progressive effect of the demand reactions, as a consequence, slightly attenuates the increase in income inequality. Compared to the first-round effects, the increase in the Gini coefficient for Germany is marginally lower (0.88%), and also for the GE(-1) index as well as the Theil index, the increase is slightly attenuated (2.54% and 1.98%, respectively). The effects from demand reactions do not differ significantly over the regions. As a result, inequality increases a bit more strongly in East- than in West-Germany, which was already found from first-round effects. The second-round income effects are not yet the entire effects of the tax reform. Income gains are reduced if utility losses

**Table 3:** Second-Round Distributional Effects by Taxable Income (in euros per year)

| | Upper Dec. Bound | Pre-Reform Eqv. Income | Post-Reform Eqv. Income | Δ (eqv.) | Δ (non-eqv.) | Δ (%) |
|---|---|---|---|---|---|---|
| **Deciles of Tax. Inc.** | | | | | | |
| 1 | 675 | 13,548 | 13,548 | 0 | 0 | 0.00 |
| 2 | 1,585 | 13,961 | 13,962 | 1 | 2 | 0.01 |
| 3 | 2,808 | 16,144 | 16,148 | 4 | 5 | 0.03 |
| 4 | 7,084 | 17,149 | 17,202 | 53 | 75 | 0.31 |
| 5 | 11,376 | 17,012 | 17,351 | 339 | 554 | 1.99 |
| 6 | 14,758 | 17,925 | 18,418 | 493 | 869 | 2.75 |
| 7 | 18,509 | 20,009 | 20,605 | 596 | 1,045 | 2.98 |
| 8 | 22,782 | 22,847 | 23,547 | 700 | 1,146 | 3.06 |
| 9 | 29,465 | 26,169 | 26,958 | 789 | 1,227 | 3.02 |
| 10 | 191,714 | 39,006 | 40,357 | 1,351 | 2,017 | 3.47 |
| **Region** | | | | | | |
| West-Germany | | 21,586 | 22,076 | 490 | 740 | 2.27 |
| East-Germany | | 16,237 | 16,558 | 321 | 493 | 1.98 |
| **Average Household** | | 20,576 | 21,034 | 458 | 694 | 2.23 |
| Gini | | 0.2704 | 0.2728 | 0.0024 | | 0.88 |
| $\text{Gini}_{west}$ | | 0.2717 | 0.2739 | 0.0022 | | 0.79 |
| $\text{Gini}_{east}$ | | 0.2206 | 0.2238 | 0.0035 | | 1.54 |
| GE(-1) | | 0.1285 | 0.1318 | 0.0033 | | 2.54 |
| $\text{GE(-1)}_{west}$ | | 0.1320 | 0.1352 | 0.0032 | | 2.39 |
| $\text{GE(-1)}_{east}$ | | 0.0844 | 0.0873 | 0.0029 | | 3.42 |
| Theil | | 0.1236 | 0.1260 | 0.0024 | | 1.98 |
| $\text{Theil}_{west}$ | | 0.1238 | 0.1261 | 0.0023 | | 1.88 |
| $\text{Theil}_{east}$ | | 0.0852 | 0.0875 | 0.0023 | | 2.73 |

*Notes*: Deciles refer to pre-reform taxable household income. Pre-reform and post-reform disposable incomes are needs adjusted by the modified OECD equivalence scale, see fn. 7 for details. Δ (eqv.) is the differential in pre-reform and post-reform disposable equivalent incomes, Δ (non-eqv.) the respective differential in non-equivalent incomes. Δ (%) denotes the differentials in relative terms and is identical for the two concepts. All incomes are in pre-reform (1998) prices. "Gini" is the Gini coefficient, "GE(-1)" the general entropy index, and "Theil" the Theil index, GE(1), all as defined in Appendix A. Number of observations is $N = 49,484$. Data weighted by population weights (36.5 mn. households in the population).

*Source*: Own calculations using the EVS data (1998).

caused by demand reactions are taken into account, which shall be done in the following.

