Income Uncertainty, Savings, and Asset Allocation of Private Households
–
Effects of Differential Income Taxation and Policy Reform Evaluation for Germany

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Thesis

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Contents

Preface

If all assets were riskless, and if different investors faced different marginal tax rates on different assets, then investors would segregate into asset clienteles. (James M. Poterba and Andrew A. Samwick, 2002)

Motivation

The decisions to save for future consumption and to allocate savings to a portfolio of assets have been made by private households in Germany in increasingly volatile environments in recent years. On the one hand, the economic environment in Germany has been subject to increasing income inequality. Income inequality has been growing for about two decades now and was only recently slowing down slightly in the course of a decreasing unemployment rate (Frick and Grabka, 2008). Generally though, increasing inequality is also present in the distribution of assets over private households in Germany (Frick and Grabka, 2009), which is only mitigated to some extent if claims to company plans for old-age incomes and to the statutory pension insurance system are taken into account (Frick and Grabka, 2010). Developments of increasing income inequality in general usually affect the planning reliability at the household level. In addition, income streams become increasingly instable. Only recently, for example, short-time work regulations were widely implemented in Germany during the recession in the year 2009 following the world-wide effects of the financial crisis. Uncertainty related to the income process, even if it is only of transitory nature, can have a significant effect on households decision to save for old-age or for unforeseen events.

On the other hand, in the recent years a couple of economic and social policy reforms were implemented in Germany, which were targeted at the simplification of income taxation law and at the subsidization of savings in general, as well as of accumulations of specific types of assets. The ongoing process of demographic change forced governments in Germany to restructure the pay-as-you-go pension system. The role of the statutory pension insurance system for securing old-age income was reduced and private accumulations of financial assets for retirement income are subsidized in the framework of the so called Riester-scheme since 2001. It was refined in the course of a major reform of the taxation of old-age pension income "Alterseinkünftegesetz" in 2005. Irrespective of this major act, an on-going reform of the subsidization of housing assets in Germany in the recent decades initiated the abolition of the home-building allowance ("Eigenheimzulage") in 2006. At least partly as a compensation for this significant cut in the incentives to invest in own real estate for old age, in 2008, subsidization in the Riester-scheme was extended to the accumulation of owner-occupied housing assets ("Eigenheimrente").

Independent of these reforms, in 2007, the value-added tax rate was raised from 16% to 19% – the greatest increase in its history – partly to finance a reduction of contributions to the unemployment insurance. In the course of the latest corporate tax reform in 2008, a homogeneous tax rate for capital income in the form of a flat tax of 25% ("Abgeltungsteuer") was implemented, separating the taxation of capital income from the taxation of labor income. Moreover, only recently a discussion revolved around reimplementing a wealth tax or implementing a capital levy on the stock of asset holdings for the most wealty in Germany. Such reforms are likely to affect the consumption-savings decision of private households, as well as the allocation of the amount of savings between various types of assets, as the relative prices of consumption and savings, as well as the relative after-tax returns of affected asset types, are altered.

Asset allocation of private households in Germany is further of particular interest for economic and social policy, as there are still significant differences in the distribution of assets over the formerly separated regions (Ochmann and Steiner, 2009). Still 20 years after reunification, stocks of asset holdings are distributed unequally throughout East- and West-Germany. Portfolios especially of the older cohorts in East-Germany are dominated by financial assets, while only very few households that lived a great part of their lives in the former German Democratic Republic (GDR) today live in their own houses. Only for the younger cohorts in the east, asset accumulation behavior assimilates to that of their neighbors in the west. Such cohort effects overlay the descriptive picture of household asset portfolios and should thus be controlled for in an analysis of the effects of capital income taxation on the structure of intertemporal consumption and on the allocation of savings to a portfolio of assets.

Ever since the famous life-cycle/permanent income hypothesis (Modigliani and Brumberg, 1954; Friedman, 1957) suggested consumption smoothing in a deterministic environment, and theoretical models advocated ambiguous effects of changes in the interest rate on the level of aggregate savings, a vast empirical literature evolved that, on the one hand, analyzes various puzzles in intertemporal consumption allocation in the context of precautionary savings, and on the other hand, investigates the interest rate elasticity of savings in aggregate consumption functions, or structural preference parameters, as the intertemporal elasticity of substitution, in Euler equations.[1]

In the most recent empirical literature on intertemporal consumption planning, life cycle models under uncertainty are typically solved by applying preference estimates conditional on an exact specification of the stochastic environment the consumer is facing (Attanasio and Weber, 2010). This is of particular relevance if the effect of changes in the interest rate on savings is found to depend on the consumers' environment, for example if it varies with demographic effects or with a change in the institutional arrangements of old-age pensions. Attanasio and Wakefield (2010) find that the effect of the interest rate on savings varies with age, household composition, and thus with consumption needs. The relevance of demographic changes related to an increase in life expectancy and changes in the composition of households becomes more apparent if its *direct* effects on the level of savings are considered (Buslei, Schulz, and Steiner, 2007; Kunert, Horn, Kalinowska, Kloas, Ochmann, and Schulz, 2008).

The link between income inequality and consumption inequality is examined by Blundell, Pistaferri, and Preston (2008). They find that the degree to which income shocks are insured by consumption smoothing depends on the persistence of the shocks and that permanent shocks are partially insured, while transitory shocks are fully insured. Other factors that probably affect the relation between changes in the rate of return to savings and its level is the presence of further motives for saving, inter alia the motive to leave a bequest and the motive to accumulate deposits to purchase a durable good, as well as the dynamics in the relevance of these motives over cohorts (Browning and Lusardi, 1996).

When considering the consumption-savings decision, the simplification of considering savings (or consumption) as a single homogeneous asset (or commodity good) implies of course a restrictive assumption concerning the effects of taxation. The assumption only appears acceptable in case the tax treatment of the single types of assets in the composition of savings is homogeneous. However, this is typically not the case in today's systems of differential taxation of income from various assets, for example housing and financial assets. Moreover, it may well be the case that the effects of taxation on the total level of savings are of less importance than its effects on the structure of asset allocation.

When it comes to the allocation of assets to a portfolio, the public finance literature primarily applies models based on early theory of portfolio choice. The fundamentals of portfolio theory can be traced back to the famous mean-variance model from the basic portfolio theory by Markowitz (1952), where diversification of risks by portfolio choice was carved in stone. This theoretically consistent model of portfolio theory was put in the context of a market equilibrium in the capital asset pricing model (Sharpe, 1964; Lintner, 1965; Mossin,

[1] A survey on general theoretical implications of taxation effects on savings as well as portfolio choice is conducted by Sandmo (1985). Attanasio and Weber (2010) provide a thorough survey on recent developments in modeling intertemporal consumption allocation.

1966), which in turn was extended to investor heterogeneity regarding differential taxation by Brennan (1970), Elton and Gruber (1978), and later by Auerbach and King (1983). However, the empirical evidence for these initial models was limited, primarily because important utility-relevant aspects of portfolio choice were largely neglected in the basic models with one or two factors of influence using macroeconomic data (Lang, 1998). Also, interrelations between assets in a portfolio were mostly ignored in these early models.

It was for the seminal work of Brainard and Tobin (1968) to emphasize for the first time interdependencies between demand for various types of assets, modeled in single demand equations in the context of a portfolio system. Subsequently, the Brainard Tobin Model was put in a framework of neoclassical consumer demand theory, where demand equations are derived from utility maximization approaches so that they fulfill specific theory-consistent constraints and became manageable for econometric analyses (Saito, 1977). These fundamental approaches built the grounds for a vast literature that applies demand systems to portfolio choice models, where demand is modeled as a function of the own rate of return to an asset as well as the rates of all other assets available, and puts it in the context of differential taxation of capital income (surveyed in Poterba, 2002).

The central research question that evolved in the literature on taxation and portfolio choice, and that shall also be subject to analysis in this dissertation, is whether and how tax-induced distortions in after-tax returns to assets, as well as to compound savings, affect households' consumption-savings decision as well as asset demand. Thereby, assumptions concerning the relevance of pre-tax as well as after-tax returns for the portfolio choice of the investor need to be made. Theoretical models lay the ground for these assumptions. For example, in the artificial case that pre-tax returns are invariant over all assets, and after-tax returns vary for investors solely because they are taxed differently on the assets, simple so-called clientele models can be constructed (see for example Miller, 1977, for a two-asset model of debt and equity), which predict that investors completely specialize their portfolios.

The substantial empirical literature that evolved subsequently on the basis of the fundamental theoretical models shall provide the starting point for this dissertation. This literature, while certainly not providing unambiguous support, generally finds that taxation plays a considerable role in the consumption-savings decision of private households, as well as their decision of which assets to buy and of how to structure the composition of their savings. However, there is not much empirical evidence yet regarding the welfare effects of capital income taxation (Bernheim, 2002, in his survey, mentions a few studies). Differential taxation of labor income and capital income can on the one hand have non-negligible effects on the intertemporal consumption allocation of private households if relative asset prices are distorted. On the other hand, significant welfare costs can arise if assets are taxed at heterogeneous rates, so that households may suffer utility losses from altering their allocation of savings to a portfolio of assets. The work at hand intends to extend the empirical literature with respect to these open issues. Contributions to be made shall be emphasized in the following.

Contributions

This dissertation shall contribute to the ongoing discussions about the relevance of income taxation in the context of asset accumulation in general. Specifically, income dynamics and consequently, income uncertainty will be identified as relevant factors of influence in the intertemporal consumption decision. Beyond this factor, the differential treatment of capital and labor income in German income tax law will be identified as an additional influential parameter in the subsequent decision to allocate a given level of savings to a portfolio of various assets. Thereby, the labor market shall be separated from the consumption-savings model as well as the asset allocation decision, and labor income will be assumed to be given exogenously. Nevertheless, dynamics in the development of labor income shall be featured in the first instance providing a source of increasing income uncertainty. The methodology of this dissertation mainly applies microsimulation as well as microeconometric techniques.

The first chapter opens up with a focus on the most dominant source of disposable income for most households, i.e. income from labor, and lays a ground for increasing uncertainty in the income processes. This chapter contributes to the growing literature on wage inequality in Germany during the 2000s. In particular, covariance structure models are applied to decompose cross-sectional variation of wages in Germany over a period between 1994 and 2006 into permanent and transitory components, in order to examine the potential driving forces behind the recent growth of permanent wage inequality in Germany. Variation from thirteen years of panel data from the German Socio-Economic Panel (SOEP) is exploited. The results identify a break in this trend around 2001. While cross-sectional wage inequality steeply rises after 2001, its permanent fraction drops significantly and then stabilizes at around its 2001 level. This evidence implies that the strong expansion of cross-sectional inequality during the 2000s can be increasingly attributed to *transitory* inequality.

The second chapter combines the findings of the first chapter on income dynamics with the consumption-savings side, as estimates for evolution of income dynamics at the household level are applied as proxies for income uncertainty. This chapter models the consumption-savings decision in a structural demand system as a function of current household income, after-tax returns to savings, and the consumption price level. The model is estimated using official pooled cross-sectional data on household consumption and savings in Germany (LWR) for the years between 2002 and 2007. Although in this chapter, the focus of analysis shall not yet be on taxation, additional household-level variation in after-tax returns to savings can be utilized through differential taxation of capital income as well as through variation in taxation rules over this time frame. Marginal tax rates at the household level are simulated in an income taxation module. The central finding is that the estimate for the uncompensated interest rate elasticity of savings is close to zero. It is concluded that policy-induced variation of net returns to savings can thus be expected to have no significant effects on the level of savings. However, a compensated interest rate elasticity of savings, that is found to be significantly different from zero, indicates that rate-of-return variation would not be welfare neutral. Moreover, savings are found to be a superior good and thus consumption an inferior good. Thus, households can only be expected to adjust their savings behavior to variations in disposable income.

This basic model is then extended to allow for effects of uncertainty in transitory household income. A model for the dynamics of household income is estimated on German panel data (SOEP) and significant effects of income uncertainty on the consumption-savings decision, in the context of precautionary savings, are found for households in Germany, excluding the self-employed. As a result of a doubling of income uncertainty, an average household increases savings by 4.4% and thereby reduces consumption by 1.8%. These effects are greater for single households and single parents and lower for couples with two and more kids; they are also greater for households that live mainly on capital income and lower for transfer recipients as well as blue collar workers.

In the third chapter, the findings on the interest rate elasticity of household savings from the second chapter are applied to investigate the effects of differential income taxation on the subsequent allocation of savings to a portfolio of assets. This chapter constructs a structural two-stage budgeting model of asset allocation, where asset demand is a function of the household's marginal tax rate through the after-tax rate of return. Such a structural asset demand model has not been applied to the identification of taxation effects in the relevant literature up until now. Given a decision how to allocate disposable income to consumption and to savings from the previous chapter, the household decides how to allocate total disposable assets to financial assets and to housing assets at a first stage. Housing assets are then at a second stage further allocated to owner-occupied housing, to non-owner-occupied housing, and to mortgages, while financial assets are further allocated to bank deposits, to building society deposits, to stocks, to bonds, to life and private pension insurances, and to consumer credits. Observing the fact that a great number of households allocate assets to only a subset of all available asset types, in a simplified form of the model, the decision of asset allocation is separated into the decision of whether to buy an asset (the discrete asset choice) and the decision of which share of total assets to allocate to an asset conditional on buying it (the continuous asset choice). Accounting for simultaneity in these decisions, demand probabilities are estimated simultaneously for all assets and jointly with conditional demand.

Two cross sections from official survey data on income and consumption in Germany (EVS) for 1998 and 2003 provide variation in the tax rates. Additional variation results from first implementations of Germany's year 2000 tax reform. As households do not report the tax rate, it is simulated in a module of income taxation. Effects of differential income taxation on conditional as well as unconditional asset demand are investigated. The hypothesis tested is that households facing higher tax rates allocate a greater fraction of total asset demand to tax-privileged assets than households with lower tax rates. Such effects are found, and they are relatively strong for owner-occupied housing, non-owner-occupied housing, mortgages, and insurances. Generally however, the effects found are of rather modest size, as the shifts in conditional demand shares resulting from a 10%-points increase in the tax rate range in absolute value from 0 to less than 5%-points only.

In the fourth chapter, the structural savings and asset demand model as well as the income taxation module elaborated in the preceding chapters are applied to evaluate a tax reform with respect to distributional and welfare effects. There is only very scarce empirical literature yet, on the quantification of welfare effects related to capital income taxation. 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). However, estimates for welfare costs of tax-induced distortions in portfolio structure are rather rare, primarily due to a lack of structural modeling of the portfolio choice. Poterba and Samwick (2002), for example, 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 further work (Alan, Atalay, Crossley, and Jeon, 2010).

This topic shall thus be subject to analysis in the final chapter of this dissertation, where Germany's year 2000 tax reform is evaluated in an ex-ante analysis. The focus is on that part of the tax reform that affects private households. Distributional as well as welfare effects of the reform, that are related to savings and asset demand, are investigated. They are quantified by simulating the reform with help of the 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 savings in Germany (EVS). Behavioral responses are derived from demand elasticities estimated in the structural asset demand model.

The main findings comprise income gains for most of the households through substantial reductions of marginal tax rates, leaving the fiscal budget unbalanced in the short run. Income inequality is found to increase as the gains are greater for households in higher tax brackets, slightly stronger in East-Germany. Furthermore, 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 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.

Finally, in closing general conclusions, the main findings of this dissertation are summarized, and some major limitations are emphasized. The relevance of the analyses is pointed out by interpreting the findings in a couple of, certainly not guidelines, but at least implications for economic and social policy which shall be elaborated from the main results. Furthermore, several unsolved issues and avenues for subsequent research will be discussed.

Chapter 1

Income Uncertainty†

1.1 Introduction

During the 1980s, wage inequality grew strongly over the entire wage distribution in the United States and the United Kingdom (e. g. Katz and Autor, 1999). Most explanations for this rapid increase of inequality are related to the skill-biased technological change hypothesis (see for example Acemoglu, 2002), which suggests an increasing demand for highly skilled labor. In contrast to this development, the growth of wage inequality in Germany during the 1980s occurred mainly at the top of the wage distribution (Antonczyk, Fitzenberger, and Leuschner, 2009). However, once labor market institutions like an implicit minimum wage or the degree of unionization are accounted for (Antonczyk et al., 2009), the evolution of wage inequality in Germany is in line with the skill-biased technological change hypothesis.

This chapter contributes to the growing literature on German wage inequality during the 2000s. In particular, covariance structure models are applied to decompose cross-sectional variance of wages in Germany over a period between 1994-2006 into permanent and transitory components, in order to examine the potential driving forces behind the recent growth of German wage inequality (e.g. Gernandt and Pfeiffer, 2007; Müller and Steiner, 2008). The analysis follows the methodology used in the literature that focuses mainly on the UK (e.g. Dickens, 2000; Ramos, 2003), the United States (Haider, 2001; Moffitt and Gottschalk, 2002) or Canada (Baker and Solon, 2003).[1] It is built on a number of previous papers which mainly

†This chapter is based on joint work with Michał Myck from Centre for Economic Analysis (CenEA) and Salmai Qari from Max Planck Institute for Intellectual Property, Competition and Tax Law, see Myck, Ochmann, and Qari (2009).

[1]For earlier work, see Lillard and Willis (1978), Lillard and Weiss (1979), as well as Abowd and Card (1989). For studies covering Italy, see Cappellari (2000) and Lilla and Staffolani (2009). Gustavsson (2007) provides a recent study for Sweden. Using a similar approach, Biewen (2005) analyzes the evolution of disposable household income inequality in Germany for the years 1990-1998.

focus on the 1990s and the early 2000s. For example, Daly and Valletta (2008) use a heterogeneous growth model to compare Germany, UK, and the USA during the 1990s and find substantial convergence in the permanent and transitory parts of inequality. This convergence is mainly a consequence of an increase in permanent inequality in Germany and a decline of permanent inequality in the United States. Sologon and O'Donoghue (2009) analyze data from the European Community Household Panel for the years 1994-2001 and also report an increasing permanent wage inequality in Germany.

The analysis at hand extends the time frame to 2006 and thereby identifies a break in this trend around 2001. While cross-sectional wage inequality steeply rises after 2001, its permanent fraction drops significantly and then stabilizes at around its 2001 level. Specifically, the main sample comprises thirteen years of data from the German Socio-Economic Panel (SOEP) for the years between 1994 and 2006. Over this period, the cross-sectional residual wage variance for full-time employed men increases – depending on the specification – by 20 to 50 percent. Consistent with previous research, the results show that the increase is much steeper in the 2000s. In fact, most of the increase occurs between 1999 and 2006, while from 1994 to 1999, the cross-sectional variance remains relatively stable. Moreover, the rise in the cross-sectional wage variance is accompanied by an increase, and followed by a reduction, in the fraction of its permanent component. Interestingly, this reversal of the evolution of the permanent fraction occurs around 2000 and 2001, when cross-sectional inequality begins to rise steeply. The fraction of the permanent inequality increases from 1994, peaks in 2001, and then declines by approximately 20 percentage points.

This evidence implies that the strong expansion of cross-sectional inequality during the 2000s can be increasingly attributed to transitory inequality. It can support the argument that changes in the labor market institutions in Germany over the last decade may have contributed importantly to increases in wage inequality but at the same time could have increased wage mobility (Dustmann, Ludsteck, and Schönberg, 2009). Increasing transitory inequality may in addition have caused increasing income uncertainty, which in turn may induce agents to adjust their savings. In the following section, the data used for the analysis is briefly described. Section 1.3 presents the method for separating the permanent and temporary components of the variance. Section 1.4 provides details on the estimation procedure. The main results for the evolution of wage dynamics are then presented and discussed in Section 1.5, whereupon Section 1.6 concludes.

1.2 Data

The analysis uses data from the German Socio-Economic Panel (SOEP). The SOEP is a panel study for Germany, which started in 1984 as a longitudinal survey of households and individuals in West-Germany and was expanded in 1990 to cover the population of the former GDR.[2] The SOEP is also used in the recent analysis by Daly and Valletta (2008), which is, in terms of methodology, very close to the analysis at hand. Other studies using SOEP data either focus on household income inequality (Biewen, 2005), or use index-based measures to analyze the evolution of inequality (Burkhauser and Poupore, 1997; Maasoumi and Trede, 2001).[3] The main sample applied is a fully balanced subsample of the SOEP for the years between 1994 and 2006 to ensure that any variation in the distribution of wages does not result from compositional changes. A robustness check is performed for the effect imposed by the balanced panel restriction, where the analysis is repeated on an unbalanced panel following the study of Moffitt and Gottschalk (2002).

Applying usual age restrictions, the sample includes individuals aged 20-60 who report to be employed in all 13 years covered by the analysis and who are full-time employees during the entire period. See Appendix 1.7, for further details on how the data has been manipulated. These two sample restrictions imply that the focus is on individuals with stable employment histories, so that as a result, the degree of transitory dispersion for the whole workforce may be underestimated. The results are particularly interesting in light of this argument, since increasing importance of the transitory component is found, which is at odds with the conjecture of underestimation.

As the subsample of full-time employed females is probably very selective, females are omitted from the analysis. For the balanced panel, the resulting sample of full-time employed males consists of 9,464 individual-year observations (728 individuals over 13 years), and for the unbalanced panel, there are 39,743 observations on a total of 6,048 men. Table 1.2 in Appendix 1.7 displays the number of individual-year observations by nationality, location, age, and by education groups for the two samples. Table 1.3, also to be found in Appendix 1.7, gives descriptive statistics on hourly wages and the corresponding monthly gross earnings in the balanced sample. Table 1.3 indicates the sharp increase in cross-sectional inequality from

[2] For further details on the data, see Haisken-DeNew and Frick (2005) and Wagner, Frick, and Schupp (2007).

[3] Another suitable data set is the employment samples from the Institute for Employment Research of Germany's Federal Employment Agency (IABS), which is based on administrative social security records (see e. g. Dustmann et al., 2009, for an application). The IABS have larger sample sizes than the SOEP, but they are only available until 2004. As the focus here shall be on the recent increase in cross-sectional inequality starting in the middle of the 1990s, advantage is taken of the fact that the SOEP sample covers the late 2000s (up to 2008). Moreover, for the years 1994-2004, the sample generates a similar evolution of cross-sectional inequality as the IABS (see e. g. Dustmann et al., 2009).

2000 onwards. While the coefficient of variation for wages slightly falls from 0.429 in 1994 to 0.405 in 1999, it sharply increases from 2000 onwards, to 0.466 in 2006. The results section provides more details on the evolution of cross-sectional dispersion.

1.3 Modeling Wage Dynamics

It is assumed that real gross hourly wages, as defined in Appendix 1.7, can be modeled by

$$Y_{it} = x'_{it}\beta_t + u_{it} \tag{1.1}$$

for individuals $i = 1, ..., N$ and periods $t = 1, ..., T$, with x_{it} denoting a $K \times 1$-vector of individual-specific characteristics including a time-varying constant, β_t denoting a $K \times 1$ time-varying parameter vector, and u_{it} the error term. This model is computed for every $t = 1, ..., T$ in two variants. In the first variant, log-wages are regressed on a time-varying constant only. In the second variant, x_{it} contains several individual-specific covariates, i.e. log-age, log-age-squared, region of residence (East- or West-Germany), years of education in four groups, and gender (for sample statistics, see Table 1.2).

For each variant, the errors u_{it} are decomposed into a permanent (μ_i) and a transitory (v_{it}) part. Throughout the entire analysis, it is assumed that these two parts are uncorrelated, i.e. $Cov(\mu_i, v_{it}) = 0$. The basic model is the "enhanced canonical" permanent-transitory model with year-specific factor loadings p_t and λ_t on the two components. It makes the strong assumption that there is no serial correlation among transitory shocks, i.e $Cov(v_{it}, v_{it-s}) = 0$ for $s \neq 0$, which will be removed later on:

$$u_{it} = p_t\mu_i + \lambda_t v_{it} \tag{1.2}$$

Intuitively, $x'_{it}\beta_t$ defines the population's mean profile and the term μ_i introduces individual heterogeneity, which allows the individuals to deviate from the mean profile. The variance of this individual heterogeneity constitutes the source for permanent inequality, and the respective factor loadings allow changes of the permanent component over time. The variance of the residual of log-wages in this model, given independence of the permanent and the transitory component, then follows as:

$$Var(u_{it}) = p_t^2\sigma_\mu^2 + \lambda_t^2\sigma_v^2 \tag{1.3}$$

An increase in either factor loading in period t leads to an increase in the cross-sectional variance at t. The interpretation of such an increase, however, depends crucially on which factor changes. An increase in p_t can be interpreted as an increase in the returns to unobserved individual-specific permanent components, for example ability. On the other hand, an increase in λ_t without an increase in p_t can be interpreted as an increase in year-to-year volatility due to short-term factors, such as temporarily powerful labor unions, or demand shocks, affecting specific sectors of the economy, without any shifts in the permanent component.

In order to remove the rather arbitrary assumption that residuals are not serially correlated, two specific models for the transitory component shall be considered.[4] The first model is an AR(1) process. In this case, the transitory part of the residuals is equal to:

$$v_{it} = \rho v_{it-1} + \varepsilon_{it} \tag{1.4}$$

In the second model, the transitory component is assumed to follow an ARMA(1,1) process:

$$v_{it} = \rho v_{it-1} + \gamma\varepsilon_{it-1} + \varepsilon_{it} \tag{1.5}$$

Under the assumptions that $E[\mu_i] = E[v_{it}] = E[\varepsilon_{it}] = 0$ and $E[\mu_i\varepsilon_{it}] = E[\varepsilon_{it}\varepsilon_{js}] = 0$ for all i and j and for all $t \neq s$, the covariance matrix of residuals is given by:

$$cov(u_{it}, u_{it-s}) = p_t p_{t-s}\sigma_\mu^2 + \lambda_t\lambda_{t-s}E[v_{it}v_{it-s}] \tag{1.6}$$

where p_t, p_{t-s}, λ_t, and λ_{t-s} are time-specific factor loadings and $E[v_{it}v_{it-s}]$ is equal to:

$$E[v_{it}v_{it-s}] = \begin{cases} \sigma_{v0}^2 & , t = 0, s = 0 \\ \rho^2\sigma_{v0}^2 + \sigma_\epsilon^2 & , t = 1, s = 0 \\ \rho^2 E[v_{it-1}v_{it-1}] + (1 + \gamma^2 + 2\rho\gamma)\,\sigma_\epsilon^2 & , 2 \leq t, s = 0 \\ \rho^{s-1}(\rho E[v_{it-s}v_{it-s}] + \gamma\sigma_\epsilon^2) & , s+1 \leq t, 1 \leq s \leq T-1 \end{cases} \tag{1.7}$$

In Equation (1.7), $\sigma_\mu^2 = var(\mu_i)$ and $\sigma_\varepsilon^2 = var(\varepsilon_{it})$. $\sigma_{v_0}^2 = var(v_{i0})$ is the initial condition for the ARMA-process.[5] In Equation (1.7), the AR(1) specification is nested with $\gamma = 0$. Altogether, three different specifications are considered:

$$\text{(S-CAN)} \quad u_{it} = p_t\mu_i + \lambda_t v_{it} \tag{1.8}$$

$$\text{(S-AR)} \quad u_{it} = p_t\mu_i + \lambda_t(\rho v_{it-1} + \varepsilon_{it}) \tag{1.9}$$

$$\text{(S-ARMA)} \quad u_{it} = p_t\mu_i + \lambda_t(\rho v_{it-1} + \gamma\varepsilon_{it-1} + \varepsilon_{it}) \tag{1.10}$$

[4] Moreover, permanent shocks could be modeled explicitly by a random walk, see for example Moffitt and Gottschalk (2002) or Baker and Solon (2003). A random walk would though imply an infinitely increasing variance, for which evidence is not found in the data. Biewen (2005) reports convergence problems with an even more flexible specification for the permanent component.

[5] The initial condition is needed for an unbiased estimation of the parameters of the ARMA-process, c. f. MaCurdy (1982).

Specification (S-CAN) is the "enhanced canonical" model with factor loadings. Specification (S-AR) models the transitory component as an AR(1) process, while specification (S-ARMA) models the transitory component as an ARMA(1,1) process. (S-CAN) is nested in (S-AR) which in turn is nested in (S-ARMA).

1.4 Estimation

The estimation is conducted in two steps. In the first step, an estimate of u_{it} is obtained, which is just the vector of residuals from the regression model $Y_{it} = x'_{it}\beta_t + u_{it}$. From these residuals, an empirical covariance matrix is constructed. The empirical covariance matrices for all specifications can be found in Tables 1.4 - 1.7 in Appendix 1.8. In the second step, the parameters of the theoretical covariance matrix are estimated by fitting the implications of specifications (S-CAN), (S-AR), and (S-ARMA) to the empirical covariance matrix.

Formally, let the vector C collect all distinct elements of the empirical covariance matrix obtained from the first stage. For each specification, the corresponding theoretical moments in Eqs. (1.6)-(1.7) can be expressed as a function $f(\theta)$, where the vector θ collects all parameters which are needed to construct these moments. For example, in specification (S-AR), θ collects the initial variance, as well as the permanent variance, the year-to-year variance, the persistence parameter of the AR(1) process, and the factor loadings for the permanent and transitory components. This results in 27 parameters for specification (S-AR) and 28 for specification (S-ARMA), respectively.[6] The model's parameters are estimated by the generalized method of moments (GMM, Chamberlain, 1984); that is the estimate $\hat{\theta}$ minimizes the distance between the empirical and the theoretical moments:

$$\hat{\theta} = \arg\min_{\theta} \left[C - f(\theta)\right]' W \left[C - f(\theta)\right] \tag{1.11}$$

Following the recent literature, the identity matrix can be applied as the weighting matrix W.[7] This approach, called "equally weighted minimum distance estimation" (Baker and Solon, 2003), boils down to applying nonlinear least squares to fit $f(\hat{\theta})$ to C.

[6] Note that p_{1994}, λ_{1994}, and λ_{1995} are normalized to unity in order to identify the parameters of the stochastic process.

[7] While an asymptotically optimal choice of W is the inverse of a matrix that consistently estimates the covariance matrix of C (Chamberlain, 1984), Altonji and Segal (1996) as well as Clark (1996) provide Monte Carlo evidence of potentially serious finite sample bias in $\hat{\theta}$ using this approach.

1.5 Results

The estimation results for the balanced and the unbalanced samples are presented in Table 1.1, which shows the estimated values of the parameters of the ARMA process; estimates for the factor loadings are relegated to Table 1.8 in Appendix 1.8.[8] There are advantages and disadvantages of using either of the sampling approaches. Taking the balanced panel seems more appropriate given the underlying model being estimated, as the empirical variances and co-variances are then computed on a stable sample. On the other hand, the compositional changes imply that the balanced sample approach disregards individuals leaving and entering the labor market in the examined period. This excludes those whose labor market position (and thus wages) is least stable. By definition it also omits retiring and school-leaving cohorts, which imposes collinearity between age and time effects. However, by inclusion of individuals with unstable employment histories, using the unbalanced panel may overestimate the role of transitory inequality. The latter argument is the key reason for the choice of the baseline approach, but the robustness check on the unbalanced panel confirms that the results are not affected very strongly by the baseline restriction.

Table 1.1: Parameter Estimates - ARMA(1,1) Specification

	Balanced		Unbalanced	
	constant	covariates	constant	covariates
$\sigma^2_{v_0}$	0.055	0.032	0.028	0.055
	(0.007)	(0.005)	(0.018)	(0.010)
σ^2_{μ}	0.087	0.030	0.111	0.032
	(0.004)	(0.003)	(0.008)	(0.005)
σ^2_{ε}	0.040	0.038	0.076	0.056
	(0.003)	(0.003)	(0.005)	(0.004)
ρ	0.857	0.884	0.857	0.872
	(0.027)	(0.020)	(0.035)	(0.022)
γ	-0.489	-0.488	-0.475	-0.479
	(0.028)	(0.021)	(0.028)	(0.022)
N	91	91	91	91

Notes: Standard errors in parentheses. See Section 1.3 for the full list of covariates.

Source: Own calculations using the SOEP data (1994-2006).

Implications of the two approaches are evident in the results presented in Table 1.1. Generally, i. e. abstracting from time effects, the two approaches yield different results on the

[8]The results for the canonical model and the AR(1) specification are very similar, they are discussed in Myck et al. (2009).

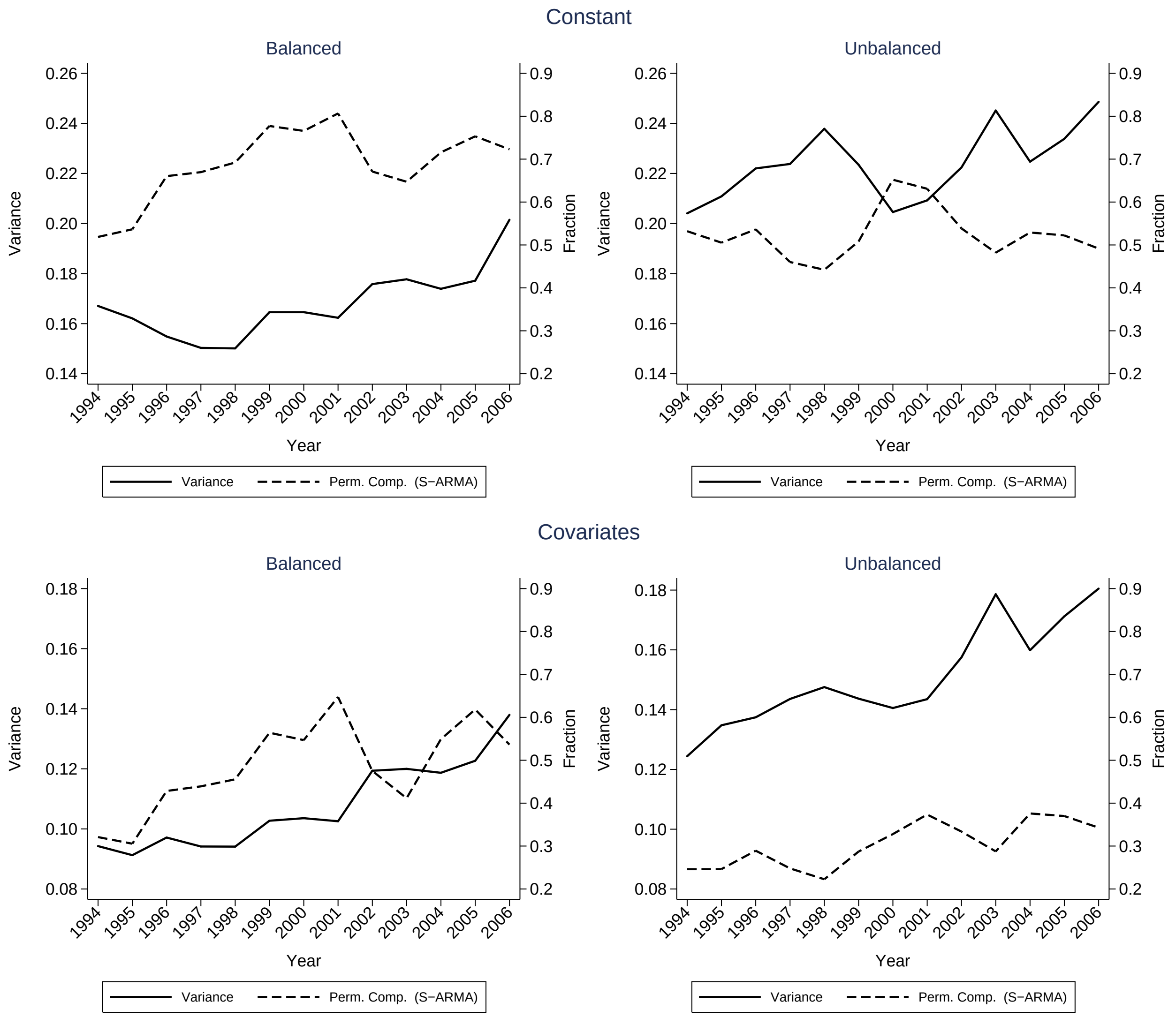
relevance of permanent and transitory variance. Comparing the estimated temporary variances (σ_ε^2) relatively to the permanent variances (σ_μ^2) for the constant-only specifications, we see that the temporary variance is much more important than the permanent variance in the unbalanced panel, whereas the opposite is true for the balanced panel. However, once additional covariates are introduced (columns 2 and 4), the ratio of permanent to temporary variance is very similar in both samples and close to unity. Interestingly, the estimated transmission of temporary shocks is very similar for the two samples, too. An estimate for ρ of between 0.86 and 0.88, together with an estimate for γ of about -0.49, implies that about 70% of a shock disappears after two periods. This result is robust over all specifications.

To summarize the estimated results and to allow for a more straight-forward interpretation, the fraction of the permanent variance from the parameter estimates is calculated as $(\hat{p}_t^2 \cdot \hat{\sigma}_\mu^2) \, / \, var(\hat{u}_{it})$, where $var(\hat{u}_{it})$ denotes the variance of residuals at time t. The development of this fraction for the two specifications on both samples, together with the evolution of the cross-sectional variance of $\hat{u}_{it}$ over time, is depicted in Figure 1.1. This illustration allows an analysis of the structure of the cross-sectional variance in relation to its level and in the context of the time frame. Generally, it becomes apparent from all plots of Figure 1.1 that there is an upwards-sloping trend in the variance, if the time frame is regarded as a whole, while the evolution of its permanent fraction is ambiguous.

The plots show a clear break around 2000 and 2001. Except for the constant model on the unbalanced sample, which is most strongly affected by compositional changes, from 1994 to 2001, the cross-sectional variance is more or less unchanged. It then rises sharply with either a slowdown or a drop around 2004 for the balanced and unbalanced samples, respectively. At the same time, the years 2000 and 2001 represent a break in the development of the role of the permanent fraction of the variance. The permanent fraction grows in prominence from 1994 on, until 2000 or 2001. Interestingly, the initial rise in the overall inequality after 2001 is accompanied by a drop in the role of the permanent part of the variance, which drops down significantly at the same time. However, the proportion of the permanent component increases again to close to 2001 levels by the end of the estimation period.

The pattern of initial growth of the permanent component, followed by a drop around 2002 and 2003 and a subsequent recovery to close to 2001 level, is evident in all but the constant model on the unbalanced panel. Naturally though, the *level* of the fraction of permanent variance strongly depends on the definition of u_{it} and, in both specifications, is lower for the unbalanced sample. Controlling for individual characteristics reduces the role of the permanent variance in both samples. The greater role of the temporary component in the unbalanced sample may result from sample composition. While variances in each year include all individuals, covariances can only be calculated for individuals observed in both years. The

Figure 1.1: Cross-sectional Variance and its Permanent Component (Fraction)



Source: Own calculations using the SOEP data (1994−2006).

latter are typically those that exhibit relatively stable labor market positions. These compositional differences make the interpretation of the results for the unbalanced panel less clear. It is however interesting that the overall pattern for the evolution of the variance and its permanent fraction is similar to that observed for the balanced panel.

Robustness of the results is checked for by using another alternative sample. Unlike the balanced panel approach, using an unbalanced panel does not impose sample-size restrictions related to the number of years of the data used. Thus, an extended unbalanced sample is used to cover two additional years of data which then cover altogether the time frame of 1994 to 2008. The results are similar to those based on the unbalanced sample for 1994 to 2006 that were presented here. Moreover, the fractions of permanent and transitory inequality remain largely stable after 2006.

1.6 Conclusion

Cross-sectional wage inequality in Germany has been increasing sharply since the middle of the 1990s with a particularly rapid growth after 2000. Employing covariance structure models on a sample of full-time employed male individuals, cross-sectional wage variance is decomposed into its permanent and its transitory parts. It is found that permanent inequality as a fraction of total variance increases from 1994 to 2001, then declines sharply in 2002 and 2003 to recover to close to its 2001 level by 2006. The sharpest increases in cross-sectional variance seem to have been accompanied by the growing role of the temporary variance component. Existing studies of permanent and transitory inequality in Germany do not cover the late 2000s and hence are unable to observe the break around the year 2001.

These findings suggest that unobservable permanent factors became more important as determinants of inequality in Germany through the 1990s but their role did not grow further at the time of the expansion of cross-sectional wage inequality during the 2000s. This indicates an important change in the dynamics of wages at about the years 2000 and 2001, potentially with a higher degree of wage mobility helping to offset the implications of growing cross-sectional inequality in Germany.

However, the emphasis of the conclusions shall here rather be on the potential relevance of increasing transitory inequality for the agents' planning reliability concerning intertemporal consumption allocation. To the extent that an increasing relevance of transitory income variation may cause income processes to become increasingly volatile and thereby increasingly unpredictable, especially in the short run, there may be subsequent effects making income processes also increasingly uncertain from the perspective of individuals. The effects of increasing uncertainty in the income processes on agents' consumption-savings decisions shall be subject to analysis in the following chapter.

1.7 Appendix - Data

The analysis is restricted to full-time employed males. Individuals need to report ‘full-time’ employment status and weekly hours above 19 to be classified as full-time employees. For these individuals, monthly gross individual labor income is applied as reported for the month prior to the interview. Earnings are deflated by Consumer Price Index to the base of year 2000. Hourly wages are generated from reported weekly hours actually worked (including hours of paid overtime) and monthly earnings (including overtime pay), and are computed as $wage = monthly\ earnings/(4.35 * weekly\ hours\ worked)$.

Table 1.2: Sample Composition by Demographics

	Balanced		**Unbalanced**	
	Obs.	Frac.	Obs.	Frac.
Nationality				
non-German	800	.08	5,452	.14
German	8,664	.92	34,301	.86
Location				
West	7,162	.76	29,365	.74
East	2,302	.24	10,388	.26
Age				
age 20 - 30	765	.08	7,682	.19
age 31 - 40	3,523	.37	13,797	.35
age 41 - 50	3,765	.40	10,881	.27
age 51 - 60	1,411	.15	7,393	.19
Education				
10 and less	817	.09	5,736	.14
10 - 13	6,114	.65	24,661	.62
13 - 15	950	.10	4,022	.10
15 - 18	1,583	.17	5,334	.13
Total	9,464	1.0	39,753	1.0

Notes: Education in years. Observations are individual-year observations.
Source: Own calculations using the SOEP data (1994-2006).

Common restrictions to outliers in the data are applied, and the distribution of monthly earnings in the balanced sample is truncated at the 0.5th percentile from below and at the 99.5th percentile from above. In the analysis, sampling weights are not applied, as any existing weights for the data do not account for the specific sampling conditions applied here.

Although the SOEP is not generally top-coded with respect to the income distribution, it nevertheless includes only a small number of individuals with high incomes in the specific sample applied here, see e. g. Dustmann et al. (2009), Bach, Corneo, and Steiner (2007) as well as Bach, Corneo, and Steiner (2008). These authors moreover conclude that the SOEP covers

Table 1.3: Summary Statistics for Earnings and Wages (Balanced Panel)

	Monthly Earnings			Hourly Wages		
year	mean	sd	cv	mean	sd	cv
1994	2,385	1,112	0.466	13.09	5.61	0.429
1995	2,494	1,143	0.458	13.69	5.69	0.416
1996	2,620	1,171	0.447	14.36	5.87	0.409
1997	2,648	1,149	0.434	14.42	5.71	0.396
1998	2,695	1,194	0.443	14.70	5.88	0.400
1999	2,748	1,214	0.442	14.90	6.03	0.405
2000	2,852	1,420	0.498	15.49	6.61	0.427
2001	2,885	1,380	0.478	15.63	6.55	0.419
2002	2,932	1,346	0.459	16.03	6.73	0.420
2003	3,080	1,603	0.520	16.78	7.43	0.443
2004	3,062	1,453	0.474	16.73	7.07	0.422
2005	3,049	1,498	0.491	16.70	7.33	0.439
2006	3,036	1,563	0.515	16.55	7.71	0.466
Total	2,807	1,354	0.482	15.31	6.62	0.432

Notes: Earnings are gross earnings, deflated by Consumer Price Index to the base of year 2000. Hourly wages are generated from earnings and reported hours, see text. cv is the coefficient of variation ($= sd/mean$).

Source: Own calculations using the SOEP data (1994-2006).

the distribution of market income quite well up to the 99th percentile. Bach et al. (2007) also find that a large share of the total market income is actually labor income, in 2001 a share of 83.1 percent on average was wage income and an additional 11.4 percent was income from business activity. Thus, it shall be concluded that by analyzing labor earnings, the main part of market income, which is representative for the income distribution in Germany, is captured, except for the very rich.

1.8 Appendix - Results

Table 1.4: Covariance Matrix - Specification with **a constant** on the **balanced** panel

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1994	.1694												
1995	.1465	.1678											
1996	.1303	.1381	.1621										
1997	.1303	.1384	.139	.1605									
1998	.1257	.1311	.1331	.1373	.1544								
1999	.1263	.1287	.1313	.135	.1352	.1556							
2000	.124	.1274	.1346	.1395	.1373	.145	.1633						
2001	.128	.1323	.1369	.1387	.1362	.1415	.1497	.1664					
2002	.1198	.1243	.1297	.1302	.1306	.1375	.1442	.1479	.1706				
2003	.1234	.1291	.1279	.1339	.1317	.1382	.1446	.148	.15	.1816			
2004	.1203	.1247	.1268	.1292	.1292	.1377	.1434	.1468	.1465	.1576	.1742		
2005	.1199	.1246	.1285	.1325	.1307	.1379	.1423	.1471	.1505	.155	.1562	.18	
2006	.1219	.1256	.1299	.1351	.1344	.1434	.147	.1492	.1513	.1582	.1599	.1639	.202

Notes: Number of observations for computing covariances is 952.
Source: Own calculations using the SOEP data (1994-2006).

Table 1.5: Covariance Matrix - Specification with **covariates** on the **balanced** panel

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1994	.0972												
1995	.0774	.1002											
1996	.0684	.0772	.1058										
1997	.0688	.0778	.0831	.1049									
1998	.0652	.0716	.0781	.0826	.1005								
1999	.0671	.07	.0761	.0799	.0811	.1007							
2000	.0624	.0666	.0771	.0819	.0808	.0873	.1083						
2001	.0649	.0697	.0781	.0798	.0783	.0827	.0933	.1083					
2002	.0622	.0667	.0744	.0747	.0759	.0816	.091	.0933	.1187				
2003	.0635	.0695	.071	.0767	.0754	.0813	.09	.0921	.0971	.127			
2004	.0634	.0676	.0721	.0741	.0749	.0821	.0905	.0926	.0952	.1047	.1231		
2005	.0627	.0672	.0738	.0775	.0764	.0822	.0898	.0931	.0993	.1024	.1056	.1298	
2006	.0615	.0647	.0707	.0758	.0759	.0838	.0897	.0907	.0962	.1013	.1051	.1096	.1444

Notes: Number of observations for computing covariances is 952. See Section 1.3 for the full list of covariates.
Source: Own calculations using the SOEP data (1994-2006).

Table 1.6: Covariance Matrix - Specification with **a constant** on the **unbalanced** panel

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1994	.224												
1995	.169	.2249											
1996	.1618	.1805	.2357										
1997	.1568	.1578	.1822	.2453									
1998	.1518	.1538	.1639	.187	.2527								
1999	.1528	.1535	.1627	.1653	.1907	.2347							
2000	.1538	.156	.167	.1682	.1722	.1715	.2258						
2001	.1446	.1413	.1552	.1666	.1644	.1621	.1819	.2219					
2002	.1335	.1351	.1469	.1501	.1511	.1557	.1717	.1734	.2305				
2003	.1356	.1328	.1493	.1567	.1592	.1564	.17	.1721	.1816	.2493			
2004	.1318	.1277	.1397	.1511	.1579	.1554	.1619	.1683	.1706	.1885	.2314		
2005	.1299	.1285	.1401	.1465	.1528	.1537	.1703	.1722	.1727	.189	.193	.2536	
2006	.1253	.1271	.137	.1477	.1568	.1549	.1661	.1665	.1675	.1796	.1845	.2012	.2633

Notes: Number of observations for computing covariances is 952.
Source: Own calculations using the SOEP data (1994-2006).

Table 1.7: Covariance Matrix - Specification with **covariates** on the **unbalanced** panel

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1994	.1393												
1995	.0993	.1464											
1996	.0932	.1078	.1495										
1997	.0903	.094	.111	.1592									
1998	.0847	.0901	.0999	.1136	.1588								
1999	.0871	.0903	.0998	.1042	.1162	.1515							
2000	.0854	.0894	.0981	.1014	.1043	.1089	.1602						
2001	.0773	.077	.0886	.1004	.0952	.0954	.1168	.1554					
2002	.0714	.0738	.0834	.0871	.0854	.0897	.1105	.1121	.1655				
2003	.072	.0718	.0842	.0916	.0875	.0893	.1085	.1105	.1196	.1817			
2004	.0687	.0668	.0787	.0874	.0873	.0901	.1006	.1043	.1103	.125	.1643		
2005	.0682	.0686	.0771	.0855	.0857	.088	.1081	.1076	.1126	.1291	.13	.1849	
2006	.0642	.067	.0728	.0851	.0887	.0894	.1032	.1016	.1059	.1174	.1217	.1368	.1923

Notes: Number of observations for computing covariances is 952. See Section 1.3 for the full list of covariates.
Source: Own calculations using the SOEP data (1994-2006).

Table 1.8: Parameter Estimates for Factor Loadings - ARMA(1,1) Specification

	Balanced		Unbalanced	
	constant	covariates	constant	covariates
p_{1995}	1.002	0.969	0.975	0.994
	(0.011)	(0.027)	(0.023)	(0.048)
p_{1996}	1.078	1.173	1.037	1.118
	(0.016)	(0.038)	(0.034)	(0.069)
p_{1997}	1.076	1.177	0.964	1.053
	(0.017)	(0.043)	(0.047)	(0.085)
p_{1998}	1.095	1.201	0.975	1.017
	(0.019)	(0.049)	(0.059)	(0.105)
p_{1999}	1.214	1.398	1.011	1.141
	(0.024)	(0.059)	(0.063)	(0.113)
p_{2000}	1.203	1.372	1.084	1.195
	(0.026)	(0.079)	(0.083)	(0.166)
p_{2001}	1.225	1.481	1.084	1.286
	(0.029)	(0.077)	(0.076)	(0.141)
p_{2002}	1.162	1.368	1.038	1.277
	(0.026)	(0.076)	(0.081)	(0.157)
p_{2003}	1.150	1.282	1.034	1.267
	(0.027)	(0.078)	(0.086)	(0.169)
p_{2004}	1.199	1.477	1.040	1.371
	(0.027)	(0.080)	(0.080)	(0.167)
p_{2005}	1.239	1.588	1.057	1.416
	(0.030)	(0.087)	(0.080)	(0.167)
p_{2006}	1.296	1.574	1.056	1.397
	(0.030)	(0.082)	(0.080)	(0.160)
λ_{1996}	0.853	0.925	0.981	1.014
	(0.033)	(0.033)	(0.042)	(0.037)
λ_{1997}	0.851	0.905	1.047	1.065
	(0.038)	(0.037)	(0.042)	(0.040)
λ_{1998}	0.836	0.892	1.087	1.106
	(0.043)	(0.040)	(0.045)	(0.042)
λ_{1999}	0.752	0.833	0.981	1.049
	(0.055)	(0.050)	(0.048)	(0.048)
λ_{2000}	0.777	0.846	0.777	1.000
	(0.060)	(0.055)	(0.065)	(0.056)
λ_{2001}	0.705	0.740	0.810	0.975
	(0.063)	(0.063)	(0.054)	(0.054)
λ_{2002}	0.961	0.973	0.936	1.057
	(0.046)	(0.045)	(0.047)	(0.051)
λ_{2003}	1.006	1.037	1.042	1.170
	(0.046)	(0.045)	(0.046)	(0.049)
λ_{2004}	0.898	0.905	0.953	1.036
	(0.046)	(0.046)	(0.045)	(0.049)
λ_{2005}	0.845	0.843	0.981	1.085
	(0.048)	(0.050)	(0.046)	(0.049)
λ_{2006}	0.957	0.988	1.041	1.136
	(0.049)	(0.046)	(0.048)	(0.050)
N	91	91	91	91

Notes: See Section 1.3 for the full list of covariates.

Source: Own calculations using the SOEP data (1994-2006).