### 4.4 Welfare Effects

Additionally to the income gains from the second-round effects, there may occur changes in household utility if relative prices of assets change and households substitute relatively more expensive assets for relatively cheaper assets in turn. If asset prices on average increase due to the reform because the severe reduction of the tax-exempt allowance on capital income offsets

the reduction of marginal tax rates as far as asset prices are concerned, and if households on average lose utility from the substitution of relatively more expensive assets, the welfare effects for an average household in money-metric terms are lower than the income gains.[39] Only if asset prices did not change and households did not adjust their asset demand, the welfare effects would reduce to the second-round income gains presented in the preceding subsection.

**Table 4:** Welfare Effects and Second-Round Income Gains by Taxable Income and Region (in equivalent euros per year)

| | Upper Decile Bound | Pre-Reform Eqv. Income | Income Gains | Welfare Effects | Winners (%) |
|---|---|---|---|---|---|
| **Deciles of Tax. Inc.** | | | | | |
| 1 | 675 | 13,548 | 0 | -4 | 55.1 |
| 2 | 1,585 | 13,961 | 1 | -6 | 64.1 |
| 3 | 2,808 | 16,144 | 4 | 1 | 61.5 |
| 4 | 7,084 | 17,149 | 53 | 44 | 66.3 |
| 5 | 11,376 | 17,012 | 339 | 326 | 94.1 |
| 6 | 14,758 | 17,925 | 493 | 478 | 95.6 |
| 7 | 18,509 | 20,009 | 596 | 578 | 96.8 |
| 8 | 22,782 | 22,847 | 700 | 681 | 97.3 |
| 9 | 29,465 | 26,169 | 789 | 766 | 97.5 |
| 10 | 191,714 | 39,006 | 1,351 | 1,278 | 97.7 |
| **Region** | | | | | |
| West-Germany | | 21,586 | 490 | 469 | 83.7 |
| East-Germany | | 16,237 | 321 | 309 | 77.8 |
| **Average Household** | | 20,576 | 458 | 439 | 82.6 |

*Notes*: Deciles refer to pre-reform taxable household income. Disposable incomes and welfare effects are weighted by the modified OECD equivalence scale, see fn. 7 for details. All incomes and welfare effects are in pre-reform (1998) prices. Number of observations is $N = 49,484$. Data weighted by population weights (36.5 mn. households in the population).

*Source*: Own calculations using the EVS data (1998).

Welfare effects by deciles of taxable income are presented in Table 4. They are needs adjusted by the applied equivalence scale so that they are comparable in absolute terms to the second-round income gains that were already presented in Table 3. Welfare effects are quantified by the compensating variation, which is approximated by compensated price elasticities, see Section 3. Estimates for the elasticities are relegated to Table B.1 in Appendix B, where compensated *rate-of-return* elasticities from demand-system estimations on the pooled 1998 and 2003 data

[39] Note that this increase in asset prices is related to the average price differential over all asset types so that the decrease in the price for savings of 0.20% is offset by increases in prices for other assets here.

are compiled.[40] Table 4 shows that for an average household, the welfare effects of the tax reform amount to 439 euros per year in equivalent terms, which corresponds to 2.13% of pre-reform equivalent income. This is 19 euros or 4.15% less than the average income gains. Thus, on average, the reform leads to utility losses for the households due to changes of relative asset prices, which are though compensated by income gains.

This result holds qualitatively over the entire income distribution as well as by region. In each income decile, welfare effects are lower than income gains on decile average.[41] In relative terms, the difference between welfare and income effects is greater than average for the deciles below the median and for the highest decile. In the lowest two deciles, welfare effects are negative and even exceed income effects in absolute terms. These households on average thus lose from the reform in welfare terms. However, these losses are with about 5 euros per year on average very small in absolute terms. While welfare effects for households in East-Germany are on average 3.74% lower than respective income effects, for households in West-Germany, they are on average 4.29% lower.

The picture becomes more detailed when grouping households in each income decile into winners and non-winners of the reform, where the latter group may consist of households that lose from the reform in welfare terms and such that are unaffected. Overall, 82.6% of all households benefit from the reform, i.e. for them the welfare effects are strictly positive. Winners are though not equally distributed over the income distribution. While in the lowest tax bracket, only some 55% of the households have positive welfare effects, and still in the fourth decile, only 66% are winners, from the fifth decile upwards, there are more than 90% reform winners in each decile. Winners are moreover unequally distributed over the regions. While in West-Germany, 83.7% of the households have positive welfare gains from the reform, in East-Germany, only 77.8% benefit.