Chapter 2

The Consumption-Savings Decision[‡]

2.1 Introduction

The consumption behavior of private households in Germany is exposed to a number of recent developments in the dynamics of income and income taxation, consumption taxation, as well as savings subsidization. On the one hand, there is increasingly relevant transitory variation in wages which was emphasized as the main result of Chapter 1. On the other hand, there were a couple of policy reforms targeted at income and consumption in Germany in recent years. Private accumulation of financial assets for old-age pension income has been subsidized since 2001 in the framework of the so called Riester-scheme, which was extended to the accumulation of owner-occupied housing assets in 2008. The value-added tax rate was raised from 16% to 19% in 2007, and a homogeneous tax rate for capital income, in the form of a flat tax rate of 25%, was implemented in 2008, separating the taxation of capital income from the taxation of labor income.

Such reforms may affect the decision to allocate income to current consumption and to future consumption through effects on the real after-tax return. On the one hand, a price effect shifts the relative returns of current and future consumption, and on the other hand, an income effect alters the disposable budget.[1] As these two effects usually affect the consumption-savings

[‡]This chapter is based on joint work with Martin Beznoska from DIW Berlin, see Beznoska and Ochmann (2010).

[1]Sandmo (1985) provides a survey on general theoretical implications of taxation effects on savings, and Boadway and Wildasin (1994) as well as Bernheim (2002) provide comprehensive surveys on the empirical literature in this field. For a survey on the specific effects of interest rate changes on the consumption-savings decision in various model frameworks, see Elmendorf (1996). Elmendorf (1996) also argues for an additional relevant effect of interest rate changes on the stock of wealth. A general survey on the savings literature

decision in opposite directions, the total effect is theoretically unclear. Public subsidization of private old-age pension savings that increases the relative net returns to savings may thus in total well have a zero effect, or even a negative effect, on the level of savings.

In theory, the life-cycle/permanent income hypothesis (LCPIH, Modigliani and Brumberg, 1954; Friedman, 1957) suggests consumption smoothing in a deterministic environment. Based on the theoretical ambiguity concerning the relation of savings and the interest rate, a vast literature empirically investigates either the interest rate elasticity of savings in aggregate consumption functions, or structural preference parameters, as the intertemporal elasticity of substitution, in Euler equations. This literature is generally inconclusive with respect to the size and even the sign of the interest rate elasticity of savings. Wright (1967) finds a positive uncompensated elasticity of 0.2 and Gylfason (1981) of 0.3, while a greater elasticity is only found by Boskin (1978) with 0.4. However, most of the studies find elasticities not significantly different from zero,[2] and some even find evidence for a slightly negative interest elasticity of savings.[3]

A couple of attempts have been made with micro data to estimate the interest rate elasticity of savings. Blundell, Browning, and Meghir (1994) estimate an Euler equation on micro data for the UK based on a preference structure that they derive from demand system estimation. Hall and Mishkin (1982) analyze the reaction of non-durable food consumption towards changes in permanent and transitory income with micro data from the Panel Study of Income Dynamics. They do not infer a conclusion on the implied interest elasticity of consumption, though. For Germany, Lang (1998) analyses the consumption-savings decision in a demand system as the top stage of a two-stage budgeting model, where the interest rate is however modeled rather as a control variable. Generally, limited cross-sectional variation in the interest rate and the consumption price at the household level makes the identification of price effects on the consumption-savings decision empirically challenging. In order to better identify price effects, additional price variation at the household level through differential taxation of capital income is usually exploited in this literature. Cross-sectional variation in after-tax rates of return to savings results from variation in households' income structure and thus marginal tax rates (see e. g. Feldstein, 1976, for portfolio choice).[4] In case the data spans

beyond interest rate and taxation effects is conducted by Browning and Lusardi (1996).

[2]See inter alia Blinder (1975); Howrey and Hymans (1978); Giovannini (1985); Baum (1988); Makin and Couch (1989); Skinner and Feenberg (1989); Schmidt-Hebbel, Webb, and Corsetti (1992); Montgomery (2007).

[3]See Evans (1983); Friend and Hasbrouck (1983); Hall (1988). A literature overview can be found in Smith (1990). Summers (1984) finds variation between permanent and transitory interest rate shifts on savings. One strand of literature focuses on cross-country comparisons, e. g. for developing countries (e. g. Ogaki, Ostry, and Reinhart, 1996), where the relevance of financial liberalization for the size of the interest elasticity is emphasized (e. g. Masson, Bayoumi, and Samiei, 1998).

[4]Yet another approach evaluates specific tax reforms or subsidization programs and their effects on savings, see Bernheim (2002) for a survey on this literature.

a time frame overlapping with a major reform of the tax rules, there is additional potential variation in after-tax returns over time available. In this analysis, the identification strategy of price effects affecting the consumption-savings decision is built on this after-tax approach.

Another strand of literature emphasizes a greater relevance of household-level heterogeneity, in the form of risk and income uncertainty, compared to price effects, for the consumption-savings decision. In the concept of precautionary savings, the basic concept of the life-cycle/permanent income hypothesis is extended by letting income be stochastic and relaxing the assumption of certainty equivalence, so that consumption becomes a function of income variation. In the theoretical literature on precautionary savings, the relevance of *transitory* income uncertainty is emphasized. Consumption puzzles, like excess sensitivity to transitory income variation (Flavin, 1981; Zeldes, 1989) or excess smoothness of consumption (Campbell and Deaton, 1989; Caballero, 1991) are explained with precautionary motives. Liquidity constraints are mentioned as another argument for sensitivity to transitory income variation (Kazarosian, 1997). In the buffer stock model (Carroll and Samwick, 1997), households react to transitory income shocks if their asset stock deviates from a target wealth-to-income ratio.

The empirical literature in this field, however, comes to very inconclusive results regarding the relevance of precautionary savings. There are a couple of studies focusing on stocks of assets, specifying e. g. wealth-to-permanent-income ratios. Some find huge effects in the range of 40-60% of total wealth attributed to precautionary motives (Zeldes, 1989; Caballero, 1990; Dardanoni, 1991; Carroll and Samwick, 1997, 1998). Other studies find much smaller effects in the range of 20-30% (Lusardi, 1997; Kazarosian, 1997; Ventura and Eisenhauer, 2006) or almost no relevance of precautionary savings (Skinner, 1988; Guiso, Jappelli, and Terlizzese, 1992). For Germany, there are medium effects found by Bartzsch (2008) (20% of total wealth) and Fuchs-Schündeln and Schündeln (2005) (22% for East-Germany and 13% for West-Germany). Skinner (1988) and Hurst, Lusardi, Kennickell, and Torralba (2010) point out the relevance of risk aversion. They find almost vanishing effects of precautionary savings when differentiating by social status, or occupation, as a proxy for risk aversion. Also Fossen and Rostam-Afschar (2009) find no precautionary effects for Germany at all, when considering that savings of the self-employed are rather dedicated to old age income than related to precautionary motives. Then, there is a study from Miles (1997) that focusses on asset *flows* rather than stocks. He analyses consumption flows for the UK and finds modest effects of a doubling of income uncertainty on savings (+9% on a two-decade average).

This chapter contributes to this literature by modeling the consumption-savings decision in a structural two-good demand system as a function of current household income, net returns to savings, and the consumption price level, similar to the approach by Lang (1998). Additionally, an appropriate treatment of durable goods is accounted for by applying user costs. The model is estimated with official cross-sectional data on household consumption in Germany for the years between 2002 and 2007. Thereby, additional household-level price variation can be utilized through differential taxation of capital income, as well as variation in income taxation rules over this time frame. Marginal tax rates at the household level are simulated in an income taxation module. In a two-goods model, savings are found to be a superior good and thus consumption an inferior good. Moreover, the estimate for the uncompensated interest rate elasticity of savings is close to zero. It is concluded that policy-induced variation of net returns to savings can thus be expected to have no significant effects on the level of savings. Finding a compensated interest rate elasticity of savings that is significantly different from zero, however, indicates that such a variation would not be welfare neutral.

This basic model is then extended, following Miles (1997), to allow for effects of uncertainty in transitory household income. A model for the dynamics of household income is estimated on German panel data and significant effects of precautionary savings on the consumption-savings decision are found for households in Germany, excluding the self-employed, in the range of Miles (1997). As a result of a doubling of average income uncertainty, an average household increases savings by 4.4% and thereby reduces consumption by 1.8%. These effects are greater for single households and single parents, while lower for couples with two and more kids; they are also greater for households that live mainly on capital income and lower for transfer recipients as well as blue collar workers. In the next section, a model for the consumption-savings decision and for income dynamics is presented. Section 2.3 deals with the estimation approach. Then in Section 2.4, the data sets and descriptive statistics on savings and income uncertainty are presented. In Section 2.5, the results for the model with, and without, income uncertainty are discussed. Section 2.6 concludes.

2.2 The Model

The consumption-savings decision shall be embedded in a structural demand system for a two-period model.[5] The budget is allocated between the two periods, where the second period

[5] A structural demand system is a non-standard framework for the intertemporal consumption allocation decision. Since the seminal work by Hall (1978), consumption or savings equations have been estimated in numerous specifications, see Muellbauer and Lattimore (1995) for an overview, but only rarely a complete structural demand system is applied. There are several macroeconomic extensions of the basic portfolio choice model by Brainard and Tobin (1968), where the consumption-savings decision is modeled as the first stage of a two-stage budgeting model in a theoretically consistent demand system (e. g. Conrad, 1980; Taylor and Clements, 1983). In the demand system approach, the consumption price and the interest rate are integrated into the savings equation in the form of two separate prices. These can be theoretically constrained and the constraints be tested empirically. Further, the consumption-savings decision can be modeled as a simultaneous process in a theoretical framework and compensated and uncompensated elasticities can be distinguished in the estimation, which is relevant for welfare analyses.

can be interpreted as an approximation for all future periods. Another interpretation of this set up is that every period a given budget is allocated discretely to *immediate* consumption and *future* consumption. In the basic model, it is assumed that the budget equals the current income. Then, this basic model is extended to future income and uncertainty about future income. Proxies for permanent income and for income uncertainty are integrated into the model in Section 2.3.

2.2.1 A Demand System for Consumption and Savings

The consumption-savings decision shall be modeled in an almost ideal demand system (AIDS) from Deaton and Muellbauer (1980a), which is flexible concerning the factors of influence. The AIDS is based on price-independent generalized logarithmic (PIGLOG) preferences and on Engel curves in the Working-Leser form, where budget shares are linear in the log-budget (see Working, 1943; Leser, 1963). It is applied here in an extended version, which allows for more flexible Engel curves, i. e. the quadratic almost ideal demand system (QUAIDS), where budget shares are modeled in a quadratic function of the log-budget (see Banks, Blundell, and Lewbel, 1997). Let $Q_{i,j}$ denote the demand of household i for good j in levels, where the two available goods are consumption and savings, and $s_{i,j} = Q_{i,j}/y_i$ is the respective demand share from the budget. Then, consumption-savings demand in this two-goods QUAIDS is represented by the following system of $J = 2$ equations:

$$s_{i,j} \;=\; \alpha_{0j} \;+\; \beta_{1j}\,\ln(y_i/P^*) \;+\; \beta_{2j}\,\ln(y_i/P^*)^2 \;+ \sum_{k\in\{s,c\}} \gamma_{jk}\,\ln(p_{ik}) \tag{2.1}$$

for households $i = 1, ..., N$ and goods $j, k = c, s$, where c denotes consumption and s savings. y_i is household i's budget, p_{ik} is the price of good k for household i, and α_{0j} is a good-specific constant. β_{1j} and β_{2j} denote parameters of the budget effects of demand and γ_{jk} a parameter of the effect of relative price changes. $\ln(P^*)$ is the translog price index, which can generally be approximated by a linear price index, e. g. by the log-linear Laspeyres index ($\ln(P^*) = \sum_j \bar{s}_j \ln(p_j)$), resulting in the linearized QUAIDS. This functional form implies an income elasticity which is non-constant over the budget (see Banks et al., 1997). Omitting household indices for simplicity, the income elasticity for demand levels corresponds to:

$$\eta_j \;\equiv\; \frac{\partial Q_j}{\partial y}\frac{y}{Q_j} = 1 \;+\; \left(\beta_{1j} + 2\beta_{2j}\ln(y/P^*)\right)/s_j \tag{2.2}$$

where Q_j is demand for good j in levels.

The uncompensated price elasticity for the demand level of good j with respect to price of good k can be written using the definition of the income elasticity as:

$$\varepsilon_{jk}^{u} \equiv \frac{\partial Q_j}{\partial p_{jk}} \frac{p_{jk}}{Q_j} = \gamma_{jk}/s_j - \delta_{jk} - \left(\beta_{1j} + 2\beta_{2j} \ln(y/P^*)\right) \bar{s}_k/s_j \tag{2.3}$$

where $\bar{s}_k$ is the average share of good k and δ_{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:

$$\varepsilon_{jk}^{c} \equiv \varepsilon_{jk}^{u} + s_k \eta_j = \gamma_{jk}/s_j - \delta_{jk} + s_k + \left(\beta_{1j} + 2\beta_{2j} \ln(y/P^*)\right)(s_k - \bar{s}_k)/s_j \tag{2.4}$$

The two-good consumption-savings demand system in Equation (2.1) then is linear in the budget parameters (linear Engel curves) and linear in the price parameters. It imposes the following *across*-equations constraints on the parameters: $\alpha_{0c} + \alpha_{0s} = 1$, $\beta_{1c} + \beta_{1s} = 0$, $\beta_{2c} + \beta_{2s} = 0$, and $\gamma_{ss} + \gamma_{cs} = 0$ as well as $\gamma_{cc} + \gamma_{sc} = 0$, where γ_{cs} is the coefficient on the savings price in the consumption equation and γ_{sc} the coefficient on the consumption price in the savings equation. These restrictions together imply adding-up of the budget shares to one for each household: $\widehat{s}_{i,c} + \widehat{s}_{i,s} = 1 \; \forall \, i = 1, ..., N$.[6] It follows in this two-good case that only one equation can be estimated. While adding-up is fulfilled by definition of the system, other properties of the compensated demand function that make a system consistent with demand theory can be imposed or tested for the QUAIDS: compensated own price elasticities shall be non positive ($\varepsilon_{cc}^{c} \leq 0$, $\varepsilon_{ss}^{c} \leq 0$), the Slutsky-matrix is symmetric if the cross-price effects coincide, $\gamma_{cs} = \gamma_{sc}$, and compensated demand is homogeneous of degree zero in prices if the *within*-equation constraints, $\gamma_{cc} + \gamma_{cs} = 0$ as well as $\gamma_{ss} + \gamma_{sc} = 0$, hold (see Deaton and Muellbauer, 1980b).

There are two prices in the two-good consumption-savings demand system: $\ln(p_c)$ and $\ln(p_s)$. For consumption, cluster-specific prices are constructed (see Lewbel, 1989), in order to exploit price variation between households within a time period. The aggregate Consumer Price Index for the commodity groups is weighted by cluster-specific expenditure shares:

$$\ln(p_{l,c}) = \sum_{g}^{G} w_{lg} \ln(p_g), \quad \forall \, l = 1, ..., L \tag{2.5}$$

where p_g is the Consumer Price Index for commodity group g and w_{lg} is the budget share of commodity group g in cluster l.[7]

[6] Adding-up of the predicted shares can not be tested, however, given adding-up of observed shares by construction (see Deaton and Muellbauer, 1980a, p. 316).

[7] Clusters are constructed by household income, age of household head, and household composition. There follow $L = 252$ clusters. In order to control for resulting cluster effects, $p_{l,c}$ is regressed on cluster dummies

The savings price is the price for substituting immediate consumption for future consumption. It is modeled as a function of the expected level of future prices and a household-specific discount rate. The latter shall be a function of the household-specific real after-tax return to savings,[8] which is approximated by average real gross returns and the household's marginal tax rate on capital income, both differentiated by three types of assets and weighted by the household's structure of capital income (also see Section 2.4 and Appendix 2.8): $r_i^n = \sum_a^A w_{ia} r_a^g (1 - t_{ia})$, where w_{ia} is household i's share of capital income from asset a, r_a^g is the average gross return to assets of type a, and t_{ia} is household i's marginal tax rate on income from asset a.[9] The expected level of future prices in period t is assumed to equal the actual price level in period $t+1$. This implies that a price shock in t was expected in $t-1$ and does not affect the price expected for $t+1$, which is a reasonable assumption if shocks are not persistent, i. e. prices return to a steady state after one period (i. e. one year here).[10] The household-specific price of savings in logs corresponds to:

$$\ln(p_{i,s}) \;=\; \ln\left(\frac{p_{l,c}^{t+1}}{(1+r_i^n)}\right) \tag{2.6}$$

where $p_{l,c}^{t+1}$ is the level of future prices for household i in cluster l, and r_i^n is the weighted average of net returns to assets relevant for household i. The aggregate price index $\ln(P^*)$ is approximated by the log-linear Laspeyres index for the two goods: $\ln(P^*) = \bar{s}_c^0 \ln(\bar{p}_c) + \bar{s}_s^0 \ln(\bar{p}_s)$, where $\bar{s}_j^0$ denotes the average expenditure share of good j in the base year and $\ln(\bar{p}_j)$ the average log-price of good j. It follows that $\ln(P^*)$ is constant within each time period and varies only between the time periods.[11]

2.2.2 Modeling Income Dynamics

In the basic model, it is assumed that the relevant budget is defined by current income exclusively. This assumption is now loosened and the consumption-savings decision is allowed to depend additionally on future income and uncertainty about future income, which shall be captured by a permanent income based on the LCPIH concept and by transitory income

and the residuals are applied in the demand system.

[8]Grimes, Wong, and Meads (1994) argue that the specification of the financial portfolio share model that is consistent with the AIDS is a function of the *real* interest rate, as also the budget is denoted in real terms.

[9]For interest income, a time series of the return on medium-term deposits is applied. As a proxy for the return to stocks, the current yield to bonds is applied, and for housing assets, a rate of return to rental income is calculated. For households reporting zero capital income, the return on medium-term deposits is applied.

[10]Alternatively, price expectations could be modeled in an autoregressive process here and the one-period-ahead prediction be applied for the expected level of future prices. This shall be implemented in future research.

[11]A time period could be a month (as it is in the data for 2002-2004) or a quarter (2005-2007).

uncertainty based on the concept of precautionary savings. Firstly, an income model is introduced, where the dynamics of permanent income and transitory income uncertainty are defined. Proxies for these budget components are then integrated into the demand system in Section 2.3.

Income uncertainty is naturally not observed by the econometrician, it is barely observed by the household members themselves. The econometrician does not know whether a household will be hit by a shock next period, while its members might receive a signal. Thus, income uncertainty can merely be proxied with the help of the information that is reported. A proxy for income uncertainty is constructed that is closely related to income risk in a model for income dynamics. The dynamics of household income shall be modeled in an error components model (Moffitt and Gottschalk, 2002), in which the variance of household income is decomposed into permanent and transitory components over time, allowing for permanence of transitory shocks. This model was already introduced in Chapter 1. The only difference is that here the decomposition of variance is undertaken for household income and differentiated by "household type", in order to account for varying degrees of risk aversion.[12] Household types will be defined either by household composition or by main source of income (in the following: social status).

It shall be assumed that disposable household income[13] in logs can be modeled – as hourly wages were modeled in Eq. (1.1) – by:

$$y_{it} = x'_{it}\beta + u_{it} \tag{2.7}$$

for households $i = 1, ..., N$ at time $t = 1, ..., T$, where x_{it} denotes a $K \times 1$-vector of household-specific characteristics including a constant, β denotes a $K \times 1$ parameter vector, and u_{it} is assumed to be a compound error term. Household-specific characteristics are related to the head of the household and contain: age, age-squared, education, interactions of age as well as age-squared with education, gender, social status, household type, and moreover federal state dummies for region of residence as well as time dummies.

From now on, the analysis shall be differentiated by household type (h). As in Chapter 1, unobserved household heterogeneity is allowed for in the income equation, and the errors $u_{it(h)}$ are decomposed into a random effect $(\mu_{i(h)})$ and a transitory shock $(v_{it(h)})$: $u_{it(h)} = p_{t(h)}\mu_{i(h)} + l_{t(h)}v_{it(h)}$, where $\mu_{i(h)}|x_{it(h)} \sim iid(0, \sigma^2_{\mu(h)})$, $v_{it(h)}|x_{it(h)} \sim iid(0, \sigma^2_{v(h)})$; $p_{t(h)}$ and $l_{t(h)}$ are year-specific factor loadings that allow the components to vary over time. In the standard error

[12] Skinner (1988) uses occupation as a proxy for risk aversion when quantifying the relevance of precautionary savings. Kazarosian (1997) finds positive effects for interactions of occupation with income uncertainty on savings. However, both authors argue for possible biases in this proxy due to self selection of less risk-averse individuals into riskier occupations. As the self-employed are excluded from the analysis here, these potential biases are expected to be less of a problem.

[13] Disposable income basically equals net income. For a detailed definition, see Appendix 2.7.

components model (see Moffitt and Gottschalk, 2002), it is assumed that the two components are uncorrelated, i. e. $Cov(\mu_{i(h)}, v_{it(h)}) = 0$, and that there is no serial correlation among transitory shocks, i. e. $Cov(v_{it(h)}, v_{iht-s}) = 0$. By independence of $\mu_{i(h)}$ and $v_{it(h)}$, it follows for the variance of the income residual:

$$\sigma^2_{u(h)} \equiv var(u_{it(h)}) = p^2_{t(h)}\sigma^2_{\mu(h)} + l^2_{t(h)}\sigma^2_{v(h)} \tag{2.8}$$

In the standard model, this cross-sectional variance may then be decomposed into a permanent part $p^2_{t(h)}\sigma^2_{\mu(h)}/(p^2_{t(h)}\sigma^2_{\mu(h)}+l^2_{t(h)}\sigma^2_{v(h)})$ and a transitory part $l^2_{t(h)}\sigma^2_{v(h)}/(p^2_{t(h)}\sigma^2_{\mu(h)}+l^2_{t(h)}\sigma^2_{v(h)})$. The rather arbitrary assumption that transitory shocks are not correlated is removed and persistence of transitory shocks is accounted for. Autocorrelation in the structure of the transitory errors is introduced by allowing them to follow an AR(1) process:[14]

$$v_{it(h)} = \rho_{(h)}\, v_{it-1(h)} + \varepsilon_{it(h)} \tag{2.9}$$

where $\varepsilon_{it(h)}$ is a white noise term with zero mean and variance $\sigma^2_{\varepsilon(h)}$. It follows for the composite error term:

$$u_{it(h)} = p_{t(h)}\, \mu_{i(h)} + l_{t(h)}(\rho_{(h)}\, v_{it-1(h)} + \varepsilon_{it(h)}) \tag{2.10}$$

Altogether, it follows for the log of disposable household income:

$$y_{it(h)} = x'_{it(h)}\beta_{(h)} + p_{t(h)}\, \mu_{i(h)} + l_{t(h)}(\rho_{(h)}\, v_{it-1(h)} + \varepsilon_{it(h)}) \tag{2.11}$$

where $x'_{it(h)}\beta_{(h)}$ can be interpreted as the population's mean income profile, $\mu_{i(h)}$ are deviations of individual profiles from the mean profile, and $\rho_{(h)}\, v_{it-1(h)}+\varepsilon_{it(h)}$ is the process for transitory deviations from the individual profiles. After a transitory shock has decayed, a household's income would revert to the individual level, $x'_{it(h)}\beta_{(h)} + \mu_{i(h)}$. Given $E[\mu_{i(h)}] = E[v_{it(h)}] = E[\varepsilon_{it(h)}] = 0$ and $E[\mu_{i(h)}\varepsilon_{it(h)}] = E[\varepsilon_{it(h)}\varepsilon_{js(h)}] = 0$ for all i, h and j and for all $t \neq s$, the covariance matrix of the compound residuals is given by:

$$cov(u_{it(h)}, u_{it-s(h)}) = p_{t(h)}p_{t-s(h)}\sigma^2_{\mu(h)} + l_{t(h)}l_{t-s(h)}E[v_{it(h)}v_{it-s(h)}] \tag{2.12}$$

where $E[v_{it(h)}v_{it-s(h)}]$ evolves recursively from Eq. (1.7) with respective household indices.

[14] Alternatively, an ARMA(1,1) process is common in the error components literature (MaCurdy, 1982), or an ARCH(1) process (Meghir and Pistaferri, 2004). If an ARMA(1,1) process is specified for transitory errors similar results are found for the fractions of permanent variance. Moreover, the permanent component could be specified by a random walk, see e. g. Moffitt and Gottschalk (2002) or Baker and Solon (2003). However, this would imply an infinitely increasing variance, for which evidence is not found in the panel data for the time frame of ten years. This might be different for a longer time period, however, which is why a random walk shall be allowed for in future research.

Similarly as in Chapter 1, for each household type h at time t, the fraction of permanent variance from overall cross-sectional group-specific variance is computed as:

$$\lambda_{t(h)} = \frac{p_{t(h)}^2 \, \sigma_{\mu(h)}^2}{var(u_{it(h)})} \tag{2.13}$$

This fraction will become a determinant in the construction of proxies for permanent income and transitory income uncertainty, which is described in the next section. Results on $\lambda_{t(h)}$ from the estimation of the error components model are presented in Section 2.4.

2.3 Empirical Strategy

Firstly, it is explained how consumption-savings demand is estimated. Then, the empirical strategy for the construction of proxies for permanent income and transitory income uncertainty, as well as for their integration into the demand equations, is presented. Demand will be estimated on pooled cross-sectional household consumption data, and for the estimation of the model for income dynamics, household panel data will be applied additionally (also see Section 2.4).

2.3.1 Estimation of Demand for Consumption and Savings

In the basic model, current disposable household income is allocated to consumption and savings, where consumption is durable and non-durable consumption. For a consistent treatment of durable consumption, user costs or service flows are applied and the analysis focuses on what shall be labeled "effective" consumption, as opposed to actual expenditures.[15] Expenditures for durable consumption goods are reallocated among households: those reporting a purchase have lower effective consumption than actual expenditures, while those not purchasing get a positive value imputed for effective consumption. For details on the calculation of user costs, see Appendix 2.7. Savings are then defined residually from income and effective consumption. Exclusively voluntary savings, such as accumulations of financial assets, expenditures for a house purchase, premiums to private insurances, and repayments of loans are analyzed.[16] By the residual savings definition, the analysis follows the concept of *net* savings, as expenditures for asset purchases are netted out against income from asset sales. The resulting net savings ratio, defined by savings related to income, falls in the open interval $[-\infty, 1]$.

[15] For a similar treatment of durable goods in aggregate consumption, see Slesnick (1992) or Christensen and Jorgenson (1969).