The variation of welfare effects over the income distribution (Table 4) is primarily related to the shift in the tax tariff, as became already apparent from the distribution of the first-round effects by income (Table 1). The welfare effects may, however, moreover vary by the level of savings, i.e. asset demand. Households with relatively greater asset demand are expected to suffer greater losses from asset substitution than households with lower asset demand. In order to test this hypothesis, the relation between relative asset demand and welfare effects of the reform shall be considered *conditional* on the second-round income gains. This is conducted with the help of a linear (OLS) regression, where the welfare effect is regressed on asset demand

[40] The respective elasticities from the system estimations on the 1998 data only are of similar size in most cases. Only for stocks and bonds, own-price and cross-price elasticities are considerably larger in absolute terms. The respective price elasticities generally follow from rate-of-return elasticities according to Eq. (5).

[41] Overall, only for about 12% of all households in the population, welfare effects are greater than income gains.

related to disposable income (i.e. the gross savings ratio at the household level) in deciles, while controlling for the second-round income gains. Results from this regression are compiled in Table B.2 in Appendix B.

It becomes apparent from the coefficient estimates in Table B.2 that the welfare effects continuously decrease over the distribution of the savings ratio for given second-round income gains. While the coefficient of the savings ratio is though not significantly different from zero up to the seventh decile, households in the three highest savings deciles have significantly lower welfare effects than households in the first decile with a same second-round income gain. Welfare effects in the eighth decile are in equivalent terms 18 euros per year lower than in the first decile, in the ninth decile they are 34 euros lower compared to the first decile, and in the tenth decile they are 71 euros lower.[42]

These results indicate that households with relatively high savings ratios suffer a greater loss from the tax reform as a result of adjusting their savings behavior and asset demand than households with relatively low savings ratios. These losses, however, are on average lower than the second-round income gains – especially if a high savings ratio is associated with high income, in which case second-round gains are the greatest, also in relative terms – so that the welfare effects from the reform are on average positive even for households which suffer significantly from asset substitution.

All in all, the welfare effects from the reform that are found in this analysis appear to be relatively small, given rather great estimates for own-rate-of-return elasticities for most of the assets. On the one hand, this is a consequence of relatively little average changes in net asset prices, as only for three out of nine assets, price differentials slightly exceed the range of 1%. On the other hand, estimates for most of the cross-rate-of-return elasticities are relatively small, often not significantly different from zero. Moreover, these are just part of the substitution effects, as only demand for asset accumulations is modeled here. If in addition households could substitute between accumulating and liquidating assets, additional welfare effects can be expected. Also, as stated earlier, it should be emphasized that no labor supply reactions are considered in this analysis. Taking the result from Haan and Steiner (2005) that labor supply is increased on average by incentives from the tax reform, income gains should be greater due to additional hours worked and welfare effects lower by utility losses from substituted leisure time.[43] Moreover, further utility losses could occur if substitutive effects within the

[42] Note that the coefficient estimate on the income gains is only slightly lower than unity. Thus, for a given savings decile, an increase in the second-round income gains results in an almost one-to-one translation into welfare effects.

[43] Haan and Steiner (2005) find that labor supply effects let the *income gains* increase on average by an additional 126 euros in annual net household income compared to 725 euros without labor supply effects (an additional 0.5%-points of pre-reform income). Haan (2007) moreover finds that welfare effects are on

consumption decision, i.e. among commodity groups, were taken into account. The income and welfare effects of the tax reform that are found here should thus rather be interpreted as a part of the entire effects.

## 5 Conclusion

Distributional and welfare effects of Germany's year 2000 tax reform have been quantified. An ex-ante analysis of those reform components that affect private households using the 1998 cross section from official survey data on income and consumption in Germany was conducted. A behavioral microsimulation model for savings and asset demand was constructed in the form of a structural demand system for asset accumulations. Estimates for compensated price elasticities were applied to approximate effects of savings reactions and asset substitution on household utility. Pre-reform and post-reform tax functions were simulated in an income taxation module that implements Germany's income tax law and accounts for reform-related shifts in the tax tariff as well as adjustments at allowances for capital income.

Second-round distributional income effects from the tax reform are estimated to gains of 458 euros per year in equivalent terms for an average household, which corresponds to 2.23% of disposable equivalent household income. Gains primarily result from significant reductions of marginal tax rates, especially in higher tax brackets, and they are increasing along the distribution of taxable income, both in absolute as well as relative terms. As a consequence, inequality in the income distribution increases due to the reform. The increase in inequality is found to be largely related to the lower end as well as the higher end of the distribution, while leaving mid-level incomes less affected. Disaggregated by region, the results differ for households in East- and in West-Germany. While income gains amount to 490 euros (2.27%) for an average household in West-Germany, they average to some 321 euros (1.98%) only in East-Germany. However, the increase in inequality is stronger in East-Germany.

The income gains together with changes in relative asset prices resulting from shifts in the tax tariff and adjustments at allowances for capital income induce households to alter their consumption-savings behavior as well as asset demand. Demand effects are relatively stronger for assets for which a strong effect of the income gains is found and for which net prices decrease through the reform. This is the case for non-owner-occupied housing, for bank deposits, and for bonds. Demand is also increased for owner-occupied housing, where a strong effect of the income gains offsets a negative price effect. Aggregating demand changes over all assets and households, the increase in aggregate net savings in the population is estimated to 4.24

average 34% (153 euros in annual equivalent income) lower than income gains (449 euros) if labor supply effects are accounted for.

bn. euros per year. The aggregate increase in disposable household income amounts to 25.5 bn. euros, by which amount in turn the income tax revenue declines. As a consequence, the aggregate savings rate increases by 0.17 percentage points, from 10.92% to 11.09%.

These changes in the consumption-savings behavior and asset demand cause slight losses in capital income for an average household, as demand is also increased for assets that became relatively more expensive through the reform, like stocks. Demand reactions moreover cause utility losses for most of the households that are related to asset substitution. Resulting welfare effects are on average lower than income gains, they amount to 439 euros per year in equivalent terms (2.13% of disposable equivalent income). This result holds qualitatively over the entire income distribution as well as by region. In each income decile, welfare effects are lower than income effects. This utility loss from asset substitution is greater in absolute terms for households with relatively high savings ratios resulting from greater asset demand.

It shall be noted that the income and welfare effects of the tax reform that are found here are to be interpreted as only a part of the entire effects. If the reform induces households to increase labor supply, and households lose utility from substituted leisure time, additional income and welfare effects would occur. This may also be the case if households could additionally substitute between accumulating and liquidating assets or between various commodity groups among the consumption decision. It shall thus be left for further research to integrate the labor supply decision as well as the decision whether to liquidate the stock of assets into the savings and asset demand model in order to account for additional effects. Future research shall moreover investigate the question which added value the use of a second-order approximation to the welfare measure has compared to one of first-order. This would clarify the contribution of the estimation of demand elasticities to approximation precision in this specific application. It shall also shed further light on the question what is the driving force behind the utility losses through this reform, i.e. which fraction of the welfare effects is related to the changes in asset prices alone and which fraction to asset substitution, and related to this, it could give further indication under which circumstances the welfare effects would be greater than found here.

The effects found should moreover be interpreted as rather short-term effects. On the one hand, it is assumed in this analysis that the reform is financed primarily by deficit spending so that the fiscal budget is unbalanced in the short term. A long-term analysis would probably consider that the budget should be balanced some day so that the income gains of the reform would at least partly be drawn back from the households. On the other hand, the asset market as well as other markets are assumed to be in equilibrium here. In the long run, this assumption might be violated and third-run effects via shifts in market asset prices might induce households to further adjust their asset demand. This opens up another avenue for further research.