[16] Mandatory or contractual savings, such as contributions to the statutory pension insurance system and employer-based savings plans, are directly subtracted from gross income and are thus not part of the disposable budget. For a detailed definition of savings, see Appendix 2.7.

Observing the fact that a great number of households have a savings ratio that falls in the negative part of this interval, for econometric concerns, the consumption-savings decision could be separated into the decision of whether to demand positive savings at all and the decision of which share of income to allocate to savings conditional on positive savings. However, no evidence is found for selection effects when estimating demand in a Tobit approach. The relevant marginal effects are not significantly different from the ordinary least squares (OLS) estimates on the non-censored observations, and the estimate for the selection term is not significantly different from zero. Thus, the estimation of the consumption-savings decision is reduced to the conditional decision of income allocation, whereby the estimation is restricted to households with positive savings, and OLS is applied. By the adding-up implication of the two-good demand system in Eq. (2.1), only one equation can be estimated, and estimates for the second equation follow residually. Thus, a single equation for savings demand is estimated on cross-sectional data:

$$
\begin{aligned}
s_{i,s} = \alpha_{0,s} &+ x_i'\beta + \beta_{1,s} \ln(y_i/P^*) + \sum_{h=1}^{H} \beta_{1(h),s} \ln(y_i/P^*) * hhcomp_h \\
&+ \beta_{2,s} \ln(y_i/P^*)^2 + \sum_{h=1}^{H} \beta_{2(h),s} \ln(y_i/P^*)^2 * hhcomp_h \\
&+ \gamma_{ss} \ln\left(\frac{p_{l,c}^{t+1}}{(1+r_i^n)}\right) + \gamma_{sc} \ln(p_{l,c}) + \epsilon_{i,s}, \quad s_{i,s} \in \,]0;1]\,, \quad \forall\, i = 1, ..., N
\end{aligned}
\tag{2.14}
$$

where x_i denotes a $K \times 1$-vector of household-specific characteristics and the stock of net assets. Interactions allow budget effects to vary with household composition.[17] The stock of net assets as well as the level of debt are potentially endogenous in Eq. (2.14). As the stock of net assets is imputed by the observed flows, endogeneity is probably less of a problem with the former. For the latter, an instrumental variables approach is applied, where the potentially endogenous level of debt is instrumented by the interest rate on debt and some of its polynomials in a Tobit regression (see Appendix 2.7 for details).

2.3.2 Measuring Income Uncertainty and Estimation of the Extended Model

When the basic consumption-savings demand model is extended by income uncertainty, in addition, household panel data is applied in order to estimate the error components model

[17] For the relevance of household composition in consumption-savings decisions, see e. g. Blundell et al. (1994). In the literature on demand for consumer goods, various specifications are applied to take into account effects of household composition in demand system estimation, see Pollak and Wales (1981) for an overview.

for the income process. The estimated variance components are then imputed in the cross-sectional consumption data. They provide variation over time and household types for the construction of proxies for permanent income and transitory income uncertainty.[18]

The estimation is conducted in three steps. Firstly, a one-level random effects model for disposable household income is estimated on the panel data according to Eq. (2.11), simultaneously with the AR(1) error process:[19]

$$y_{it} \;=\; x_{it}'\beta_{(h)} + \mu_i + \rho v_{it-1} + \varepsilon_{it}, \quad \forall\; i = 1, ..., N;\; t = 1, ..., T \tag{2.15}$$

where y_{it} is disposable household income in logs, and x_{it} contains the same household characteristics as in Eq. (2.7), including household composition and main source of income. Assumptions for the AR(1) specification of the stochastic terms are maintained from Section 2.2. From Eq. (2.15), the compound residuals are predicted as $\widehat{u}_{it} = \widehat{\mu}_i + \widehat{\rho}\,\widehat{v}_{it-1} + \widehat{\varepsilon}_{it}$, and an empirical $(T \times T)$ covariance matrix $\mathbf{C}_{(h)}$ of the residuals is constructed separately for each household type.

This is done for two different definitions of household types. In the first variant, household types are defined by household composition, where the following types are considered: single households, single parents, parents with no kids (younger than 18), parents with one kid, parents with two and more kids, and large households.[20] In the second variant, household types are defined by social status, which is related to the main source of household income, and the following types are differentiated: white collar workers, public servants, blue collar workers, pensioners, transfer recipients, and "capital income households".[21]

In the second step, the parameters of the theoretical covariance matrix in Eq. (2.12) are estimated by fitting the implications of the error specification in Eq. (2.10) to the empirical covariance matrix, separately for each household type. The parameters of the model are estimated by the generalized method of moments (GMM), as in Chapter 1. For $T = 10$

[18] For a similar strategy of imputing parameters of income dynamics, estimated on a household panel, in consumption cross-sections for Germany, see Buslei, Mouratidis, Steiner, and Weale (2006). Alternatively, a pseudo panel could be constructed from the cross-sectional data and the analysis of income uncertainty could be modeled on the cohort level. See e. g. Banks, Blundell, and Brugiavini (2001) or Blundell and Preston (1998) for applications in the context of precautionary savings. A construction of pseudo panel data is planned for future research.

[19] Given this structure of households observed over time and nested in groups of household type, the model could be extended to a multilevel random effects model. Also, the specification of the AR(1) error process could alternatively be omitted here, as it appears again in the error components model estimated in the second step. If the AR(1) process is omitted in the random effects estimation, the results do not change much.

[20] The group "large households" is the residual group of all remaining households. It mainly consists of households with more than two adults.

[21] The group "capital income households" is the residual group of all remaining households. It largely consists of pensioners and unemployed, in case they receive a greater part of their income from the investment of capital than from transfers. Most of the remaining households consist of students.

periods, $T(T+1)/2 = 55$ moments from each covariance matrix can be exploited. Again, "equally weighted minimum distance GMM estimation" (Baker and Solon, 2003) is applied, which effectively is a non-linear least squares (NLS) estimation.[22] The fraction of group-specific permanent variance from the parameter estimates is then calculated as:

$$\widehat{\lambda}_{t(h)} \;=\; \frac{\widehat{p}^2_{t(h)}\,\widehat{\sigma}^2_{\mu(h)}}{var(\widehat{u}_{it(h)})} \tag{2.16}$$

In a third step, the parameter estimates from the income estimation of Eq. (2.15), $\widehat{\beta}$ are imputed in the consumption cross-sections to predict disposable household income:

$$\widehat{y}_i \;=\; x_i'\widehat{\beta}, \quad \forall\, i = 1, ..., N \tag{2.17}$$

where x_i includes the same characteristics as in Eq. (2.7). Thus, the compound residual for the consumption cross-sections can be derived as: $\widehat{u}_i \;\equiv\; \widehat{y}_i - y_i$. It is then decomposed into a random effect and a shock by the time-variant group-specific fractions of permanent variance, $\widehat{\lambda}_{t(h)}$, from the estimation of the error components model in Eq. (2.10):

$$\widehat{\mu}_{i(h)} \;=\; \widehat{\lambda}_{t(h)}\,\widehat{u}_i \tag{2.18}$$

where $\widehat{\mu}_{i(h)}$ is the best linear unbiased prediction (BLUP) estimator of the random effect for household i of type h, observed in cross-section t (Prasad and Rao, 1990), and $\widehat{\lambda}_{t(h)}$ is defined in Eq. (2.16). The shock follows residually as:

$$\widehat{v}_{i(h)} \;\equiv\; \left(1 \,-\, \widehat{\lambda}_{t(h)}\right)\,\widehat{u}_i \tag{2.19}$$

The random effect is interpreted as the systematic component of the compound residual, which is linked to household characteristics but is not observed, and the shock as the true random element, which is unknown even to the household. If the *systematic* component is known to the household, the effects of $\widehat{y}_i$ and $\widehat{\mu}_{i(h)}$ in a consumption function should be of similar size (Miles, 1997). The proxy for permanent income shall thus be defined by the estimated mean population income profile, plus the predicted random effect:

$$\widehat{y}^p_{i(h)} \equiv \widehat{y}_i + \widehat{\mu}_{i(h)} \tag{2.20}$$

This estimator for permanent income in logs together with the residual shock ($\widehat{v}_{i(h)}$) then substitute current income in the savings demand equation in Eq. (2.14). As a result, budget

[22] Also see Chapter 1 for further details on the implementation of this method.

effects can be differentiated by permanent shifts and effects that are rather transitory. By the QUAIDS model, this results in a log-linear quadratic specification of the savings function in permanent income and transitory shocks.

In constructing a proxy for income uncertainty, the concept of precautionary savings shall be followed, in that income uncertainty is measured by variation in transitory shocks.[23] It is assumed that the remaining random element, $\widehat{v}_{i(h)}$, resulting from the imputation of $\widehat{\lambda}_{t(h)}$ and defined in Eq. (2.19), is of purely transitory nature.[24] Then, a function of $\widehat{v}_{i(h)}$ is applied to construct a proxy for income uncertainty.[25] A third polynomial of the transitory residuals is specified, as concavity is found in their effect on savings.[26] The polynomial in the second and the third moment of $\widehat{v}_{i(h)}$ is then interpreted as effects of transitory income uncertainty on the consumption-savings decision, i. e. for a given first moment.[27] When quantifying the effects of income uncertainty, a doubling of transitory income uncertainty is evaluated, which is measured by the variance of transitory shocks conditional on household type ($\sigma^{2\,c}_{\widehat{v},(h)}$). Finally, this single savings equation of the demand system for the extended model is estimated:

$$
\begin{aligned}
s_{i,s} = {} & \alpha_{0,s} + x_i'\beta + \beta_{1,s}\,\widehat{y}^{\,p}_{i(h)} + \sum_{h=1}^{H} \beta_{1(h),s}\,\widehat{y}^{\,p}_{i(h)} * hhtype_h \\
& + \delta_{1,s}\,\widehat{v}_{i(h)} + \sum_{h=1}^{H} \delta_{1(h),s}\,\widehat{v}_{i(h)} * hhtype_h \\
& + \delta_{2,s}\,(\widehat{v}_{i(h)})^2 + \sum_{h=1}^{H} \delta_{2(h),s}\,(\widehat{v}_{i(h)})^2 * hhtype_h \\
& + \delta_{3,s}\,(\widehat{v}_{i(h)})^3 + \sum_{h=1}^{H} \delta_{3(h),s}\,(\widehat{v}_{i(h)})^3 * hhtype_h \\
& + \gamma_{ss}\ln\left(\frac{p^{t+1}_{l,c}}{(1+r^n_i)}\right) + \gamma_{sc}\ln(p_{l,c}) + \epsilon_{i,s}, \quad s_{i,s} \in \left]0;1\right], \quad \forall\, i = 1, \dots, N
\end{aligned}
\tag{2.21}
$$

where $\widehat{y}^{\,p}_{i(h)}$ is the proxy for permanent income in logs (Eq. 2.20), and $\widehat{v}_{i(h)}$ is the deviation of

[23] As mentioned in Section 2.1, the literature on precautionary savings often finds stronger reactions to transitory than to permanent shocks (see inter alia Hall and Mishkin, 1982; Pistaferri, 2001).

[24] This follows directly from the variance components model, where permanent and transitory variance components are defined. Miles (1997) also finds that true shocks to income are rather transitory. It could be argued, however, that the interpretation of variation in individual-specific income residuals, even conditional on a random effect, should be further differentiated by permanent and transitory shocks (Kazarosian, 1997).

[25] Similar proxies for income uncertainty have been applied in the literature (Miles, 1997; Dardanoni, 1991; Carroll and Samwick, 1997, 1998; Kimball, 1990; Dynan, 1993).

[26] Miles (1997) also finds nonlinearities in the effects of shocks on consumption in a similar specification.

[27] The idea here is to interpret a shift in the variance of transitory shocks as transitory income uncertainty or income risk, while leaving the *level* of a shock unchanged. Note that the level of $\widehat{v}_{i(h)}$ is centered around an expected value of zero by construction.

current income from permanent income in logs (Eq. 2.19). The second moment $(\widehat{v}_{i(h)})^2$ and the third moment $(\widehat{v}_{i(h)})^3$ of the residuals denote the polynomial of the proxy for transitory income uncertainty. The proxies for permanent income and the transitory shock are interacted with household type, similarly as the budget in the basic demand model is interacted with household composition. However, price and income effects are not affected by uncertainty.[28] Furthermore, the effects of income uncertainty are allowed to differ by household type, estimating two specifications of Equation (2.21), either interacting the uncertainty proxy with household composition, or with social status.[29] For the interpretation of average budget elasticities and average effects of income uncertainty, a third specification ("pooled") is estimated, where the interactions with uncertainty are omitted. Results are presented and discussed in Section 2.5.

2.4 Data and Descriptive Evidence on Household Savings and Income Uncertainty

Firstly, the data sets applied are introduced and the simulation of the tax rate is briefly summarized. Then, some descriptive evidence on household savings and on income uncertainty for the various groups is presented. Finally, the evolution of income dynamics over time for the various household types estimated in the error components model is described.

2.4.1 Data and Simulation of the Tax Rate

The cross-sectional consumption data applied in this analysis stems from the Continuous Household Budget Survey for Germany ("laufende Wirtschaftsrechnungen", LWR). It contains information on income, consumption, and savings, very detailed by single components, at the household level. The LWR is maintained by the German Federal Statistical Office ("Statistisches Bundesamt").[30] The six cross sections for the years between 2002 and 2007 applied here contain 92,091 households when pooled together. For more details, see Appendix 2.7.

In order to apply after-tax returns to savings in Eq. (2.6), income taxation is simulated for each individual on the basis of information on income components that is observed for the time period when the consumption-savings decision is taken. A marginal tax rate is generated for each household member by incrementing taxable income and assuming the increment is fully

[28]Interactions of uncertainty with price and income effects are planned to be implemented in future research.

[29]In these specifications, the second moment of $\widehat{y}^p_{i(h)}$ is omitted as no significant effects are found here, once it is interacted with the respective group variable.

[30]The LWR data was provided by the Research Data Centre of the Statistical Offices of the Länder ("Forschungsdatenzentrum der Statistischen Landesämter", FDZ).

taxable and is not accompanied by any deductible expenses. Individual marginal tax rates are aggregated to a household marginal tax rate on taxable income in general, which is assumed to be relevant for the household's consumption-savings decision. For details on the taxation module, see Appendix 2.8 and Beznoska and Ochmann (2010). Figure 2.3 in Appendix 2.8 displays some descriptive statistics on the simulated marginal tax rate.

The panel data applied for the estimation of the model for income dynamics stems from the German Socio-Economic Panel (SOEP). A balanced panel on waves 1999-2008 is applied, where all subsamples available until 1999 are included.[31] In the balanced panel, there are 4,234 households at each time t. By household composition, these can be split into: 900 single households, 255 single parents, 1,355 couples with no kids, 674 couples with one kid, 972 couples with two and more kids, and 78 large households. By social status of the household head, they can be grouped into: 1,296 white collar workers, 200 public servants, 820 blue collar workers, 1,368 pensioners, 347 transfer recipients, and 203 "capital income households". Some 536 households with a self-employed head were excluded, because they are not observed in the consumption data. Income in the error components model is monthly observed household net income. For the balanced panel design, in case of variation in household type within i over t, household i is grouped in the household type that is most frequently observed for i over t.

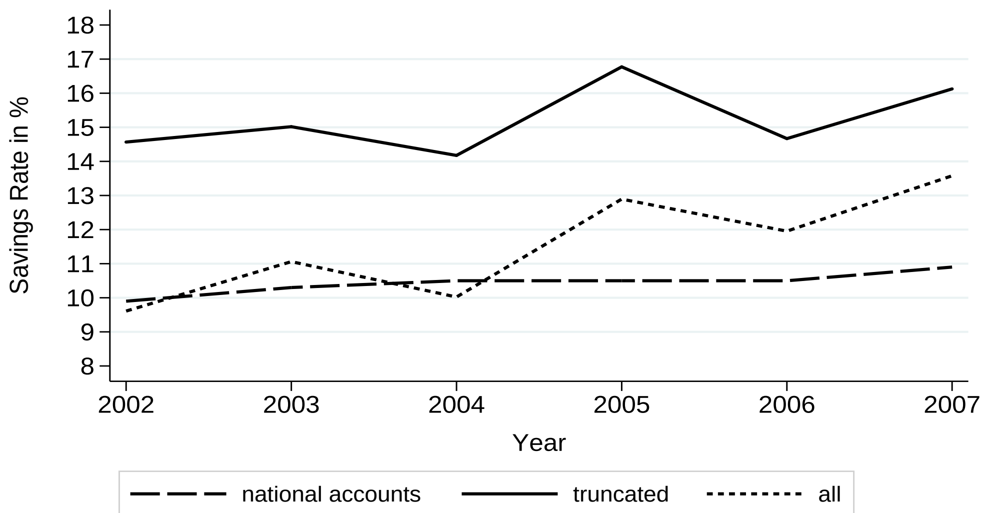
2.4.2 Descriptive Micro Evidence on Household Savings and Income Uncertainty

Over the time frame that is analyzed here, there was not much variation in the aggregate savings rate of private households in Germany. It increased only slightly from 9.9% in 2002 to 10.8% in 2007. Figure 2.1 compares the average savings ratio from the LWR data to the aggregate savings rate from national accounts. In the full sample of all observations, the average savings ratio is on average similar in size to the macro savings rate from national accounts. It increases from 9.6% in 2002 to 13.6% in 2007 (plot "all"). It should be noted, though, that comparability is limited as the sums for private households are derived residually in national accounts and include non-profit institutions serving households (*private Organisationen ohne Erwerbszweck*), which are not included in the micro data. Comparability of the micro savings ratio with the macro savings rate is moreover limited by the definition of savings. The definition of savings is widened in the micro data by durable goods, the interest component of

[31] These are the subsamples labeled A-E, which exclude a high-income subsample. For further details on the SOEP data, see Wagner et al. (2007). Extending the sample to earlier waves would substantially reduce the number of observations for the balanced panel. The model was also estimated on an extended unbalanced panel and no significant differences were found in the results. A balanced panel approach ensures consistency with the underlying theoretical model and that any variation in the distribution of wages does not result from compositional changes.

loans, and expenditures for contributions to several private insurances (see Appendix 2.7 for details), which shifts the mean savings ratio slightly upwards.[32]

Figure 2.1: Savings Rate of Private Households in Germany (National Accounts vs. Micro Data)



Notes: Savings rate from national accounts includes changes in net claims from company pension plans.
Truncated savings rate from micro data is average savings rate truncated at −100%.
All−plot refers to the average non−truncated savings rate from micro data.
Micro data weighted by population weights.
Source: Own calculations with the LWR data (2002−2007) provided by the FDZ.
National accounts from Statistisches Bundesamt (2009).

Based on this micro savings ratio (plot "all"), the sample of households is restricted for estimation purposes. Some 1% outliers with a savings ratio of below -1 are excluded, whereby the savings ratio is shifted upwards by about 4 percentage points on average. This results in, what shall be labeled, the "unconditional" savings ratio (the "truncated" plot in Figure 2.1). The unconditional savings ratio increases on average from 14.6% in 2002 to 16.1% in 2007.[33] In the estimation, the sample is further restricted to households with a savings ratio greater than zero ("conditional" savings rate), as argued in Section 2.3, which shifts the savings ratio further upwards, as Table 2.1 reveals. The average unconditional savings ratio in the population – when weighting the micro data by population weights – is 14.9%, and the average conditional savings ratio is 29.1% in the population of savers.[34]

Taking a closer look at the descriptive statistics in Table 2.1 also reveals that there is great cross-sectional variation in income and savings by household composition as well as by

[32] Slesnick (1992) also finds a great upward shift in the savings rate when accounting for service flows from durable consumption.

[33] The times series are adjusted for a structural break in 2005 due to changes in the survey scheme of the LWR data.

[34] Note that the population weights applied do not take into account the distribution of savers in the population, however, so that the interpretation of the conditional savings ratio should be limited to the sample, rather than extended to the population.

Table 2.1: Descriptive Statistics on Income, Savings, and Income Uncertainty by Household Type

	Unconditional					Conditional				
	N	N_j/N	$\bar{s}^u_{(h)s}$	$\bar{y}^u_{(h)}$	$\sigma^{2\,u}_{\hat{v},(h)}$	N	N_j/N	$\bar{s}^c_{(h)s}$	$\bar{y}^c_{(h)}$	$\sigma^{2\,c}_{\hat{v},(h)}$
average hh:	90,863	100.0	14.9	2,264	0.0322	73,194	100.0	29.1	2,599	0.0299
hh-composition:										
Singles	22,388	24.7	8.6	1,431	0.0409	15,794	21.6	26.1	1,645	0.0380
Single parents	3,282	3.6	9.5	1,675	0.0523	2,479	3.4	23.4	1,837	0.0510
Couples, no kids	32,085	35.3	15.5	2,775	0.0219	25,406	34.7	28.2	3,038	0.0205
Couples, 1 kid	4,857	5.3	22.0	3,089	0.0396	4,205	5.7	31.2	3,309	0.0368
Couples, 2+ kids	10,284	11.3	26.0	3,783	0.0351	9,356	12.8	32.5	3,930	0.0336
Large households[a]	17,967	19.8	24.3	3,470	0.0305	15,954	21.8	32.0	3,688	0.0276
social status:										
White collar w.	33,063	36.4	22.6	2,948	0.0391	28,833	39.4	32.2	3,213	0.0366
Public servants	9,684	10.7	26.3	4,103	0.0200	8,773	12.0	32.5	4,235	0.0190
Blue collar w.	8,881	9.8	16.5	2,673	0.0284	7,170	9.8	26.4	2,915	0.0254
Pensioners	25,573	28.1	7.7	1,668	0.0135	18,223	24.9	22.6	1,837	0.0129
Transfer recipients	4,010	4.4	1.1	1,050	0.0733	2,488	3.4	19.3	1,198	0.0658
Capital income hh[a]	9,652	10.6	16.8	2,390	0.0723	7,707	10.5	25.5	2,925	0.0650

Notes: $\bar{s}^u_{(h)s}$ is the average savings ratio in percent, $\bar{s}^c_{(h)s}$ is the average savings ratio conditional on positive savings, $\bar{y}^u_{(h)}$ is current monthly disposable household income, $\bar{y}^c_{(h)}$ is current monthly disposable household income conditional on positive savings, $\sigma^{2\,u}_{\hat{v},(h)}$ is the variance of a transitory shock, and $\sigma^{2\,c}_{\hat{v},(h)}$ is the variance of a transitory shock conditional on positive savings. Data weighted by population weights for all figures, except for N.

[a]: Large households and "capital income households" are residual groups. They are defined in footnotes 20 and 21.

Reading example: The share of public servants in the population is 10.7%. Among this group, the average savings ratio is 26.3%. In the population conditional on positive savings, there are 12.0% public servants and their average savings ratio is 32.5%.

Source: Own calculations using the SOEP data (1999-2008) and LWR data (2002-2007), the latter provided by the FDZ.

social status. Generally speaking, the savings ratio appears to be positively correlated with income. An average household is equipped with a monthly disposable household income, in real terms[35] and on a six-year average, of 2,264 euros in the unconditional and of 2,599 euros in the conditional population. Households with below-average income (single households and single parents) have a below-average mean savings ratio (8.6% and respectively 9.5% in the unconditional population), while households with above-average income (couples with one kid, with two and more kids, and large households) have an above-average mean savings ratio (22.0%, 26.0%, and 24.3%). Couples without any kids have about-average income and average savings ratios. This relation between income and savings is also observed for groups of social status. Public servants as well as white collar workers have above-average income and have

[35]Income is deflated by the log-linear Laspeyres index for consumption and savings, $\ln(P^*)$, as in the demand system.

the greatest savings ratios (26.3% and 22.6%), while pensioners and transfer recipients have the lowest incomes and also the lowest savings ratios (7.7% and 1.1%). Blue collar workers and "capital income households" have about-average income and average savings ratios.

This between-group variation in the savings ratios is greatly reduced if the population is conditioned on positive savings, however, the positive correlation between group-average income and the savings ratio still holds. The average conditional savings ratio varies by household composition between 23.4% for single parents and 32.5% for couples with two and more kids. It varies by social status between 19.3% for transfer recipients and 32.5% for public servants.[36] The average conditional savings ratio is 29.1%.

The variation that is relevant for the identification of price effects is related to the interest rate and the consumer price. In this model, the cross-sectional variation in the interest rate is significantly greater here than in the consumer price, which is mainly driven by the variation in marginal tax rates over the households. The standard deviation of the net returns to savings is about four times as great as the standard deviation of the consumer price for a given cross section. As a result, the estimate for the effects of interest rate changes turns out to be much more robust in the empirical analysis as the estimate for consumer price effects, see Section 2.5.

Between-group heterogeneity is observed moreover in group-specific average income uncertainty, measured by variation in transitory income shocks ($\sigma^{2\ u}_{\hat{v},(h)}$ and $\sigma^{2\ c}_{\hat{v},(h)}$). While single parents, single households, as well as couples with kids face above-average income uncertainty, the variation in transitory shocks is lower for couples without kids and for large households. Again, there is more variation by social status, where transfer recipients as well as "capital income households" face the greatest levels of uncertainty, while public servants as well as pensioners face the lowest levels. This descriptive relation between household demographic characteristics and non-systematic variation in income is what would be expected. Groups of households whose members probably have a relatively unstable employment profile, such as single parents, transfer recipients, and "capital income households", face relatively greater transitory variation in income residuals. However, households with relatively stable employment, like couples without kids and public servants, or those with relatively stable income streams that are based on prior employment patterns, like pensioners, have relatively lower residual variation. In the next subsection, a closer look at the income dynamics and the persistence of shocks is taken.

[36] By conditioning on positive savings, the relative group sizes of single households, pensioners, and transfer recipients slightly decrease, as there are relatively more households with negative savings in these groups compared to couples with two and more kids and white collar workers, for example, whose relative group sizes increase in turn. As a consequence, the savings ratio of transfer recipients is shifted upwards significantly by conditioning on positive savings, as there are many households in this group that have great dissavings compared to their income.

2.4.3 Income Dynamics

Now, the evolution of income dynamics over time for the various household types estimated in the error components model shall be briefly described. The complete results for the NLS estimation of Eq. (2.12) on the balanced panel are compiled in Table 2.4 by groups of household composition and in Table 2.5 by groups of social status, both to be found in Appendix 2.9. The autoregressive parameter of the AR(1)-specification of transitory shocks, ρ, is estimated at between 0.48 and 0.57 depending on the group. These estimates imply that a shock in period t, ε_{it}, is reduced to some 26% already after two periods.[37] Thus, random shocks to income, as they are modeled here, can be characterized as transitory rather than permanent.[38] This finding confirms the assumption that the variation in the imputed random shocks, $\widehat{v}_{i(h)}$ from Eq. (2.19), is of predominantly transitory nature and can thus be applied as a proxy for transitory income uncertainty, as it has already been argued in Section 2.3.