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# A Appendix - Data and Methodology

## Indices of Inequality

The general entropy index, GE(-1), is defined as:

$$I_{GE} = \frac{1}{2n}\sum_{i=1}^{n}\left(\frac{\bar{x}}{x_i}-1\right) \tag{9}$$

The Gini coefficient is defined as:

$$I_{Gini} = \sum_{i=1}^{n}\frac{x_i}{n\bar{x}}\frac{(2i-n-1)}{n} \tag{10}$$

The Theil index, GE(1), is defined as:

$$I_{Theil} = \frac{1}{n}\sum_{i=1}^{n} log\left(\frac{x_i}{\bar{x}}\right)\frac{x_i}{\bar{x}} \tag{11}$$

## Approximating the Compensating Variation

A second-order Taylor expansion of $c(u^0, p^1)$ around $(u^0, p^0)$ yields (see Deaton and Muellbauer (1980), p.174, or an application in Banks et al. (1996)):

$$c(u^0,p^1) \approx c(u^0,p^0) + \sum_j \frac{\partial c(u^0,p^0)}{\partial p_j^0}(p_j^1-p_j^0) + \frac{1}{2}\sum_j\sum_k \frac{\partial^2 c(u^0,p^0)}{\partial p_j^0 \partial p_k^0}(p_j^1-p_j^0)(p_k^1-p_k^0) \tag{12}$$

Applying the fact that the first derivative of the cost function equals Hicksian demand (Mas-Colell, Whinston, and Green, 1995, pp. 67-75):

$$\frac{\partial c(u^0,p^0)}{\partial p_j^0} = h_j(u^0,p^0) = q_j^0 \tag{13}$$

it follows from Eq. (12) that

$$c(u^0,p^1) \approx c(u^0,p^0) + \sum_j q_j^0(p_j^1-p_j^0) + \frac{1}{2}\sum_j\sum_k \frac{\partial h_j(u^0,p^0)}{\partial p_k^0}(p_j^1-p_j^0)(p_k^1-p_k^0) \tag{14}$$

where $h_j(u^0, p^0)$ denotes pre-reform Hicksian demand for asset $j$.

Rewriting the definition of the $CV$ for a compound income and price change in Eq. (6) and

applying the fact that $c(u^1, p^1) = y^1$, yields:

$$CV = y^1 - y^0 - c(u^0, p^1) + c(u^0, p^0) \tag{15}$$

Plugging Eq. (14) into Eq. (15) and rearranging, it follows that:

$$CV \approx y^1 - y^0 - \sum_j p_j^0 q_j^0 \left( \frac{p_j^1 - p_j^0}{p_j^0} \right) \left( 1 + \frac{1}{2} \sum_k \widehat{\varepsilon}_{jk}^c \frac{p_k^1 - p_k^0}{p_k^0} \right) \tag{16}$$

where $\widehat{\varepsilon}_{jk}^c$ is an estimate for the compensated price elasticity of asset $j$ w.r.t. price of asset $k$.

# B Appendix - Results

**Table B.1:** Compensated Rate-of-Return Elasticities on Unconditional Asset Demand Levels (from the unconstrained estimation on the pooled 1998 and 2003 data)