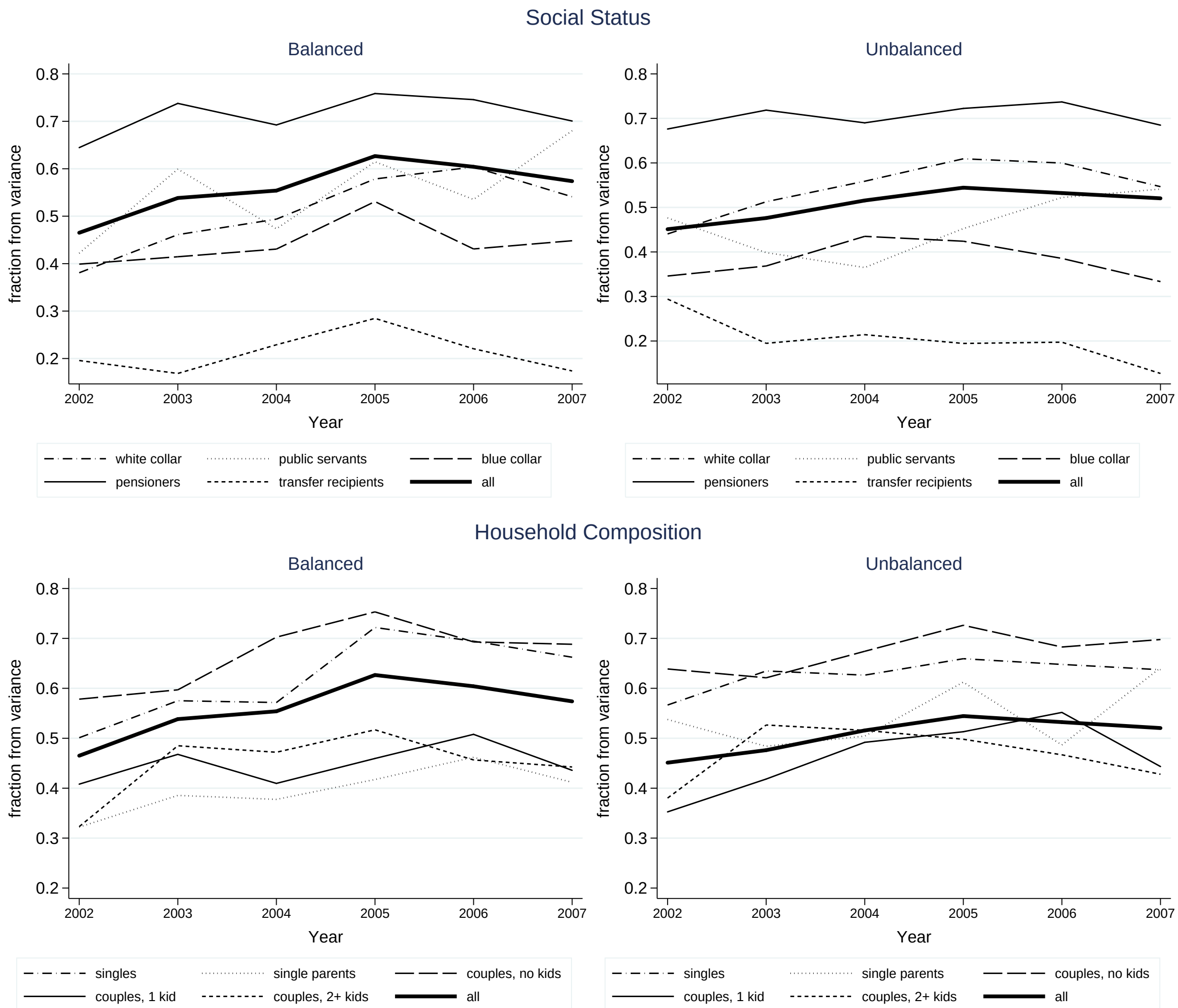
For the imputation of the group-specific random effect, $\widehat{\mu}_{i(h)}$ from Eq. (2.18), the estimated group-specific permanent variance component, $\widehat{\lambda}_{t(h)}$, is applied. Figure 2.2 plots the evolution of the cross-sectional income variance and its permanent component for the six groups by household composition and the six groups by social status over the time frame 2002-2007, on the balanced and on the unbalanced panel. In all four panels, a similar picture evolves. The permanent variance component steadily increases until 2005 for most of the groups. After that, it slightly decreases again, or remains constant, depending on the group. For an average household in the balanced panel, about 50-60% of overall variance are permanent and 40-50% transitory. There is little variation between the groups by household composition, with single households and couples with no kids facing more than average permanent variance, while for single parents and couples with one as well as couples with two and more kids, transitory variance is more relevant.

There is more variation between the groups by social status. For pensioners, permanent variation is dominant, while for blue collar workers as well as transfer recipients, transitory variation plays a greater role. The picture is similar for the balanced and the unbalanced panel. While there is a little level effect, with a 10%-points greater permanent variation in the more stable balanced panel, the structure over the groups is mostly similar. Thus, the

[37] If ρ is constrained to 0.35, which is the coefficient estimate from the simultaneous estimation of the random effects model and AR(1) error specification, similar results for the variance components are obtained. There is a little level effect, shifting the fraction of the permanent component upwards by 0-10%-points depending on the group, but the general evolution over time does not change for any group. One of the few studies that applies the same method to income at the household level is from Biewen (2005). In an ARMA(1,1) specification for transitory income in West-Germany during 1990-1998, he estimates a ρ of 0.28 and a γ of -0.37, which implies similar dynamics of shocks as are found here.

[38] Although his shock definition includes the random effect, Miles (1997) also concludes from differing estimated coefficients for permanent income and income shocks that true shocks to income are rather transitory and income does not follow a random walk.

Figure 2.2: Fraction of Permanent Component from Cross-Sectional Income Variance



Source: Own calculations with the SOEP data (1999−2008).

$\widehat{\lambda}_{t(h)}$ from the balanced panel estimation shall be applied, as it ensures consistency with the underlying theoretical model and that any variation in the income distribution does not result from compositional changes.[39]

2.5 Results

The main results that shall be focused on are related to the interest elasticity of savings and to the effects of income uncertainty on the consumption-savings decision. Firstly, results are presented for the base model neglecting income uncertainty and then for the extended model. For both models, budget and price elasticities of consumption and savings levels for the condi-

[39]For the residual groups, i. e. large households and “capital income households”, the average $\widehat{\lambda}_{t(h)}$ is applied.

tional population of savers are presented and interpreted. The results for consumption follow implicitly from the results for savings by definition (and vice versa). Nevertheless, elasticities are presented for both of them for the sake of illustration. Then, results for the estimated effects of income uncertainty are presented, though here limited to savings. Group-specific effects of conditional income uncertainty on the level of savings are derived and interpreted.

2.5.1 Price and Income Effects on Consumption and Savings

The dominant result from the literature, that the uncompensated interest elasticity of savings is close to zero, can be confirmed with the results found here. Apparently, a shift in the rate of return to postponed consumption does not induce agents to alter their projected consumption path. In the case of an interest rate increase, current consumption on the one hand decreases due to a significantly negative substitution effect, while on the other hand it increases by a significantly positive income effect. Together, these two effects leave the levels of consumption and savings essentially unchanged. Extending the base model by income uncertainty does not change this fundamental finding. In the base model, there is only a slight decrease in consumption and thus a slight increase in savings, whereas for the extended model, consumption is slightly increased. Budget and price elasticities are computed according to Eqs. (2.2)-(2.4) based on the coefficient estimates of the OLS estimations and evaluated for a mean conditional savings share of $\bar{s}^c_{(h)s} = 29.1$ and a mean conditional consumption share of $\bar{s}^c_{(h)c} = 70.9$.[40] The results are presented in Table 2.2 and are interpreted in more detail in the following. Coefficient estimates for the estimation of the savings equation in all specifications are compiled in Table 2.6 in Appendix 2.9.

In the base model, for the conditional population of savers, the point estimate for the income elasticity of the level of consumption is 0.66, i.e. consumption is found to be a relatively inferior good, and the income elasticity of savings is estimated to 1.84,[41] i.e. savings are found to be a superior good.[42] If current income in the conditional population increases by 10% from a monthly average income of 2,600 euros, an average household that consumes 1,843

[40]As no selection effects are found for estimating the demand system on the conditional sample (see Section 2.3), it shall be concluded that the estimated coefficients for the budget effects could be considered as valid for the entire population. However, as the QUAIDS model applied here is only defined for the conditional population of savers, the budget elasticities are evaluated for this population only. Also, the interpretation of the estimated coefficients for the price effects should rather be restricted to the conditional population.

[41]Note that by adding-up, the weighted budget elasticities sum up to unity: $\bar{s}^c_{(h)s}\eta_s + \bar{s}^c_{(h)c}\eta_c = 1$.

[42]The estimated budget effects are comparable in size to the results in Lang (1998). For consumption, he finds an income elasticity of 0.85 and for savings, a budget elasticity of 1.5-2.0, where 1.5 is for savings in financial assets and 2.0 for housing assets. A lower income elasticity of consumption is found here, as the budget effects are evaluated for the conditional population of savers with a relatively great average savings share. If the estimated budget effects were evaluated for the *un*conditional population ($\bar{s}^u_{(h)s} = 14.9$), the budget elasticity of consumption increases to 0.72.

euros (share of 70.9%) and saves 757 euros (share of 29.1%), would allocate these additional 260 euros more or less evenly between consumption and savings. As $2,600*0.709*0.066 = 121$ euros are consumed, savings are increased by the residual $2,600*0.291*0.184 = 139$ euros. This implies a marginal savings ratio of 53.5%, which is, as a result of the finding that savings are a superior good, greater than the average (conditional) savings ratio of 29.1%.

Table 2.2: Estimated Demand Elasticities for Levels of Consumption and Savings

	No Uncertainty		**Income Uncertainty**	
at the conditional mean[a]	Savings	Consumption	Savings	Consumption
Budget Elasticities:[b]				
current income	$+1.84^{***}$	$+0.66^{***}$	–	–
permanent income	–	–	$+1.84^{***}$	$+0.66^{***}$
transitory income	–	–	$+2.64^{***}$	$+0.33^{***}$
Price Elasticities:[b]				
Compensated:				
savings price (p_s)	-0.55^{**}	$+0.23^{**}$	-0.28^{***}	$+0.12^{***}$
consumption price (p_c)	$+1.43^{**}$	-0.59^{**}	$+1.32^{**}$	-0.54^{**}
Uncompensated:				
savings price (p_s)	-0.11^{*}	$+0.05^{*}$	$+0.18^{***}$	-0.07^{***}
consumption price (p_c)	$+0.06$	-1.03^{c}	$+0.00$	-1.00^{c}

Notes: Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$, based on robust standard errors.
[a]: Elasticities evaluated for the population of savers, at a mean conditional savings share of $\bar{s}^{c}_{(h)s} = 29.1$ and a mean conditional consumption share of $\bar{s}^{c}_{(h)c} = 70.9$.
[b]: Budget elasticities computed according to Eq. (2.2) and as weighted averages over the group-specific effects (groups by household composition); for the case of uncertainty, in the pooled version omitting group interactions; fraction of permanent variance imputed by household composition. Price elasticities computed according to Eqs. (2.3) and (2.4).
[c]: The null hypothesis for the consumption own-price elasticity is -1, see Eq. (2.3).
Reading example: In the approach with income uncertainty, savings are increased by 1.84% in turn of a 1%-increase in income if it is a permanent increase and by 2.64% if it is a transitory increase. A 1%-increase in the price for savings lowers current consumption in total by 0.07% and increases savings in total by 0.18%.

Source: Own calculations using the SOEP data (1999-2008) and LWR data (2002-2007), the latter provided by the FDZ.

The compensated consumption cross-price elasticity is estimated at 0.23. The negative substitution effect largely offsets the positive income effect, and the resulting total effect of an interest rate increase on consumption is slightly negative, though almost zero (uncompensated cross-price elasticity of 0.05). With everything else unchanged, an increase in the interest rate, i. e. a decrease in the savings price, slightly decreases consumption, as on the one hand, the implied increase in income increases the level of consumption (positive income effect), but on the other hand, consumption is substituted for savings due to the shift in relative prices (negative substitution effect), to a slightly greater extent than it is increased by the income effect alone.

The effects of an interest rate increase on the level of savings follow implicitly. The compensated savings own-price elasticity is estimated at -0.55. On the one hand, savings decrease by the positive income effect of an interest rate increase on consumption, while on the other hand, they increase by the negative substitution effect on consumption. As the latter dominates the former, savings effectively increase slightly in turn of an interest rate increase. The uncompensated own-price elasticity of savings is estimated at -0.11, but this effect is statistically almost zero.[43] The effects of a shift in the consumption price are also found to be small. The compensated own-price elasticity of consumption is estimated at -0.59 and the uncompensated own-price elasticity at -1.03, statistically not different from -1.00. This implies that a 1%-decrease in the consumption price increases consumption effectively by 1% and in turn leaves savings unchanged (uncompensated cross-price elasticity of 0.06, statistically not different from zero).[44] The entire effect of a consumption price effect is absorbed by current consumption so that the level of savings remains unaffected.[45]

The effects found here have important policy implications. Finding an uncompensated interest rate elasticity of savings with a slightly negative point estimate, that is though statistically almost zero, it can be concluded that policy-induced variation of net returns to savings is expected to have no effects on the amount of savings. Moreover, a *compensated* interest rate elasticity of savings that is significantly different from zero, however, indicates that such a variation would not be welfare neutral. Increasing the incentives to save more for old-age by increasing the net return to certain assets, for example, would not have any effects on the exterior margin, as the amount of total savings is unchanged. Increases of savings in a certain type of assets (e. g. in the Riester-scheme) could thus, if at all, only be obtained on the interior margin by shifting savings from other assets, while the general consumption-savings behavior is not affected by price-related incentives. The level of total savings can only be increased by indirect incentives through disposable income. As savings are found to be a superior good, policy reforms that increase disposable income could induce households to increase their level of savings. These qualitative policy implications also hold for policy reforms affecting the consumption price. An increase, for example, in the value-added tax rate would induce households to reduce their current consumption, but would leave their level of savings unchanged. Again, the level of savings could only be affected by policy reforms that significantly alter

[43] The resulting total effect on consumption in $t+1$ is greater (uncompensated own-price elasticity of -1.11) than the effect on savings as it additionally includes the effect of the interest rate change on the budget.

[44] This result is precisely the Cobb-Douglas case, where cross-price effects are zero and thus uncompensated own-price effects are -1.

[45] When interpreting the size of these estimated effects on both savings and consumption, it must be kept in mind that the implied reactions are more of a long-term nature, as the investment character of the consumption of durable goods is accounted for by calculating user costs. If only a fraction of durable consumption is interpreted as current consumption and the residual as savings, the reaction of a price shift on durable consumption has a mitigated total effect on effective consumption, compared to an approach, where the entire durable consumption is treated as current consumption.

disposable household income.

The results in Table 2.2, together with the coefficient estimates from Table 2.6, further indicate that the theoretical homogeneity restriction ($\widehat{\gamma}_{ss} + \widehat{\gamma}_{sc} = 0$) – implying symmetry here – does not hold empirically for consumption-savings demand in this model ($\widehat{\gamma}_{ss} = 0.05$, $\widehat{\gamma}_{sc} = 0.21$; F-test statistic $F_{1,\,73064} = 8.46$). The coefficient of the interest rate is estimated with more precision due to relatively more cross-sectional variation (Section 2.4) and problems of multicollinearity between the time dummies and the consumer price.[46] If the estimation is constrained to homogeneity, the savings price is mostly unchanged and only the consumption price is altered to fulfill the constraint. As the homogeneity restriction must be rejected, this constraint is not imposed in the estimation of the main specification, and all results presented refer to the unconstrained estimation.

In the theoretically consistent context of the demand system, the rejection of the homogeneity restriction indicates that in the savings equation, either the estimate for the own-price elasticity ($\widehat{\varepsilon}^c_{ss}$) is too low, or the estimate for the cross-price elasticity ($\widehat{\varepsilon}^c_{sc}$) is too high. This empirical finding suggests that households react slightly differently in response to a shift in the consumption price and in response to a change in the interest rate. This could be interpreted as an overreaction to shocks on the consumption price, in a sense of surprise inflation, compared to interest rate shocks that are perceived less sensitively. Or households mistake a nominal interest rate increase for an increase in the real rate so that effects of the consumption price may to some extent also reflect reactions to shifts in the nominal interest rate.[47]

Despite the violation of the homogeneity constraint, the elasticities estimated in the main specification can be applied for evaluating specific price changes in welfare analysis. If households' demand for savings is more elastic to price shocks than to shocks in the interest rate, one possible policy implication from a welfare point of view could be that a tax on capital income would be favorable compared to a consumption tax.

For the extended model including income uncertainty, the estimated elasticities do not differ much from the base model elasticities.[48] Budget elasticities can now be interpreted, differentiated by the degree of permanence of a budget shift. It is found that the reaction in

[46] The correlation between the consumption price and the time dummies is very high (R^2 of 0.92 in a linear regression). If the time dummies are omitted in the unconstrained model, for another specification not presented here, consumer price effects turn out to be similar to the constrained model. In the main specification, the time dummies are nevertheless kept, as evidence for their joint significance is found (F-test statistic $F_{4,\,73064} = 17.12$).

[47] Lusardi and Mitchell (2009), in evaluating questions on financial literacy, find that only about half of the respondents understand the basic implications of interest rates and inflation. They moreover conclude that this fundamental lack of financial knowledge has relevant effects on households' decision to save for retirement.

[48] Note that in the savings equation estimated for the extended model in Eq. (2.21), the proxy for income uncertainty is interacted with household type, but neither with permanent income nor with the prices, so that this result would be expected.

savings is relatively stronger if the budget shift is of transitory nature, than if it is a permanent shift, and thus the opposite holds for consumption.[49] The estimated effects of a 1%-increase in income that is of permanent nature equal the budget effects found in the base model: savings are increased elastically by 1.84%, and thereby consumption is increased inelastically by 0.66%. If however the 1%-increase in income is of transitory nature, savings are increased by even 2.64%, and in turn consumption is increased by only 0.33%.[50] As in the base model, an increase in the interest rate does not affect consumption significantly. The result is only a small effect, which this time slightly increases consumption and thus decreases savings. Again, effects of a shift in the consumption price are entirely absorbed by current consumption.

2.5.2 Effects of Income Uncertainty on Consumption and Savings

In this subsection, the estimated effects of transitory income uncertainty, or income risk, on the consumption-savings decision shall be presented and discussed. Significantly positive effects of transitory income uncertainty on savings, and thus significantly negative effects on consumption, are found. Table 2.3 presents the results. The elasticity of savings with respect to a doubling of transitory income uncertainty for an average household is estimated at about 0.04 and thus of consumption at about -0.02. A doubling of transitory income uncertainty is measured by a doubling of the variation in transitory income shocks ($+\sigma^{2\,c}_{\tilde{v},(h)}$) from the average level. This means that if an average household faces twice the average transitory income risk, its members shift an amount of 43 euros from current monthly consumption to savings, thereby decreasing the level of consumption by 1.8% and increasing the level of savings by 4.4%.[51] If this average reaction would hold for each household, the average conditional consumption ratio in the population would decrease from 70.9% to 69.6% and the average conditional savings ratio would in turn increase from 29.1% to 30.4%.[52]

A comparison of these results to the empirical literature on precautionary savings demands caution concerning comparability of the approaches. Comparability to the results found for uncertainty effects on the *stock* of precautionary wealth appears to be limited. Even when

[49] Paxson (1992) also finds great reactions of savings towards transitory income shifts in Thailand, measured by variability in seasonal rain fall.

[50] Miles (1997) estimates similar relative sizes for permanent income and shock elasticities of consumption. However, it should be noted that his shock definition differs from the one applied here, as it additionally includes the random effect.

[51] In Table 2.3, uncertainty effects are displayed for savings only. The corresponding effects on consumption follow implicitly from adding-up. They can be computed from the effects on savings, Mfx_s, as follows: $\text{Mfx}_c = -\,\text{Mfx}_s * \bar{s}^{\,c}_{(h)s}/\bar{s}^{\,c}_{(h)c}$.

[52] This may seem a rather little effect. However, it should be kept in mind that the effects related to a doubling of solely *transitory* income uncertainty are evaluated. From the estimates of the model for income dynamics, transitory variance for an average household amounts to about 40-50% of overall variance (Figure 2.2).

Table 2.3: Marginal Effects (in %) of a Doubling of Income Uncertainty on the Level of Savings

	Uncertainty Effects ($+\sigma^{2\,c}_{\widehat{v},(h)}$)		Budget Elasticities		Savings		
	Mfx$_s$	t-stat	η_s^{perm}	η_s^{tran}	Mean	$\bar{s}^{\,c}_{(h)s}$	$\sigma^{2\,c}_{\widehat{v},(h)}$
average household:	4.4***	(22.2)	1.843	2.636	756	29.1	0.0299
hh-composition:							
Singles	4.0***	(15.5)	1.959	2.662	429	26.1	0.0380
Single parents	4.0***	(7.7)	2.151	3.185	430	23.4	0.0510
Couples, no kids	3.1***	(16.7)	1.810	2.632	857	28.2	0.0205
Couples, 1 kid	2.8***	(8.2)	1.803	2.708	1,032	31.2	0.0368
Couples, 2+ kids	2.2***	(8.0)	1.865	2.597	1,277	32.5	0.0336
Large households[a]	2.9***	(16.3)	1.729	2.533	1,180	32.0	0.0276
social status:							
White collar w.	3.0***	(21.8)	1.801	2.748	1,035	32.2	0.0366
Public servants	2.4***	(8.7)	2.089	3.223	1,376	32.5	0.0190
Blue collar w.	2.6***	(10.6)	1.713	2.596	770	26.4	0.0254
Pensioners	3.4***	(8.2)	1.761	2.778	415	22.6	0.0129
Transfer recipients	2.3	(1.4)	1.786	2.672	231	19.3	0.0658
Capital income hh[a]	4.5***	(13.2)	1.682	2.530	746	25.5	0.0650

Notes: $\bar{s}^{\,c}_{(h)s}$ is the population average savings ratio conditional on positive savings. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, based on robust standard errors.
[a]: Large households and "capital income households" are residual groups. They are defined in footnotes 20 and 21.
Reading example: A doubling of group-specific income uncertainty from the group-average level conditional on positive savings increases the level savings of by 3.1% for a couple household with no kids. For an average household, a doubling of average income uncertainty from the average level conditional on positive savings increases the level of savings by 4.4%.

Source: Own calculations using the SOEP data (1999-2008) and LWR data (2002-2007), the latter provided by the FDZ.

compared to the uncertainty effects on consumption flows by Miles (1997), comparability in the interpretation of income uncertainty needs to be accounted for. Miles (1997) finds a decrease in consumption by 3-9% (for the UK in the time frame of 1968-1990) – on average 5% – in turn of a doubling of income uncertainty. But, he evaluates a doubling of average *permanent*, rather than transitory income risk, and his measure for variation in income shocks additionally includes a random effect. If the estimates found here are related to a doubling of *permanent* income variation, measured by the variance of permanent income, $var(\widehat{y}^{\,p}_{i(h)})$, a decrease in consumption by 9.1% is found, which is about what Miles (1997) finds as a maximum reaction in the cross-section for the year 1983. It can be concluded that the uncertainty effects found are comparable in size to the results found in the literature that applies a similar approach, i. e. Miles (1997). However, on the one hand, the results found here are considerably more conservative compared to even those mid-level effects in the range of 20-30% found in the literature on precautionary savings for Germany, see Section 2.1. On the other hand, uncertainty effects found for households in Germany, excluding the self-employed, are greater than found in Fossen and Rostam-Afschar (2009).

Furthermore, it is found that the effects of income uncertainty on the consumption-savings decision vary by household composition and especially by social status. Table 2.3 shows that the effects of a doubling of transitory income uncertainty on the level of savings vary over all groups between 2.2% and 4.5%. The estimated effects are evaluated at the average group-specific conditional transitory income uncertainty ($\sigma^{2\ c}_{\widehat{v},(h)}$). The evolution of uncertainty over time by the groups of household type has been described in Section 2.4, based on the plots for the fraction of permanent variation in Figure 2.2. The uncertainty effects vary by household composition, from 2.2% for couples with two and more kids to 4.0% for single households as well as single parents.[53] Savings of the latter two groups are also more than average elastic to permanent and transitory income shocks (η_s^{perm}, η_s^{tran}).

These results on savings shall be interpreted as follows: for households with otherwise equal characteristics, couples with kids are generally less elastic to transitory income shocks than couples without kids or single households, and couples with two and more kids are the most inelastic. Apparently, kids in a couple's household restrict that part of the budget which is flexibly disposable for purposes of precautionary savings. As couples with one or with two and more kids both have above-average savings ratios, this result indicates that their savings are probably dedicated to other purposes, like intergenerational transfers for future higher education for the kids, or bequests.[54] Single parents however, are more elastic to transitory shocks than couples without kids. A relatively great group-specific shock variance (Table (2.1)) indicates, that single parents are probably more often and more severely affected by transitory income shocks than couples, for example due to unstable employment patterns, and thus react more strongly by saving for precautionary purposes.[55] There might in turn not be enough room for other savings purposes besides the precautionary one, as a below-average group-specific savings ratio indicates.

Furthermore, it is found that the effects of income uncertainty also vary by social status: for transfer recipients, they are not significantly different from zero, and for public servants as well

[53] The maximum group-specific uncertainty effect by household composition (4.0%) is lower than the effect for an average household (4.4%). This, at first sight seemingly odd relation, results from a composition effect due to the evaluation of uncertainty effects by a non-linear combination of the group-specific mean savings share, the group-specific mean variance of transitory shocks, and the coefficient estimate.

[54] Yilmazer (2008) finds that higher education for kids is a major savings purpose of parents. On savings motives of German households, see Börsch-Supan and Essig (2003). For the relevance of intergenerational transfers in general concerning household savings, see Kotlikoff (1988). Gale and Scholz (1994) identify transfers from parents to their children as the major part of intergenerational household transfers.

[55] There is a vast literature on the employment patterns of single parents compared to couple households, see e. g. Millar and Rowlingson (2001).

as blue collar workers, they are also relatively low. For pensioners and white collar workers, uncertainty effects are only slightly greater. The greatest effects are found for "capital income households" (4.5% increase in savings when income uncertainty is doubled). These results shall be interpreted as follows: transfer recipients – although they have a relatively great shock variance (Table 2.1) – react rather inelasticly to transitory income shocks. They most likely do not have many possibilities to significantly reduce consumption, as their relatively low disposable income indicates ($\bar{y}^c_{(h)} = 1,198$). White collar workers, blue collar workers, and public servants usually devote at least some additional savings on a regular basis to mandatory contractual savings (statutory pension insurance or employer-based contracts), so that their voluntary savings reaction towards uncertainty would be expected to be attenuated. Public servants moreover face a relatively low group-specific transitory income uncertainty (Table 2.1). The latter also holds for pensioners, but they react nevertheless more strongly to income uncertainty. The most elastic reaction is found for "capital income households". As mentioned in footnotes 20 and 21, this group largely consists of households for which savings determine the main source of income. Nevertheless, they have a slightly below-average savings ratio. If their capital income is affected by a transitory shock, it would be expected that these households respond by adjusting the level of savings in order to balance out the income shock.[56]

It remains to note that the results discussed here can only be a proxy for the actual effects of transitory income uncertainty that households face. Limitations of the understanding of households' savings rationale become apparent when it was speculated about the causality of the effects found. However, it is believed that a proper approximation of the actual mechanism behind temporary uncertainty in the income stream and intertemporal consumption allocation for households, that take their composition and social status as given and observe group-specific income risk, could have been contributed.

2.6 Conclusion

The theory, as well as the empirical literature, is not unambiguous about the question whether tax reforms that affect the after-tax rate of return to postponing consumption, or reforms of the pension system that should generate incentives to save for old age, have any effect on the intertemporal consumption decision of households at all. The predominant result from the literature, that the uncompensated interest rate elasticity of savings is close to zero, can be confirmed with the results found. It can be concluded that policy reforms that aim at an increase in private savings for retirement in certain types of assets, through incentives on the

[56]For "capital income households", the buffer stock model of precautionary savings (Carroll, 1997) mentioned in Section 2.1 could give a good explanation for the savings behavior.

net rate of return, can at most be obtained on the interior margin by shifting savings from other assets, while the amount of aggregate savings is not affected by incentives related to the interest rate. Such policy reforms would moreover not be welfare neutral, as the compensated interest elasticity is significantly different from zero. Similarly, policy reforms that are related to the consumption price, as for example an increase in the value-added tax, do not affect the level of household savings, as the entire effect is absorbed by current consumption.

An empirical analysis of income, price, and interest rate effects on the consumption-savings decision was conducted with consumption survey data from official statistics on private households in Germany for the time of 2002 to 2007. In the base model, a structural demand system for the consumption-savings decision was constructed. Effects of the consumption price have been identified by expenditure-specific price weights and effects of interest rate variation with the help of household heterogeneity in marginal tax rates on capital income. An income tax module was constructed to simulate differential taxation of labor income and income from the investment of capital. In addition, an appropriate treatment of durable goods in the definition of savings was accounted for by applying user costs. It was found that savings are a superior good and thus that consumption is an inferior good, estimating the income elasticity of savings at 1.8 and of consumption at 0.7. Policy reforms that mainly aim at an increase in aggregate savings should thus focus on increasing households' disposable income, rather than on the net rate of return.

Furthermore, a contribution to the vast literature on precautionary savings was made, finding significant effects of transitory income uncertainty on the consumption-savings decision. Income dynamics were modeled in an error components model with panel data for Germany and the base demand model extended to account for income uncertainty. It was found that an average household increases savings by 4.4% in response to a doubling of average transitory income risk. In addition, it is found that the effects of income uncertainty on the consumption-savings decision vary by household composition and especially by social status. Apparently, kids in a couple's household restrict that part of the budget which is flexibly disposable for purposes of precautionary savings. As couples with one or with two and more kids both have above-average savings ratios, this result indicates that their savings are dedicated to other purposes, like intergenerational transfers for future higher education for the kids, or bequests. It is also found that transfer recipients are rather inelastic towards transitory income uncertainty, as they only have a small budget disposable for adjusting savings to a shock. So are public servants, who face a relatively low group-specific income risk and usually devote additional savings to mandatory contractual savings that are beyond the analysis here. The greatest uncertainty effects are found for "capital income households", for which savings determine the main source of income.

It shall also be concluded that generally, the understanding of households' savings rationale is limited by the quality of the proxy for income uncertainty applied here. As a transitory income shock is naturally unknown ex ante, the actual mechanism behind temporary income uncertainty and households' intertemporal consumption allocation can only be approximated. A plan to improve on the research includes the construction of a pseudo-panel on the LWR data in order to control for household/cohort-specific effects and in order to circumvent the imputation of the estimates of the process for income dynamics from the panel data and have a better capture of household heterogeneity in the proxy for income risk at the household level.

2.7 Appendix - Data and Definition of Income and Savings

Data

For the LWR consumption data, households are recruited voluntarily for reports every year according to stratified quota samples from Germany's current population census ("Mikrozensus") and report for a time of four months (one month out of each quarter of the year). Since 2005, recruited households stem from a subsample of the Income and Consumption Survey for Germany ("Einkommens- und Verbrauchsstichprobe", EVS), which is described in Section 3.5 and Appendix 3.10 of Chapter 3. They are aggregated to the population according to a marginal distribution of demographic variables. The entire population covered by the LWR is restricted, as there are groups that are not covered: self-employed, institutionalized people (i. e. military people in barracks, 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 18,000 euros. When descriptive statistics on the LWR data are presented (see Section 2.4), data are weighted by population weights. Population weights for the LWR are constructed with respect to the marginal distribution of households in the "Mikrozensus"-population by strata of household composition, social status, and net household income. For further details on the LWR data, see Statistisches Bundesamt (2007b).

Treatment of Durables

The investment character of the consumption of durables goods is accounted for, by calculating user costs or depreciation rates for these goods for current consumption, and the residual of actual expenditures and user costs is interpreted as savings. The durable goods considered include: furniture, electric devices, entertainment electronics, clothes, shoes, and carpets. For most of them, user costs are calculated by mean imputation. Household are clustered by age, income, composition. For each durable good in each cluster, aggregate expenditures are reallocated equally among all households in the cluster. Then, an estimated quarter effect is added to every adjusted category of expenditure to avoid a bias in the quarter dummies of the main equation. This is necessary because non-durable consumption is not adjusted for quarter effects.

Expenditures for car purchases form the most significant durable good related to the macroeconomic expenditures, except for housing expenditures. Cars are treated a little differently here from the described mean imputation. Firstly, a tobit regression is estimated for households owning exactly one car with the reported expenditures for leasing as the dependent variable and the disposable income and household characteristics as explanatory variables. Then, the unconditional value is predicted for each household owning at least one car assuming that 90% of the leasing rate is depreciation and 10% is interest payment. The depreciation is calibrated dependent on the number of cars in the household and their characteristics (bought new or second-hand). If the household reports expenditures for car purchases, 15% of this value is taken directly as depreciation for the first year (5% in case of a second-hand purchase). Furthermore, if there are expenditures reported for preventive maintenance or spare parts then these are taken into account in calculating the depreciation. Finally, aggregate expenditures for each good are roughly conserved after adjustment.[57]

Following Ruggles and Ruggles (1970), the market rental value approach is also applied to the measurement of services from owner-occupied housing. For owner-occupied housing, rents that are provided with the data are applied and imputed both in current income as well as in consumption. The rents applied are computed by the Federal Statistical Office as follows: an average gross rent (excluding heating and maintenance) per square meter differentiated by federal states is applied to the reported size of the house or flat, and this is added to the reported expenditures for heating and maintenance (Statistisches Bundesamt, 2005).

Definition of Income and Savings

For the relevant budget in the basic consumption-savings model, disposable household income is applied. Disposable household income is defined as net household income, added income from sales of home-made products, second-hand goods, and jewelery. Net household income results from subtracting compulsory contributions to the social security funds and to employer-based pension funds as well as income tax prepayments from gross household income. Gross household income in turn is defined as the sum of income from agriculture and forestry, income from trade or business, income from self-employment,[58] income from dependent employment, income from transfers from the social security funds, income from inter-household transfers, income from investment of capital, and income from renting and leasing. Income from renting and leasing additionally includes the imputed rent for owner-occupied housing, as explained in the previous subsection.

[57] On arguments for this market rental value approach for the measurement of services from durables, see Ruggles and Ruggles (1970). For a survey on various approaches for the measurement of durable service flows, see Katz (1983).

[58] Although there are no households with a self-employed head in the LWR data, some 2% of all households report positive income from self-employment. In this group, 50% of the households are categorized as white collar workers by main source of income. However, given the low number of households with any income from self-employment, it shall be assumed that additional income from self-employment does not affect the group of white-collar worker households differently than all other groups in the savings reaction to increasing income uncertainty.

As explained in Section 2.3, savings are defined residually from disposable household income and effective consumption. In detail, this definition of savings includes net accumulations of the following assets: housing assets that are owner-occupied or rented, financial assets such as bank deposits (i. e. savings accounts, fixed deposits, and money market investments), building society deposits (or home-building savings plans), stocks (including mutual stock funds, certificates, and other shareholdings), and bonds (i. e. private and public securities). Savings moreover include contributions to capital life and private pension insurances net of payouts, and net repayments of loans such as mortgages and consumer credits, where the interest component is included, because it is usually not disposable given the fixed annuity of a loan, see Morgan (1951) for a similar argumentation.

In addition, the definition of savings includes user costs for durable consumption goods, such as cars and furnitures, as explained in the previous subsection. Further included are expenditures for contributions to several private insurances, such as term life insurances, private health and long term care insurances, as well as voluntary contributions to the statutory pension insurance funds. Also included are premiums to personal liability insurances, to household insurances, and to liability as well as own-damage insurances for cars.[59]

Imputation of Wealth

Accounting for owner-occupied housing tax allowances, and for wealth and debt, as control variables in the demand equations, Eqs. (2.14) and (2.21), requires information that is not available in the LWR data. Financial wealth is imputed via capital income components assuming a market interest rate that varies with time period and maturity. For housing wealth, classical regression imputation is used to match the housing market values given in the EVS data with the LWR data. In addition, reported tax payments on land and real estate are applied inverting the tax function. If tax payments on land and real estate are not reported, imputed housing wealth can be improved using the correlation between the assessed tax value and the market value of the housing wealth. Further, information on income from renting and leasing is used to improve the imputation of rented housing wealth. Imputations have also been made for capital income. See Beznoska and Ochmann (2010) for further details.

[59]The treatment of these private insurance premiums as savings is debatable, as it is for insurance premiums in general. Premiums to insurances with a pure risk-insuring character, rather than a provisional character, could just as well be treated as consumption. Yet, it shall be argued with the investment character of insurances, as claims for future payoffs are generated by current contributions. Forgoing current consumption and insured future consumption form a trade off that attaches an intertemporal dimension to insurance premiums that allows a treatment as savings. For a comparison of the effects of applying various concepts of the definition of savings on the household savings ratio as well as on the national savings rate, see Blades and Sturm (1982).

2.8 Appendix - Simulation of the Tax Rate

In order to apply after-tax returns to savings, a marginal tax rate on capital income is simulated at the household level in a tax simulation module that implements the German income tax law as of the time of 2002 to 2007. This is necessary, since the actually assessed income tax burden is not reported in the data. Households only report tax prepayments in the LWR data based on the current income from dependent employment in the particular month (in the data, for the years 2002 to 2004), respectively in the particular three months period (2005 to 2007). Thus, to simulate a tax assessment for each household, the observed income and expenditure components need to be aggregated to an entire year. Generally, this is done assuming that the monthly/quarterly observation is representative for the entire year and thus multiplying it by twelve/four. Deviations from this procedure, in case of strong irregularities or seasonal patterns observed, are explicitly stated in the module.

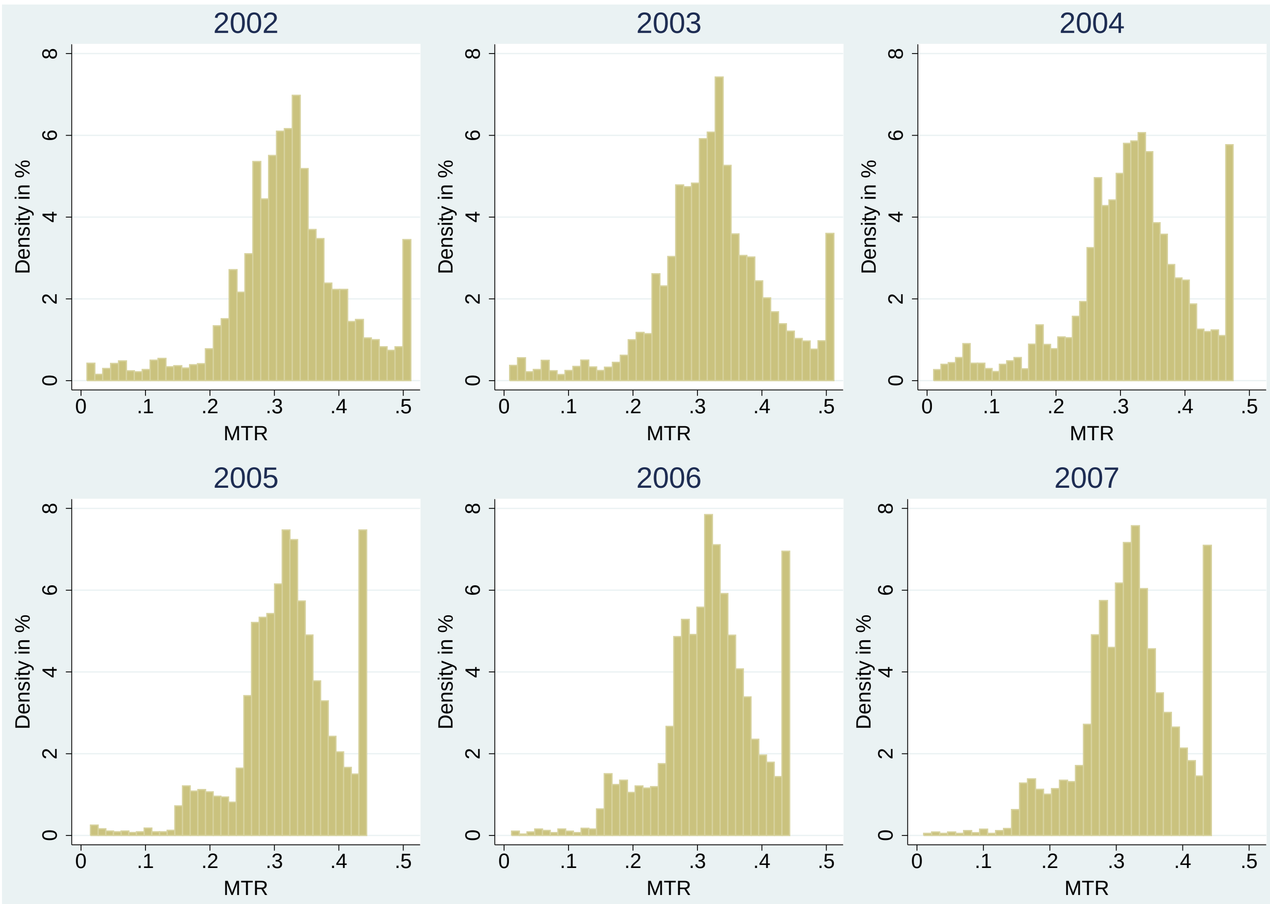
This simulation module considers all income components that are observed in the LWR data; assumptions on components that are not observed are explicitly stated. A detailed description of the module in the context of portfolio choice is provided in Appendix 3.9 of Chapter 3. The simulation module applied to the LWR data in this chapter does however differ slightly from the simulation module applied to the EVS data in Chapter 3, as the list of income and expenditure components observed slightly differs between the LWR and the EVS data, and because of changes in taxation laws between the time periods of 2002-2007 considered here and the years 1998 and 2003 considered in Chapter 3. A documentation of the exact elements of the simulation module that are related to the LWR data for the time frame of 2002 to 2007 can be found in Beznoska and Ochmann (2010).

The module returns individual-specific marginal tax rates aggregated to the household level. Household-specific marginal tax rates are generated by incrementing taxable income assuming the increment is fully taxable and is not accompanied by any deductible expenses. The difference in tax burdens resulting from the increment is applied as a general marginal tax rate on income. Zero is imputed for the tax rate in case the allowance on income from investment of financial capital is not yet fully exploited at the household level. Thus, the resulting marginal tax rate can be interpreted as a tax rate on income from financial capital specifically.

Figure 2.3 plots the conditional distributions of the resulting household marginal tax rate over time, where the condition is on a positive tax rate. Comparing the distribution over time, the variation that results from the final implementations of the income tax reform, starting in the year 2000, becomes apparent. The marginal tax rate on the lowest incomes was reduced from 23% (excluding solidarity surcharge and church taxes) in 1998 to 15.0% in 2005 and the top income tax rate was reduced from 51.0% in 2002 to 42.0% in 2005 and raised again to

45.0% in 2007,[60] while the general tax-free allowance was steadily increased. For more details, see Section 4.2 of Chapter 4.

Figure 2.3: Conditional Distributions of the Marginal Tax Rate by Cross-Sections (2002-2007)



Source: Own calculations with the LWR data (2002−2007).

[60]There are no cases in the data, though, that are affected by this increase in the tariff at the top, see Figure 2.3.

2.9 Appendix - Results

Table 2.4: NLS Estimates for Variance Components - By Househ. Comp. (Balanced)

	singles	single parents	couple, no kids	couple, 1 kid	couple, 2+ kids	pooled
dv.: $Var(y_t, y_{t-s})$	Coeffs (SE)	Coeffs (SE)	Coeffs (SE)	Coeffs (SE)	Coeffs (SE)	Coeffs (SE)
$\sigma^2_{v_0}$	0.1734	0.1371	0.1120	0.0684	0.0279	0.1006
	(0.0332)***	(0.0492)**	(0.0251)***	(0.0310)*	(0.0296)	(0.0268)***
σ^2_ε	0.0568	0.0545	0.0445	0.0447	0.0497	0.0490
	(0.0053)***	(0.0094)***	(0.0033)***	(0.0053)***	(0.0045)***	(0.0043)***
σ^2_μ	0.0568	0.0328	0.0445	0.0410	0.0320	0.0437
	(0.0029)***	(0.0053)***	(0.0016)***	(0.0034)***	(0.0027)***	(0.0023)***
ρ	0.5211	0.5685	0.4526	0.5265	0.4809	0.5032
	(0.0236)***	(0.0365)***	(0.0217)***	(0.0278)***	(0.0279)***	(0.0231)***
p_{2000}	1.0583	1.1162	1.1065	0.9521	0.9438	1.0466
	(0.0349)***	(0.1123)***	(0.0256)***	(0.0524)***	(0.0543)***	(0.0365)***
p_{2001}	1.0224	1.1809	1.1591	0.9239	0.9950	1.0609
	(0.0358)***	(0.1218)***	(0.0274)***	(0.0555)***	(0.0595)***	(0.0387)***
p_{2002}	1.1637	1.1249	1.2660	1.0191	1.0305	1.1527
	(0.0406)***	(0.1273)***	(0.0302)***	(0.0634)***	(0.0660)***	(0.0432)***
p_{2003}	1.2552	1.2613	1.3368	1.1080	1.1442	1.2375
	(0.0447)***	(0.1455)***	(0.0323)***	(0.0714)***	(0.0731)***	(0.0474)***
p_{2004}	1.2893	1.2871	1.3996	1.0795	1.2118	1.2760
	(0.0470)***	(0.1551)***	(0.0342)***	(0.0746)***	(0.0788)***	(0.0500)***
p_{2005}	1.3680	1.3822	1.4156	1.1655	1.2513	1.3299
	(0.0516)***	(0.1643)***	(0.0351)***	(0.0787)***	(0.0803)***	(0.0520)***
p_{2006}	1.4022	1.3882	1.3860	1.2497	1.1581	1.3246
	(0.0512)***	(0.1631)***	(0.0335)***	(0.0799)***	(0.0734)***	(0.0505)***
p_{2007}	1.3666	1.3821	1.3709	1.1643	1.1247	1.2914
	(0.0482)***	(0.1551)***	(0.0326)***	(0.0715)***	(0.0683)***	(0.0476)***
p_{2008}	1.3244	1.6005	1.3734	1.1498	1.1474	1.2870
	(0.0447)***	(0.1670)***	(0.0315)***	(0.0663)***	(0.0656)***	(0.0452)***
l_{2001}	1.0317	1.1772	0.9295	0.9985	0.8982	0.9823
	(0.0548)***	(0.1054)***	(0.0458)***	(0.0712)***	(0.0567)***	(0.0526)***
l_{2002}	0.9872	1.0376	0.9641	0.9987	1.0499	1.0071
	(0.0593)***	(0.1083)***	(0.0486)***	(0.0761)***	(0.0594)***	(0.0563)***
l_{2003}	0.9195	1.0149	0.9803	0.9620	0.8292	0.9343
	(0.0627)***	(0.1148)***	(0.0504)***	(0.0795)***	(0.0635)***	(0.0589)***
l_{2004}	0.9521	1.0543	0.8130	1.0549	0.9013	0.9337
	(0.0642)***	(0.1179)***	(0.0547)***	(0.0806)***	(0.0648)***	(0.0606)***
l_{2005}	0.7242	1.0420	0.7234	1.0288	0.8506	0.8371
	(0.0755)***	(0.1205)***	(0.0593)***	(0.0824)***	(0.0671)***	(0.0641)***
l_{2006}	0.7935	0.9562	0.8235	1.0014	0.8884	0.8745
	(0.0713)***	(0.1207)***	(0.0535)***	(0.0839)***	(0.0631)***	(0.0621)***
l_{2007}	0.8324	1.0539	0.8235	1.0785	0.8877	0.9076
	(0.0665)***	(0.1192)***	(0.0522)***	(0.0812)***	(0.0614)***	(0.0596)***
l_{2008}	0.8641	1.0575	0.8615	1.1447	0.9681	0.9510
	(0.0626)***	(0.1232)***	(0.0501)***	(0.0812)***	(0.0602)***	(0.0578)***

Notes: N=55 moments. Signif. lev.: $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. p_{99}, l_{99} and l_{00} normalized to 1.
Source: Own calculations with the SOEP data (1999-2008).

Table 2.5: NLS Estimates for Variance Components - By Social Status (Balanced)

	white collar	public servants	blue collar	pensioners	transfer recipients	pooled
dv.: $Var(y_t, y_{t-s})$	Coeffs (SE)	Coeffs (SE)	Coeffs (SE)	Coeffs (SE)	Coeffs (SE)	Coeffs (SE)
$\sigma^2_{v_0}$	0.1256	0.1674	0.0615	0.0742	0.1318	0.1006
	(0.0287)***	(0.0348)***	(0.0356)	(0.0305)*	(0.0535)*	(0.0268)***
σ^2_{ε}	0.0587	0.0285	0.0428	0.0432	0.0662	0.0490
	(0.0050)***	(0.0053)***	(0.0043)***	(0.0038)***	(0.0098)***	(0.0043)***
σ^2_{μ}	0.0332	0.0192	0.0268	0.0620	0.0243	0.0437
	(0.0026)***	(0.0031)***	(0.0023)***	(0.0021)***	(0.0057)***	(0.0023)***
ρ	0.5269	0.5763	0.4208	0.4347	0.5306	0.5032
	(0.0235)***	(0.0354)***	(0.0275)***	(0.0281)***	(0.0288)***	(0.0231)***
p_{2000}	1.0672	1.0533	1.0566	1.0365	1.2560	1.0466
	(0.0535)***	(0.1053)***	(0.0600)***	(0.0231)***	(0.1781)***	(0.0365)***
p_{2001}	1.0799	1.1325	1.0077	1.0842	1.0325	1.0609
	(0.0562)***	(0.1130)***	(0.0616)***	(0.0249)***	(0.1661)***	(0.0387)***
p_{2002}	1.2014	1.4320	1.1415	1.1547	1.0277	1.1527
	(0.0634)***	(0.1381)***	(0.0695)***	(0.0271)***	(0.1793)***	(0.0432)***
p_{2003}	1.2847	1.5944	1.1595	1.2012	1.0543	1.2375
	(0.0696)***	(0.1626)***	(0.0727)***	(0.0288)***	(0.1967)***	(0.0474)***
p_{2004}	1.3560	1.4780	1.2215	1.1865	1.1015	1.2760
	(0.0749)***	(0.1560)***	(0.0766)***	(0.0287)***	(0.2050)***	(0.0500)***
p_{2005}	1.4393	1.5384	1.2591	1.1896	1.2578	1.3299
	(0.0801)***	(0.1736)***	(0.0786)***	(0.0290)***	(0.2234)***	(0.0520)***
p_{2006}	1.4411	1.6269	1.2268	1.2117	1.0964	1.3246
	(0.0800)***	(0.1755)***	(0.0749)***	(0.0288)***	(0.1953)***	(0.0505)***
p_{2007}	1.4203	1.6695	1.1677	1.1901	0.9148	1.2914
	(0.0748)***	(0.1915)***	(0.0703)***	(0.0276)***	(0.1656)***	(0.0476)***
p_{2008}	1.3981	1.5471	1.1825	1.1481	1.2037	1.2870
	(0.0702)***	(0.1599)***	(0.0681)***	(0.0259)***	(0.1890)***	(0.0452)***
l_{2001}	0.9515	1.2247	0.9497	0.9623	1.0002	0.9823
	(0.0493)***	(0.1105)***	(0.0627)***	(0.0558)***	(0.0850)***	(0.0526)***
l_{2002}	0.9775	1.1034	1.0054	0.9253	1.0680	1.0071
	(0.0534)***	(0.1257)***	(0.0663)***	(0.0586)***	(0.0921)***	(0.0563)***
l_{2003}	0.8872	0.8682	0.9889	0.7729	1.2019	0.9343
	(0.0565)***	(0.1489)***	(0.0677)***	(0.0642)***	(0.1002)***	(0.0589)***
l_{2004}	0.8773	1.0421	1.0079	0.8538	1.0376	0.9337
	(0.0593)***	(0.1386)***	(0.0695)***	(0.0617)***	(0.0965)***	(0.0606)***
l_{2005}	0.7852	0.8152	0.8495	0.7245	1.0238	0.8371
	(0.0649)***	(0.1552)***	(0.0730)***	(0.0669)***	(0.1002)***	(0.0641)***
l_{2006}	0.7462	1.0150	1.0116	0.7637	1.0580	0.8745
	(0.0665)***	(0.1422)***	(0.0692)***	(0.0649)***	(0.0959)***	(0.0621)***
l_{2007}	0.8363	0.7668	0.9297	0.8397	1.0241	0.9076
	(0.0598)***	(0.1646)***	(0.0676)***	(0.0608)***	(0.0909)***	(0.0596)***
l_{2008}	0.8890	1.0334	0.9677	0.8989	1.0808	0.9510
	(0.0565)***	(0.1335)***	(0.0664)***	(0.0580)***	(0.0960)***	(0.0578)***

Notes: N=55 moments. Signif. lev.: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. p_{99}, l_{99} and l_{00} normalized to 1.
Source: Own calculations with the SOEP data (1999-2008).