| **on Levels** | | Owner | Non-O. | Mortg. | Bank D. | Building | Stocks | Bonds | Insur. | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| **Compensated** | Own-Rate $\left(\widehat{\varepsilon}_{jj}^{(r)}\right)$ | Cross-Rate Elasticity $\left(\widehat{\varepsilon}_{jk}^{(r)}\right)$ | | | | | | | | |
| Owner Occ. | 0.972 | . | −0.323 | 0.429 | 0.035 | −0.005 | 0.003 | 0.001 | −0.006 | 0.004 |
| | (0.096)*** | . | (0.219) | (0.081)*** | (0.150) | (0.045) | (0.021) | (0.003) | (0.059) | (0.034) |
| Non-Owner | 1.185 | 0.453 | . | −0.036 | 0.040 | −0.006 | 0.003 | 0.001 | −0.007 | 0.004 |
| | (0.380)*** | (0.165)*** | . | (0.111) | (0.170) | (0.050) | (0.024) | (0.003) | (0.067) | (0.038) |
| Mortgages | 0.609 | −0.072 | 0.106 | . | 0.026 | −0.004 | 0.002 | 0.000 | −0.004 | 0.003 |
| | (0.051)*** | (0.023)*** | (0.046)** | . | (0.112) | (0.033) | (0.016) | (0.002) | (0.044) | (0.025) |
| Bank Deposits | 0.328 | −0.004 | −0.002 | −0.045 | . | 0.030 | 0.298 | 0.596 | −0.306 | −0.044 |
| | (0.126)*** | (0.010) | (0.004) | (0.040) | . | (0.038) | (0.028)*** | (0.055)*** | (0.050)*** | (0.029) |
| Building S. Dep. | 0.494 | −0.002 | −0.001 | −0.026 | 0.165 | . | 0.082 | 0.070 | −0.185 | −0.027 |
| | (0.025)*** | (0.006) | (0.002) | (0.024) | (0.074)** | . | (0.043)* | (0.110) | (0.032)*** | (0.017) |
| Stocks | −0.215 | −0.005 | −0.002 | −0.051 | 0.489 | −0.028 | . | −0.690 | −0.223 | −0.071 |
| | (0.077)*** | (0.011) | (0.004) | (0.046) | (0.145)*** | (0.048) | . | (0.195)*** | (0.062)*** | (0.034)** |
| Bonds | −0.599 | −0.006 | −0.003 | −0.065 | 0.551 | 0.263 | −0.532 | . | −0.164 | −0.121 |
| | (0.581) | (0.014) | (0.005) | (0.059) | (0.189)*** | (0.086)*** | (0.224)** | . | (0.105) | (0.049)** |
| Insurances | 1.158 | −0.001 | −0.001 | −0.015 | 0.125 | −0.071 | −0.376 | −0.709 | . | −0.043 |
| | (0.020)*** | (0.003) | (0.001) | (0.014) | (0.043)*** | (0.016)*** | (0.033)*** | (0.084)*** | . | (0.010)*** |
| Credits | 0.675 | −0.003 | −0.001 | −0.028 | 0.198 | 0.022 | −0.111 | −0.687 | −0.004 | . |
| | (0.019)*** | (0.006) | (0.002) | (0.026) | (0.081)** | (0.028) | (0.053)** | (0.134)*** | (0.036) | . |

*Notes*: Standard errors computed by the delta method in parentheses. Significance levels: $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Elasticities are computed at the mean of all covariates. $\widehat{\varepsilon}_{jj}^{(r)}$ is the compensated unconditional own-rate elasticity of asset $j$ on asset levels. $\widehat{\varepsilon}_{jk}^{(r)}$ is the respective compensated unconditional cross-rate elasticity.
*Source*: Own calculations using the EVS data (1998, 2003).

**Table B.2:** Estimates for OLS Regression of Welfare Effects on Savings Ratio

| dep. var.: welfare effect in eqv. euros per year | Coeff. | (SE) |
|---|---|---|
| **Second-Round Distributional Effects**: | | |
| income gain | 0.9857 | (0.0024)*** |
| **Deciles of Savings Ratio:** | | |
| Decile 1 (ref.) | | |
| Decile 2 | -0.5201 | (7.6263) |
| Decile 3 | -2.3176 | (7.4815) |
| Decile 4 | -3.9545 | (7.3990) |
| Decile 5 | -6.3933 | (7.3581) |
| Decile 6 | -8.5658 | (7.3106) |
| Decile 7 | -11.5070 | (7.2739) |
| Decile 8 | -17.7095 | (7.2524)* |
| Decile 9 | -34.2905 | (7.2712)*** |
| Decile 10 | -70.9706 | (7.2979)*** |
| Constant | 2.4874 | (5.7137) |
| Observations | 49,484 | |
| $R^2$ | 0.781 | |

*Notes*: Standard errors in parentheses. Significance levels: $\dagger\, p < 0.10$ $^{*}\, p < 0.05$, $^{**}\, p < 0.01$, $^{***}\, p < 0.001$. Savings ratio is for *gross* savings, defined as total assets disposable related to disposable income.

*Source*: Own calculations using the EVS data (1998).