Table 2.6: OLS Estimates for Savings (Share) Demand Equation

	No Uncertainty		**Income Uncertainty**					
			Pooled		**HH Comp.**		**Social Status**	
dep. var.: $s_{i,s}$	Coeffs	(SE)	Coeffs	(SE)	Coeffs	(SE)	Coeffs	(SE)
Income Polynomial:								
y (or $\widehat{y}^p$)	-0.418	(0.05)***	0.250	(0.01)***	0.243	(0.01)***	0.216	(0.01)***
y (or $\widehat{y}^p$) $* hhtype2$	-0.260	(0.13)**	0.020	(0.02)	0.031	(0.02)**	0.054	(0.01)***
y (or $\widehat{y}^p$) $* hhtype3$	-0.284	(0.07)***	-0.022	(0.01)***	-0.018	(0.01)**	-0.008	(0.01)
y (or $\widehat{y}^p$) $* hhtype4$	-0.137	(0.20)	0.001	(0.01)	0.003	(0.01)	0.028	(0.01)***
y (or $\widehat{y}^p$) $* hhtype5$	0.067	(0.12)	0.032	(0.01)***	0.033	(0.01)***	0.047	(0.01)***
y (or $\widehat{y}^p$) $* hhtype6$	-0.491	(0.08)***	-0.017	(0.01)**	-0.013	(0.01)*	0.008	(0.01)
y^2	0.038	(0.00)***	—		—		—	
$y^2 * hhtype2$	0.015	(0.01)**	—		—		—	
$y^2 * hhtype3$	0.013	(0.00)***	—		—		—	
$y^2 * hhtype4$	0.007	(0.01)	—		—		—	
$y^2 * hhtype5$	-0.004	(0.01)	—		—		—	
$y^2 * hhtype6$	0.024	(0.01)***	—		—		—	
Prices:								
p_s	0.046	(0.02)**	0.124	(0.02)***	0.122	(0.02)***	0.120	(0.02)***
p_c	0.209	(0.09)**	0.179	(0.09)**	0.217	(0.09)**	0.112	(0.09)
Transitory Income:								
$\widehat{v}$	—		0.434	(0.01)***	0.467	(0.01)***	0.473	(0.01)***
$\widehat{v} * hhtype2$	—		0.078	(0.01)***	0.041	(0.02)**	0.060	(0.01)***
$\widehat{v} * hhtype3$	—		0.027	(0.01)**	0.020	(0.01)	-0.004	(0.01)
$\widehat{v} * hhtype4$	—		0.099	(0.01)***	0.098	(0.01)***	0.097	(0.01)***
$\widehat{v} * hhtype5$	—		0.086	(0.01)***	0.089	(0.01)***	0.087	(0.01)***
$\widehat{v} * hhtype6$	—		0.056	(0.01)***	0.043	(0.01)***	0.037	(0.01)***
Shock Polynomial:								
$\widehat{v}^2$	—		0.549	(0.03)***	0.358	(0.02)***	0.324	(0.02)***
$\widehat{v}^2 * hhtype2$	—		—		-0.165	(0.04)***	0.236	(0.08)***
$\widehat{v}^2 * hhtype3$	—		—		0.180	(0.04)***	-0.056	(0.03)*
$\widehat{v}^2 * hhtype4$	—		—		-0.055	(0.04)	0.308	(0.05)***
$\widehat{v}^2 * hhtype5$	—		—		-0.090	(0.04)**	-0.225	(0.03)***
$\widehat{v}^2 * hhtype6$	—		—		0.035	(0.03)	0.045	(0.04)
$\widehat{v}^3$	—		-0.451	(0.05)***	-0.279	(0.04)***	-0.197	(0.02)***
$\widehat{v}^3 * hhtype2$	—		—		0.252	(0.06)***	-0.467	(0.16)***
$\widehat{v}^3 * hhtype3$	—		—		-0.208	(0.09)**	0.200	(0.05)***
$\widehat{v}^3 * hhtype4$	—		—		0.052	(0.05)	0.002	(0.16)
$\widehat{v}^3 * hhtype5$	—		—		0.075	(0.06)	0.131	(0.04)***
$\widehat{v}^3 * hhtype6$	—		—		0.064	(0.06)	-0.098	(0.05)**
Control Variables:								
age (household head)	yes		yes		yes		yes	
gender (head)	yes		yes		yes		yes	
education (head)	yes		yes		yes		yes	
marital stat. (head)	yes		yes		yes		yes	
hh-comp	yes		yes		yes		yes	
social status	yes		yes		yes		yes	
net assets (2^{nd} pol.)	yes		yes		yes		yes	
(asset pol.)*(renting)	yes		yes		yes		yes	
durables dummies	yes		yes		yes		yes	
dummy for renting	yes		yes		yes		yes	
location (fed. states)	yes		yes		yes		yes	
time dummies	yes		yes		yes		yes	
Observations	73,194		73,194		73,194		73,194	
R^2	0.4208		0.4212		0.4209		0.4224	

Notes: y is current disposable income in logs, $\widehat{y}^p$ is permanent income in logs, and $\widehat{v}$ is residual from log-income regression. Significance levels: $^* p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$, based on robust standard errors.
Source: Own calculations using the SOEP data (1999-2008) and LWR data (2002-2007) provided by the FDZ.

Chapter 3

Portfolio Choice and Taxation[††]

3.1 Introduction

The asset accumulation behavior of private households in Germany is exposed to a number of recent developments in income taxation and savings subsidization. The ongoing process of demographic change induces German governments to reduce the role of the statutory pension system for old-age income and to subsidize private accumulations of financial assets for retirement income in the framework of the Riester-scheme (since 2001). The Riester-scheme was extended to the accumulation of owner-occupied housing assets ("Eigenheimrente") in 2008, following an on-going reform of the subsidization of housing assets in Germany in the recent decades which initiated the abolition of the home-building allowance ("Eigenheimzulage") in 2006. In the course of the latest corporate tax reform in 2008, a homogeneous tax rate for income from financial capital, in the form of a flat tax rate of 25% ("Abgeltungsteuer"), was implemented, separating the taxation of capital income from the taxation of labor income. Such reforms might affect aggregate savings of private households, as well as the allocation of savings between various types of assets given a fixed level of savings, as the relative prices of consumption and savings as well as the relative net returns of affected assets are altered.[1] The results from Chapter 2 suggest that households are expected to not alter their level of *aggregate* savings significantly in turn of such changes in the rate-of-return. In this chapter, the effects of differential taxation of capital income on households' decisions of portfolio choice and asset allocation at the household level shall be investigated.

There is vast literature of comparable studies that empirically identifies effects of differ-

[††]This chapter is based on the discussion paper Ochmann (2010a).

[1]A comprehensive survey on relevant issues in the field of taxation effects on household portfolio choice and asset allocation is provided by Poterba (2002).

ential income taxation on asset allocation.[2] One of the first studies is from Feldstein (1976), using micro data for the US. He finds positive tax effects on stocks (a 8.6%-points increase in the conditional share if the marginal tax rate increases by 10%-points[3]) as well as on tax-privileged bonds (+1.2%-points) and negative effects on other non-privileged financial assets (-7.3%-points on deposits), while housing assets are not analyzed. More evidence for the US is found by Hubbard (1985). He generally confirms and extends Feldstein's results: he finds significant positive tax effects on debt (+7.0% in the conditional share), on equities (+5.3%), and on housing assets (+1.8%). Generally, tax effects are found to be stronger on the probability of positive asset demand than on conditional demand. King and Leape (1998) find great tax effects on the demand probability, but smaller effects on conditional demand (conditional share of checking accounts increases from 4.9% to 5.8% and of mortgages from 61.1% to 65.6%). Poterba and Samwick (2002) also find significant tax effects on the demand probability for most of the assets, but significant effects on conditional demand are only found for tax-exempt bonds (between +18% and +56% on the unconditional share) and for non-privileged interest bearing accounts (between -2% and -6% on the unconditional share).

Following Feldstein (1976), this issue was also explored for a couple of other countries. For Canada, Dicks-Mireaux and King (1983) find positive effects on the demand probability as well as on conditional demand for deposits, tax-privileged stocks, and bonds, as well as slightly negative effects on housing demand. In a recent study, Alan et al. (2010) find significant, but relatively modest effects with Canadian data when exploring intra-household heterogeneity in tax rates. Hochguertel, Alessie, and van Soest (1997) find positive tax effects on risky assets using data from the Netherlands, an elasticity of 2.3 for the unconditional share of stocks and bonds from total financial assets. Agell and Edin (1990), using data for Sweden, find significant effects on the demand probability and on unconditional demand for tax-privileged financial assets (elasticity of 0.4-1.9 for stocks, depending on the specification), on housing assets (elasticity of 0.4-0.5), and on mortgages (elasticity of 0.9-1.4). For Germany, only Lang (1998) conducts a comparable analysis.[4] He finds positive tax effects on unconditional demand for tax-privileged life insurances (+2.5%-points) and negative effects on unconditional demand for building society deposits (-4.8%-points). He uses the same data set that is applied in the study at hand, but from older cross sections.[5]

[2]On the theory of taxation and portfolio allocation, see Auerbach and King (1983).

[3]All tax effects mentioned in this section that are not in elasticity terms are evaluated for a 10%-points increase in the marginal tax rate.

[4]Börsch-Supan and Eymann (2002) use various tax and subsidy changes during the time of German reunification to identify significant effects on the ownership probabilities of long-term saving contracts, bonds, and investments in foreign mutual funds.

[5]For a recent study on effects of dividend taxes on the portfolio choice of institutional investors in the U.S., see Desai and Dharmapala (2011). Other determinants of household asset allocation are analyzed in various contexts. Asset allocation in the life-cycle is analyzed by King and Leape (1987), Arrondel and Masson (1990),

This chapter extends the empirical literature by constructing a structural two-stage budgeting model of asset allocation, where asset demand is a function of the household's marginal tax rate (MTR). Such a structural asset demand model has not been applied to the identification of tax effects in the portfolio choice literature until now. Even in the most recent literature, it is still on top of the agenda for further work (Alan et al., 2010). Given a decision how to allocate disposable income to consumption and to savings from the previous chapter, the household decides how to allocate the amount of savings to financial assets and to housing assets at a first stage. Savings are defined to be *gross* savings, in terms of expenditures for asset accumulations. Housing assets are then, at a second stage, further allocated to owner-occupied housing, to non-owner-occupied housing, and to mortgages, while financial assets are further allocated to bank deposits, building society deposits, stocks, bonds, life and private pension insurances, and consumer credits. Observing the fact that a great number of households allocate assets to only a subset of all available asset types, in a simplified form of the model, the decision of asset allocation is separated into the decision of whether to buy an asset (the discrete asset choice) and the decision of which share of total assets to allocate to an asset conditional on buying it (the continuous asset choice). Accounting for simultaneity in these decisions, demand probabilities are estimated simultaneously for all assets and jointly with conditional demand.

Two cross sections from official survey data on income and consumption in Germany for 1998 and 2003 (EVS) provide the variation in the MTR exploited. Additional variation results from first implementations of a major income tax reform in the years of 2000/2001. As the MTR is not observed, it is simulated in a module of income taxation. The effects of differential income taxation on conditional asset demand, as well as on unconditional asset demand, are investigated. The hypothesis tested is that households facing a higher MTR on income allocate a greater fraction of their savings to tax-privileged assets than households with a lower MTR. Such effects are found, and they are relatively strong for owner-occupied housing, non-owner-occupied housing, mortgage repayments, and insurances. Generally however, the effect size is rather modest, as the effect of a 10%-points increase in the MTR on conditional asset shares ranges in absolute value from 0 to less than 5%-points only. In the next section, the rules on capital income taxation in Germany are briefly introduced, whereupon a two-stage budgeting model of asset allocation is derived in Section 3.3. Section 3.4 deals with the estimation approach and the identification strategy for the tax effects, and Section 3.5 presents the data

Ioannides (1992), Alessie, Hochguertel, and van Soest (2001), Milligan (2005), as well as by Sommer (2005). The impact of labor income risk on asset choice is investigated by Guiso, Jappelli, and Terlizzese (1996). Heaton and Lucas (2002) emphasize the effect of entrepreneurial risk. Stock holding behavior is explored by Haliassos and Bertaut (1995) and Bertaut (1998). Hochguertel and van Soest (2001) investigate the relation between financial and housing assets. Income and wealth effects in particular are treated in Uhler and Cragg (1971).

set as well as descriptive statistics on portfolio choice and asset allocation. In Section 3.6, results for conditional and unconditional tax effects are discussed, and Section 3.7 concludes.

3.2 Asset Returns in the German Income Tax Law

Income from the investment of capital (in the following: capital income) is exposed to differential taxation in Germany. Due to various allowances, tax exemptions, and deductibility of income-related expenses, the tax treatment is different for income from capital and income from labor, i. e. the tax schedule is not synthetic. Moreover, the treatment of income from capital differs for the various types of assets under consideration here. In the following, the taxation regulations concerning capital income in the German income tax law ("Einkommensteuergesetz", EStG) are introduced. The focus here is on the regulations as of the time for which the analysis is undertaken, which is for 1998 and 2003. This was a time frame with a lot of variation with respect to income tax regulations in Germany due to a major tax reform with its first implementations in 2000/2001. The major regulations that are related to capital income are sketched in the following, especially as far as they are relevant for the assets under consideration here. More details can be found in the documentation of the income tax module in Appendix 3.9.

For income from financial assets in general, there exists a tax-exempt allowance in the EStG. It amounts to 6,000 DM for 1998 and 1,550 euros for 2003, both for single tax payers. Income exceeding this allowance is subject to personal income tax (PIT). In addition, a withholding tax on income from financial capital ("Kapitalertragsteuer", KEST) is raised at the time and the point where the capital income accrued to the taxpayer; however, it has only a prepayment character and can thus be credited against PIT. For housing assets in general, there used to be a subsidization in form of allowances for deductions of expenses in the EStG, especially for owner-occupied housing. This allowance has been subject to various changes between 1998 and 2003. For all types of assets, in addition, income from price arbitrage sales is tax exempt if there is a time frame of at least six months in 1998 (twelve months in 2003) between buying and selling the financial asset and of at least 24 months between purchase and sale of housing assets in general. Otherwise, these capital gains are fully subject to PIT in the form of other income from private disposals.[6]

Among the various financial assets considered here, the treatment of capital income is relatively homogeneous. Capital income from financial assets, as far as it exceeds the allowance, is generally taxable by PIT. Specifically, interest income from deposits in interest

[6] In addition, there is a threshold for tax exemption. In case this threshold is exceeded, the entire amount of capital gains from price arbitrage sales is taxable.

bearing accounts at banks and in building society savings contracts (Bausparverträge, a kind of homeownership savings plans) are fully taxable by PIT (and a prepayment of 30% KEST). Dividends from stocks are generally also fully taxable by PIT.[7] Interests from bonds and other fixed-income investments are also fully taxable by PIT (30% KEST). Before the Retirement Income Act in 2005, interest gains ("Ertragsanteil") from capital life- and private pension insurance contracts were tax exempt, if contract duration was at least twelve years and contributions were paid for a minimum of five years. Moreover, contributions were tax deductible in terms of old age pension provision expenses up to a cap (§ 20 EStG). Interest payments on consumer credits could not be deducted from taxable income.

The treatment of capital income from housing assets, however, is relatively heterogeneous in the EStG with respect to housing assets that are devoted to owner-occupation only and such that serve other purposes, typically renting. While both forms were greatly subsidized in Germany during the recent decades, the regulations regarding tax allowances for expenditures for owner-occupied housing were changed in 1996. If construction was started before 1996, an annual 6% of the purchasing costs, up to a cap, was deductible for four years and 5% for another four years. If construction was started after 1996, a tax-exempt home-building allowance subject to income limits was granted for eight years. Income from speculative trading with owner-occupied real estates is fully taxable (§ 23 EStG) if there were less than two years between buying and selling the real estate. The "saved rents" of owner-occupied housing (resulting from the absence of expenditures for alternatively rented flats) are not subject to income taxation. Expenses for interest on loans for owner-occupied housing could not be deducted from income (§ 21 EStG).

Interest payments on loans for *non*-owner-occupied housing, however, are tax deductible. Income from speculative trading with rented real estates was subject to income tax (§ 23 EStG) if the time frame between buying and selling the real estate did not exceed two years in 1998 (ten years in 2003), *or* the real estate was owner-occupied during the year of selling and the entire two years before. Net income from renting or leasing of real estates is entirely subject to PIT (§ 21 EStG). However, as net income results from reducing gross rental income by expenses that are related to rental income, for example operating, maintenance, and financing costs, net rental income may be negative and may thus *reduce* taxable income.

Based on the treatment in the EStG, the asset types that are considered in this study

[7] There was a shift in the taxation rules for dividends in the EStG in 2000/2001 with respect to the corporate taxes at the company level that are due when dividends are paid out. In 1998, *gross* dividends at the shareholder level were subject to PIT and there was a KEST prepayment of 25%, while the corporate tax payment was considered as a tax credit ("Anrechnungsverfahren"). However in 2003, *net* dividends were subject to PIT, but with only 50% of the net dividend taxable, and the KEST was reduced to 20% ("Halbeinkünfteverfahren"). Net dividends are net of corparate taxes and net of withholding tax on capital income at the shareholder level. Also see Appendix 3.9.

shall be classified as either relatively more tax privileged, or relatively less tax privileged, or not tax privileged at all. Among the financial assets, capital and private old-age pension insurances are regarded as tax privileged assets, stocks and bonds to a lesser extent, whereas bank deposits, as well as building society deposits and consumer credits are classified as not tax privileged. Among the housing assets, non-owner-occupied housing as well as mortgage repayments are regarded as greatly tax privileged and owner-occupied housing as relatively less privileged. This theoretical classification shall be used in Section 3.6 as a benchmark to evaluate the estimated tax effects. Firstly, a model of asset allocation is introduced in the next section.

3.3 Two-Stage Budgeting Model of Asset Allocation

The decision of a household to allocate assets to a portfolio of various available asset types shall be modeled here in a two-stage budgeting model (2SBM) (Deaton and Muellbauer, 1980b, chap. 5), which assumes that there are allocation decisions to be made at two stages.[8] In this section, firstly total assets disposable for allocation are defined, then the allocation is structured into the two stages, and finally asset allocation is embedded in a demand system.

3.3.1 Definition of Total Assets Disposable for Allocation

The basic set up of the model for asset demand is closely related to Taylor and Clements (1983). It is supposed that a utility function for each household exists, that is defined over service flows which in turn can be generated from a number of J assets. Service flows of an asset may involve the return to investment (including price differentials, interest rate payments, or payouts to shareholdings, like dividends), risk-related attributes (e. g. solvency, volatility), transaction-related characteristics (like time of repayment, liquidity), and other asset-specific services (such as living space for owner-occupied housing assets). Let service flows from asset j be denoted by ψ_j. Then household i's utility is a function of J service flows:

$$U_i = U(\psi_1, \ldots, \psi_J) \tag{3.1}$$

where it is assumed that $U(\cdot)$ is strictly concave, twice continuously differentiable, and strictly increasing in ψ_j.

Regarding the budget constraint, it shall be assumed that the household intends to hold a

[8] For a basic portfolio choice model, see Brainard and Tobin (1968). There are several macroeconomic extensions of the Brainard-Tobin model, where asset demand is modeled in a two-stage budgeting model (e. g. Conrad, 1980; Taylor and Clements, 1983). For a similar approach with micro data, see Lang (1998).

certain aggregate stock of assets at the end of period t: K_t. For that purpose, the household can either save the residual of disposable income[9] and consumption, $Y_t - C_t$, or liquidate the stock of asset holdings from period $t-1$: K_{t-1}, or raise loans: L_t. The shift in the capital stock then results from the duality:

$$\begin{aligned} & K_t - K_{t-1} \\ = \; & Y_t - C_t \\ = \; & S_t \\ = \; & A_t^+ + L_t^+ - (A_t^- + L_t^-) \end{aligned} \tag{3.2}$$

where $A_t^+ = \sum_{j=1}^{J_A} A_j^+$ are expenditures for asset accumulations at time t, for $j = 1, \dots, J_A$ assets, $L_t^+ = \sum_{k=1}^{J_K} L_k^+$ are expenditures for loan repayments, for $k = 1, \dots, J_K$ loan types, $A_t^- = \sum_{j=1}^{J_A} A_j^-$ is income from asset liquidations, and $L_t^- = \sum_{k=1}^{J_K} L_k^-$ is income from loans raised. Treating loan repayments as assets, the total number of available assets follows as $J \equiv J_A + J_K$.

It may be optimal for the household to reduce the asset stock in some period t, i. e. to dissave ($K_t < K_{t-1}$). This would result in negative (net) savings ($S_t < 0$). However, the decision of whether to build-up or to reduce the asset stock in a given period t and the decision of how to allocate assets to a portfolio may well be determined by different factors (see the discussion in Section 2.3 of Chapter 2). As the former decision has already been subject to analysis in Chapter 2, the focus in this chapter shall be on the latter decision, and thus the accumulation of K_t is separated from the asset allocation here, and it is assumed that S_t is exogenous. This implies that the allocation of income between durable consumption (except for housing assets), non-durable consumption, and savings (i. e. the consumption-savings decision) is assumed to be separable from the asset allocation decision, as is the labor supply decision.[10] In addition, results from Chapter 2 on the consumption-savings decision will be applied here in order to extend the results. Firstly though, it shall be assumed that, given the level of savings in t, the household allocates savings between various types of assets.

The definition of savings under consideration in this analysis shall be further refined. By the separability assumption, it follows for the decision of how to allocate savings, that the origin of the savings does not matter, and only the *level* of savings is relevant. Thus, for the decision of whether to allocate savings to housing assets or to financial assets, it is not relevant

[9] Disposable income includes labor income and capital income and is net to income taxes and social security contributions. Consumption is non-durable as well as durable, the latter excluding housing assets.

[10] Furthermore, by intertemporal separability, it is assumed here that the asset allocation decision today is not affected by expectations about future asset returns. The assumptions on separability may be very restrictive and only approximately valid. A test for separability suggested by Browning and Meghir (1991) (also see fn. 19) provides evidence here that separability of the asset allocation decision from the consumption-savings decision should be rejected, while separability from the labor supply decision cannot be rejected.

whether the savings stem from current income, from raising a loan, or from liquidating the stock of assets. This is not true however, in case an investment in an asset is liquidated and then immediately reinvested in the same asset class (so called revolving assets).[11] These assets are excluded here from the definition of total assets disposable for allocation:

$$\begin{aligned} A_j &= A_j^+ - min(A_j^+, A_j^-) \qquad \forall\, j = 1, \ldots, J_A \\ L_k &= L_k^+ - min(L_k^+, L_k^-) \qquad \forall\, k = 1, \ldots, J_K \end{aligned} \tag{3.3}$$

As a result of this definition, the focus is effectively on net asset accumulations *censored at zero*, i. e. expenditures for asset purchases reduced by income from asset liquidations. This concept of "gross savings" leads to asset accumulations that are non-negative, so that shares from total asset demand, as they will be defined for the demand system in Section 3.3.3, fall in the interval $[0, 1]$.[12] This savings concept is consistent with the analysis from Chapter 2, where price effects were estimated for the conditional population of households with a positive savings rate. This consistency in the applied savings concepts allows an application of the results for the estimated interest rate elasticity of savings at the first stage from Chapter 2, to the results found in this chapter for the portfolio allocation of savings at the second stage.[13]

The resulting budget, i. e. asset demand at time t (in the following: total disposable assets), follows from:[14]

$$A_t = A \equiv \sum_{j=1}^{J_A} A_j + \sum_{k=1}^{J_K} L_k = \sum_{j=1}^{J} A_j \tag{3.4}$$

For the detailed definition of A_j for the J asset categories, see Appendix 3.10.

It follows that the household solves the following maximization problem in the rationale of structuring asset demand:

$$\max_{\substack{\psi_j \\ j=1,\ldots,J}} \; U_i \;=\; U\left(\psi_1, \ldots, \psi_J\right) \qquad \text{s. t. } A \;=\; \sum_{j=1}^{J} A_j \tag{3.5}$$

This results in the portfolio choice and asset allocation decision for the household that is optimal given the household's preferences for risk, return, and other relevant service flows

[11] This is usually the case with fixed-term deposits or money market investments. Such investments usually have a fixed termination, after which they are often immediately reinvested in the same asset class. In these cases, neither does the household accumulate any assets, nor does the portfolio structure change.

[12] If net accumulations were not left-censored at zero, this could result in negative asset shares, which are not defined. The limitations of restricting the analysis to left-censored accumulations appear to be acceptable.

[13] See also the discussion about assumptions related to demand effects on asset liquidations in Section 4.4 of Chapter 4.

[14] Note that thereby this approach focuses on asset *flows* and models directly asset accumulations, rather than variations in asset stocks as usual in this literature. See Lang (1998) for a similar approach.

mentioned above. From the optimal choice, asset demand equations shall be derived in the framework of a structural demand system. Firstly, the structure of asset allocation with respect to the types of assets available is briefly introduced.

3.3.2 The Structure of Asset Allocation

Given the decision of how many assets to accumulate is taken, the household can generally allocate total disposable assets, A, to two clusters of assets at a first stage (in the following also: the upper stage):[15] housing assets and financial assets.[16] At a second stage (in the following also: the lower stage), expenditures devoted to the clusters are simultaneously allocated to sub-categories, i. e. the asset types, within the clusters. In the housing cluster, expenditures are further allocated to owner-occupied housing assets, to non-owner-occupied housing assets, and to mortgage repayments. Expenditures for financial assets are further allocated to bank deposits (such as savings accounts, fixed deposits, and money market investments), to building society deposits (home-building savings plans), to stocks (including mutual stock funds, certificates, and other shareholdings), to bonds (private and public securities), to capital life and private pension insurances,[17] and to consumer credit repayments.[18] This two-stage structure is displayed in Figure 3.1.

By the two-stage budgeting approach, the sequential decision process, i. e. the decisions of asset allocation at the two stages, can be analyzed separately for the two stages. The argument is similar to the one for non-relevance of the origin of disposable assets mentioned earlier. It results from an assumption of weakly separable preferences for the utility function in this approach. This means, for example, that the decision of how many assets to invest in stocks is only affected by the decision of how to allocate total assets to housing and to financial assets (and in turn to all other sub-categories of financial assets), but not by the decision of how to allocate aggregate housing assets to owner-occupied housing, non-owner-occupied housing,

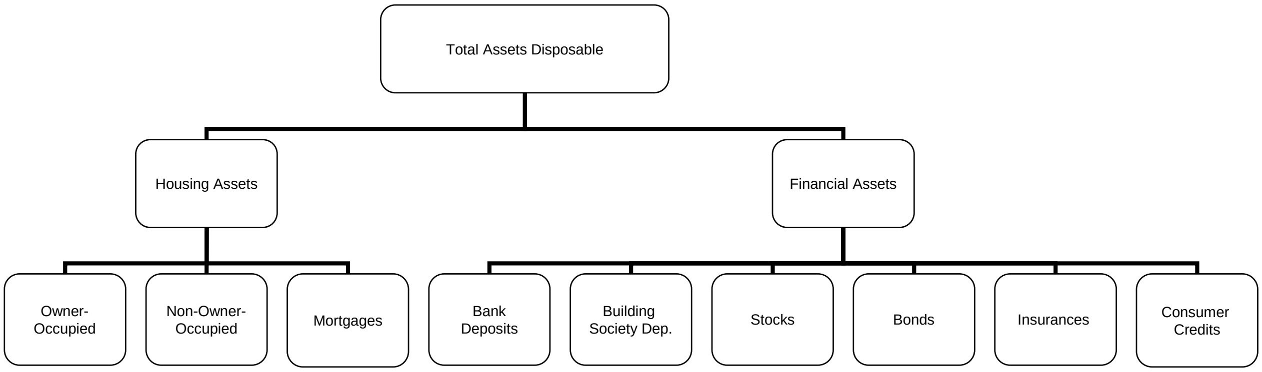
[15] Given the exogeneity of the consumption-savings decision, this allocation of asset accumulations shall be labeled the decision at the *first* (or upper) stage here.

[16] In line with the definition of total disposable assets, expenditures for housing assets are to be understood in gross terms, i. e. including loans raised to buy a house. Reinvestments of business profits are generally excluded from the analysis. They are considered exogenous, as the stock of corporate assets is not observed in the data.

[17] In the data, contributions to private old-age pension insurances are not differentiable into contributions to regular contracts and to such contracts that are subsidized by state allowances in Germany since 2001, such as the "Riester-Rente" or the "Rürup-Rente". Thus, they shall not be further differentiated in this analysis. For approaches of evaluating the "Riester-Rente", see e. g. Börsch-Supan, Reil-Held, and Schunk (2006) or Corneo, Keese, and Schröder (2009).

[18] Mortgage repayments as well as consumer credit repayments exclude the interest component. Generally, similar asset classifications are undertaken in the literature when analyzing asset holdings with the same data, e.g. by Lahl and Westerheide (2003), by Börsch-Supan, Reil-Held, Rodepeter, Schnabel, and Winter (1999), or by Börsch-Supan and Eymann (2002).

Figure 3.1: The Structure of Asset Allocation



and mortgage repayments.[19]

3.3.3 Asset Accumulations in a Structural Demand System

Asset demand shall be modeled in an almost ideal demand system (AIDS) from Deaton and Muellbauer (1980a) allowing for interdependencies between demand for the various types of assets.[20] The AIDS is flexible concerning the factors of influence on the portfolio decision and is applied here in an extended version, which is more flexible regarding budget (or income) effects, the quadratic almost ideal demand system (QUAIDS), where demand is a quadratic function of the log-budget (Banks et al., 1997).

In each cluster, asset shares are defined with respect to the total cluster budget. There are three cluster budgets defined here: total housing assets, total financial assets, and total disposable assets. Thus, the share invested in, for example financial assets, is related to total disposable assets, and the share allocated to bonds is related to total financial assets: $s_{fin} = A_{fin}/A$, and $s_{bonds} = A_{bon}/A_{fin}$. Let s_{ij} denote the share from the respective budget that household i decided to invest in asset j. Demand equations can be derived by Shepard's lemma as first price derivatives of the cost function and assuming PIGLOG preferences for the utility maximization problem in Eq. (3.5). 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

[19] Separability is again tested for here by the test from Browning and Meghir (1991). For this test, the demand equations in each asset cluster are augmented with variables for all asset shares from the respective other cluster, and the shares are tested for significance. Many of the shares are found insignificant here at the lower stage of the 2SBM, providing evidence for separability, while only some shares are found significant. The assumption of separability shall nevertheless be kept up here for estimation purposes regarding the discrete asset choice, see Section 3.4.

[20] Lang (1998) also embeds asset demand in the AIDS framework. Zietz and Weichert (1988) e. g. model asset demand in a complete structural demand system of the AIDS style. For a theoretical argumentation how the consumer commodity demand theory can be applied to asset demand, see Sandmo (1977).

of all asset types available to the household:

$$s_{ij} = \alpha_{0j} + \beta_{1j} \ln(A_{il}/P^*) + \beta_{2j} \ln(A_{il}/P^*)^2 + \sum_{k=1}^{J} \gamma_{jk} \ln(p_{ik}) \qquad (3.6)$$

for households $i = 1, \dots, N$ and assets $j, k = 1, \dots, J$ and clusters $l = 1, \dots, L$. A_{il} is household i's budget for cluster l (which is constant for all assets within cluster l), p_{ik} is the price of asset k for household i, and α_{0j} is an asset-specific constant. β_{1j} and β_{2j} denote parameters of the budget effects and γ_{jk} a parameter of the effects of relative price changes. $\ln(P^*)$ is the translog price index, which can generally be approximated by a linear price index, e. g. by the log-linear Laspeyres index ($\ln(P^*) = \sum_j \bar{s}_j \ln(\bar{p}_j)$), resulting in the linearized QUAIDS.

The demand system in Eq. (3.6) is linear in the budget and the price parameters. It imposes across-equations constraints on the parameters: $\sum_j^J \alpha_{0j} = 1$; $\sum_j^J \beta_{1j} = 0$; $\sum_j^J \beta_{2j} = 0$; $\sum_j^J \gamma_{jk} = 0$. These restrictions imply adding-up of the budget shares to one, $\sum_j^J \widehat{s}_{ij} = 1 \; \forall \, i = 1, ..., N$.[21] While adding-up is fulfilled by definition of the system, other properties of the compensated demand function that make a system consistent with demand theory can be imposed or tested: compensated own-price elasticities shall be non-positive ($\varepsilon^c_{jj} \leq 0 \; \forall \, j = 1, ..., J$), the Slutsky-matrix is symmetric if cross-price effects coincide, $\gamma_{jk} = \gamma_{kj} \; \forall \, j, k = 1, ..., J$, and compensated demand is homogeneous of degree zero in prices if the *within*-equation constraints, $\sum_k^J \gamma_{jk} = 0 \; \forall \, j = 1, ..., J$, hold (see Deaton and Muellbauer, 1980b).

The price for asset j shall generally be modeled as a function of the expected after-tax real rate of return to the asset: $p_{ij} = \left(1 + r^{net}_{ij} - \pi_i\right)^{-1} = \left(1 + r^{gro}_{ij}(1 - t_{ij}) - \pi_i\right)^{-1}$, where r^{gro}_{ij} is the expected pre-tax return to asset j for household i, t_{ij} is household i's marginal tax rate on capital income from asset j, and π_i is the inflation rate relevant for household i. The expected gross return is assumed to equal the actual gross return.[22] Generally, gross returns may vary over asset types and over households. This heterogeneity between households is however not observed, so that gross returns are assumed invariant over households: $r^{gro}_{ij} = r^{gro}_{j}$, $\forall \, j$. Using quarterly data on two cross-sections, there is not much variation in gross returns observed to identify price effects, while controlling for seasonal effects. Thus, the identification strategy here relies on additional variation in the MTR resulting from between-household variation in the structure of taxable income and in the structure of capital income. As a consequence, the price effects are estimated as compound effects of net real returns to assets. This implies the

[21] Adding-up of the predicted shares can however not be tested, given adding-up of observed shares by construction (see Deaton and Muellbauer, 1980a, p. 316).

[22] Alternatively, expectations could be modeled in an autoregressive process here and the one-period-ahead prediction be applied for the expected return. This shall be implemented in future research.

assumption that the relevant returns for the asset allocation decision are net real returns.[23] The log-price of asset j for household i in the demand equations in Eq. (3.6) follows as:

$$\ln(p_{ij}) \;=\; \ln\left((1 + r_j^{gro}(1 - t_{ij}) - \pi_i)^{-1}\right) \tag{3.7}$$

In the linearized QUAIDS, the budget elasticity for demand levels is non-constant in the budget (see Banks et al., 1997):

$$\eta_{ij} \;\equiv\; \frac{\partial A_{ij}}{\partial A_{il}} \frac{A_{il}}{A_{ij}} = 1 \,+\, \left(\beta_{1j} + 2\beta_{2j}\ln(A_{il}/P^*)\right)/s_{ij} \tag{3.8}$$

where A_{ij} is demand for asset j in levels, and A_{il} is the budget of the relevant cluster l. From adding-up, it follows that the weighted budget elasticities sum up to one ($\sum_j^J \bar{s}_{ij}\,\eta_{ij} \;=\; 1$).

The uncompensated price elasticity for demand level of asset j with respect to price of good k can be written as:

$$\varepsilon^u_{ijk} \;\equiv\; \frac{\partial A_{ij}}{\partial p_{jk}} \frac{p_{jk}}{A_{ij}} \;=\; -\delta_{jk} + \gamma_{jk}/s_{ij} - (\beta_{1j} + 2\beta_{2j}\ln(A_{il}/P^*))\;\bar{s}_k/s_{ij} \tag{3.9}$$

where $\bar{s}_k$ is the average share of asset k and δ_{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:

$$\varepsilon^c_{ijk} \;\equiv\; \varepsilon^u_{ijk} + s_{ik}\eta_{ij} \;=\; -\delta_{jk} + \gamma_{jk}/s_{ij} + s_{ik} + (\beta_{1j} + 2\beta_{2j}\ln(A_{il}/P^*))\;(s_{ik} - \bar{s}_k)/s_{ij} \tag{3.10}$$

For the sake of interpretation, also rate-of-return elasticities for the levels will be derived. They follow from the price elasticities as:

$$\varepsilon^{(r)\,u}_{ijk} \;=\; -\varepsilon^u_{ijk}\,\frac{\tilde{r}^{net}_{ij}}{1 + \tilde{r}^{net}_{ij}} \tag{3.11}$$

where $\tilde{r}^{net}_{ij} = r_j^{gro}(1 - t_{ij}) - \pi_i$ is the after-tax real rate of return to asset j. And accordingly, the compensated rate-of-return elasticity for the levels follows as:

$$\varepsilon^{(r)\,c}_{ijk} \;=\; -\varepsilon^c_{ijk}\,\frac{\tilde{r}^{net}_{ij}}{1 + \tilde{r}^{net}_{ij}} \tag{3.12}$$

Estimation results on rate-of-return elasticities will be presented in Section 3.6.1.

[23] Grimes et al. (1994) argue that the specification of the financial portfolio share model that is consistent with the AIDS is a function of the *real* interest rate, as also the budget is denoted in real terms.

3.3.4 A Simplified Model for the Tax Rate

For most of the assets considered here, the actual functional relation between the price of the specific asset and the MTR is not as simple as in the general definition in Eq. (3.7). Various tax-exempt allowances, tax credits, deductible expenses, and subsidizing allowances in the German income tax law make this relation highly complex. This complexity is partly implemented in the functional form of the asset prices when the model is brought to the data. See Section 3.5 for the exact definition of each asset price in the context of the tax schedule. However, as the primary hypothesis to test in this analysis shall be whether households facing a higher MTR allocate a greater fraction of assets to tax-privileged assets than households with a relatively low MTR, the complexity of the asset price function shall be reduced. For this simplified model, which shall be estimated in addition to the structural model in Eq. (3.6), it is assumed that the effects of gross returns are invariant over the assets. It follows for the demand equations in Eq. (3.6), that the log-price for household i is asset invariant: $\ln(p_i) = \ln\left(\frac{1}{1+r(1-t_i)-\pi_i}\right)$. This log-price can be approximated, if $r(1-t_i)-\pi_i$ is assumed to be close to zero, by:[24]

$$\ln(p_i) \approx -\left(r(1-t_i)-\pi_i\right) \tag{3.13}$$

where $r(1-t_i)-\pi_i$ is the net real return to assets for household i. For the aggregate price index, P^*, the average interest rate on domestic bonds for the respective year is applied. The demand equations in Eq. (3.6) then only contain a single asset-invariant price and simplify to:

$$s_{ij} \;=\; \alpha_{0j} \;+\; \beta_{1j}\,\ln(\widetilde{A}_{il}) \;+\; \beta_{2j}\,\ln(\widetilde{A}_{il})^2 \;+\; \gamma_{jj}\,\ln(p_i) \tag{3.14}$$

where the variables and parameters are defined as in Eq. (3.6) and $\ln(p_i)$ is defined in Eq. (3.7) and approximated as in Eq. (3.13). While adding-up still holds for this simplified demand system, homogeneity, as well as symmetry in prices can not be imposed, as cross-price elasticities are not defined for this model with an asset-invariant price.

Estimated tax effects will be interpreted with respect to the asset *shares*. The budget elasticity for the asset shares follows as:

$$\frac{\partial s_{ij}}{\partial A_{il}}\frac{A_{il}}{s_{ij}} = \left(\beta_{1j} + 2\beta_{2j}\ln(A_{il}/P^*)\right)/s_{ij} \tag{3.15}$$

From adding-up, it follows that demand is homogeneous in the *budget* ($\sum_j^J \beta_{1j} = 0$; $\sum_j^J \beta_{2j} = 0$) and that budget elasticities for the shares sum to zero: $\sum_j^J(\beta_{1j} + 2\beta_{2j}\ln(A_{il}/P^*))/s_{ij} \;=\; 0.$

[24]The implied approximation error appears negligibly small for all reasonable values for the interest rate and the inflation rate. In case, for example, $r = 0.05$, $t = 0.3$, and $\pi = 0.02$, the approximation error is $< 10^{-3}$.

The uncompensated own-price elasticity for the share of asset j in this simplified model follows as:

$$\frac{\partial s_{ij}}{\partial p_{ij}} \frac{p_{ij}}{s_{ij}} = \gamma_{jj}/s_{ij} \tag{3.16}$$

Results on estimated uncompensated own-price elasticities will be used in Sections 3.6.2 and 3.6.3 to derive direct and unconditional tax effects. The next section deals with the empirical strategy for the estimation of the tax effects.

3.4 Empirical Strategy

The risk-minimizing strategy from fundamental models of portfolio theory, in the case of risk averse agents, clearly advocates for perfect diversification (Markowitz, 1952; Auerbach and King, 1983). Nevertheless, households are usually observed holding rather incomplete portfolios. Instead of allocating assets to the maximum number of asset types available, their portfolios are often limited to a subset of asset types. Apparently, there are other service flows besides risk-related and return-related ones, like transaction-related characteristics or asset-specific services (see Section 3.3.1), that are relevant in the investor's utility maximization problem of Eq. (3.5).[25]

Given a frequent observation of incomplete portfolios in the data, the decision of asset allocation shall be separated into the decision of whether to buy an asset (the discrete asset choice) and the decision of how much of this asset to demand conditional on buying it at all (the continuous asset choice). The econometric model for estimating these two decisions must consider both, the probability of accumulating an asset, as well as the share of total assets allocated to an asset conditional on accumulating it at all. It must be accounted for, that the demand probability and the conditional demand for an asset are likely to depend on the same observable, and unobservable, characteristics, as well as on the respective demand probabilities and conditional demand for all other assets available. These cross-equation correlations need to be accounted for in the estimation approach.

Estimating such an entire system of equations, considering all possible cross-equation restrictions in full-information maximum likelihood estimation, becomes computationally very challenging already with four assets. Thus, a two-step approach shall be applied here with separate models for the discrete and the continuous choice and with correction for selection at

[25] Various arguments for incomplete portfolios can be found in the literature, for example differential tax treatment altering relative prices of assets (e. g. Feldstein, 1976), fixed or unique transaction costs, monitoring costs (inter alia Perraudin and Sørensen, 2000), and borrowing or liquidity constraints (e. g. Auerbach and King, 1983).

the continuous choice à la Heckman (1979), though applied to multinomial selection.[26] Generally, asset demand shall be divided into the following system of equations for the discrete and the continuous choice, with limited dependent variables of asset shares:

$$s_{ij}^* = x_i' \alpha_j + \epsilon_{ij} \quad (3.17)$$

$$a_{ij}^* = x_i' \delta_j + \nu_{ij} \quad (3.18)$$

$$a_{ij} = \begin{cases} 1 & \text{if } a_{ij}^* > 0 \\ 0 & \text{if } a_{ij}^* \leq 0 \end{cases} \quad (3.19)$$

$$s_{ij} = a_{ij}\, s_{ij}^* \quad (3.20)$$

for households $i = 1, \ldots, N$ and assets $j = 1, \ldots, J$, where a_{ij}^* and s_{ij}^* are the latent propensity to buy asset j and latent demand for asset j, respectively, and a_{ij} and s_{ij} are the corresponding observed variables. ϵ_{ij} is an i. i. d. error term and ν_{ij} an error term with generalized extreme value distribution. x_i is a vector of explanatory variables to be specified later on, and α_j and δ_j are coefficients to be estimated. Eq. (3.19), together with Eq. (3.18), mirrors the discrete asset choice, and Eq. (3.20), together with Eq. (3.17), represents the continuous asset choice. In the first step, the discrete asset choice is estimated taking into account dependencies between the probabilities of buying the various assets in a multinomial setting. In the second step, the conditional demand for the various assets is estimated in a demand system accounting for selection from the discrete choice.

Both the structural model in Eq. (3.6) and the simplified model in Eq. (3.14) are estimated. For the estimation of the simplified model, the two-step selection correction approach is applied. Results on this estimation in Section 3.6.2 show that there are no significant differences found for the effects of the marginal tax rate between a specification correcting for selection and one that omits selection correction. It is thus assumed that selection is negligible for price effects of the structural demand system in Eq. (3.6), and thus selection correction is omitted in the estimation there.[27]

[26] Such a two-step approach is common in the portfolio choice literature, see e. g. Poterba and Samwick (2002), King and Leape (1998), Agell and Edin (1990), or Hubbard (1985), and for earlier work, Uhler and Cragg (1971), Dicks-Mireaux and King (1983), Ioannides (1992), or Perraudin and Sørensen (2000). An alternative approach that accounts for the simultaneity of the discrete and the continuous asset choice would be a multivariate tobit model. Amemiya, Saito, and Shimono (1993) apply a multivariate tobit approach and compare it to a two-step approach. Lang (1998) estimates univariate tobit models. This approach, however, assumes that effects are identical for the discrete and the continuous choice, which is why the two-step approach is preferred here to the multivariate tobit approach. One argument that certainly contradicts this assumption is the presence of fixed transaction costs associated with accumulating an asset for the first time which are relevant at the discrete choice, but not at the continuous choice, once the asset is owned.

[27] Selection is found to only slightly affect the tax rate coefficient in the simplified model for the within-cluster allocation of housing assets, whereas in the financial cluster and at the upper-stage, the tax rate coefficients do not differ significantly between the specification with, and respectively without, selection correction.

3.4.1 The Discrete Asset Choice

In the context of the discrete asset choice, unconditional probabilities of positive demand for each asset $j = 1, \ldots, J$ shall be estimated, which can then be used to generate selection terms, like inverse Mills' ratios, and adjust the continuous choice estimation on the conditional sample. A popular approach in the literature applies reduced-form univariate probit models separately to each selection equation.[28] However, as Shonkwiler and Yen (1999) show, applying inverse Mills' ratios from univariate selection equations to the conditional demand system, results in an inconsistency in the unconditional expectation of the observed demand share.[29]

Thus, all j discrete choices of buying an asset shall rather be estimated simultaneously in a multinomial approach here. For that purpose, portfolios of assets are considered, i. e. mutually exclusive combinations of all available assets. Households pick a specific portfolio and thereby select themselves into buyers and non-buyers of each asset. Generally, for J assets, 2^J regimes come about, including the null portfolio. By the two-stage structure of the 2SBM, the number of combinations stays manageable here. The two asset clusters from the upper-stage decision imply four combinations: portfolio (1 0) stands for housing assets only, (0 1) denotes financial assets only, (0 0) is the null portfolio, and (1 1) represents the portfolio where both assets are accumulated. At the lower stage, combinations are formed within each cluster: there are eight combinations of housing assets, for example (0 1 1) for non-owner-occupied housing assets and mortgage repayments, and 64 combinations of financial assets, for example (0 1 1 0 0 1) for a portfolio of exclusively building society savings, stocks, and consumer credit repayments. This structure implies that each household picks exactly three portfolios in the entire 2SBM, one at the upper stage and one in each of the two clusters at the lower stage.

Each portfolio choice is estimated in a multinomial logit approach (MNL), whereby the discrete choices for each asset *within a cluster* are treated as a simultaneous decision. Demand for stocks, for example, is investigated conditionally on the demand, possibly zero or non-zero, for any combination of all other financial assets.[30] Given the structure of the 2SBM, the three portfolio choices are estimated in two steps, at which the decisions within the clusters can be considered separately by the weak separability assumption. Firstly, within the clusters, there is one MNL estimated among the combinations of housing assets and one MNL among the combinations of financial assets,[31] each of them conditionally on positive demand in the

[28]See e. g. King and Leape (1998), Agell and Edin (1990), Ioannides (1992), or Poterba and Samwick (2002).

[29]Shonkwiler and Yen (1999) relate this procedure to Heien and Wessells (1990), who estimate a demand system in a two-step procedure of a censored regression approach.

[30]Similar approaches have been undertaken by Uhler and Cragg (1971), Arrondel and Masson (1990), Amemiya et al. (1993), and by Perraudin and Sørensen (2000).

[31]For computational reasons, stocks and bonds are aggregated to "equities" for the MNL estimation within the financial cluster. For the generation of selection terms, they are disaggregated again.

respective cluster, so that each MNL is reduced by one alternative (i. e. the null portfolio):[32]

$$U_{j|l} \;=\; x_l' \, \delta_{j|l} + \eta_{j|l} \qquad \forall \, l \in \{hou, fin\} \tag{3.21}$$

Secondly, among the two clusters at the upper stage, one MNL is estimated for the four combinations of housing assets and financial assets.[33]

$$U_j \;=\; x' \, \delta_j \;+\; \eta_j \tag{3.22}$$

The vector of explanatory variables, x_l (respectively x), includes a function of the respective budget (A_{hou}, A_{fin}, or A_{tot}), the household's MTR, the stock of total net wealth in quintiles, variables for household composition, demographics related to the household head (age in groups, education), dummy variables for self-employed heads, for residence in East Germany, and for the year 2003.[34] From the MNLs in Eqs. (3.21) and (3.22), conditional probabilities for the $8+64 = 72$ asset combinations within the clusters, $\widehat{P}_{j|l}$, $l \in \{fin, hou\}$, and unconditional probabilities for the four combinations among the clusters, $\widehat{P}_j$, can be predicted.[35]

These predicted probabilities for the combinations are used to generate a term that will be applied at the continuous asset choice estimation to correct for selection. There are various approaches of selection correction in the framework of multinomial discrete choice estimation applied in the literature, see Maddala (1983, pp. 275-278). Bourguignon, Fournier, and Gurgand (2007) find that the method proposed by Dubin and McFadden (1984) is the one that performs best in simulations, which is why this one shall be applied here.[36] The implied selection term is similar to an inverse Mills' ratio in the style of Heckman (1978). For asset

[32] Let, for the moment, index j denote an asset *combination*. Later on, it will stand for a single asset again.

[33] At the upper stage of the 2SBM, the discrete asset choice is estimated *un*conditionally, including some 10 percent of all households that do not accumulate any assets at all. For these households picking the null portfolio in all choices, zero is imputed for the log of total budget. For further 0.2 percent of the sample with positive total accumulations below 1 euro, the total budget is replaced by 1 euro.

[34] Note that disposable household income is not among the x here, as the consumption-savings decision is considered exogenous. In the MNL, a cluster-specific, but alternative-invariant set of regressors, x_l, implies alternative-specific coefficients given the cluster, $\delta_{j|l}$, see Greene (2003, pp. 725-726), and Cameron and Trivedi (2005, pp. 507-512).

[35] Estimating this nested structure of MNLs in two steps resembles a two-step maximum likelihood estimation (LIML) of a nested logit model (NLM). In the NLM, Eq. (3.22) is additionally augmented with inclusive values from the within-cluster MNLs. This is done in Appendix 3.8 in order to test for the appropriateness of the nested structure applied here. The NLM does not rely on the assumption of independence of the outcomes from irrelevant alternatives (IIA) among the clusters, as opposed to the MNL. The results suggest that the nesting structure is appropriate here. However, for the estimation of unconditional asset demand probabilities at the upper stage, inclusive values are omitted here, as they do not precisely have the interpretation of within-cluster utility for *two* clusters if the MNL at the upper stage has *four* alternatives.

[36] Bourguignon et al. (2007) also find that the performance of the Dubin and McFadden (1984) method depends on the validity of a normalization assumption on the correlations between the errors in the selection and the outcome equation and propose a variation of this approach which does not have this limitation.

combination j in cluster l, it is defined by (see Dubin and McFadden, 1984, pp. 355-356):

$$\lambda_{j|l} = \sum_{k \neq j}^{J_l} \left(\frac{\widehat{P}_{k|l} \, \ln(\widehat{P}_{k|l})}{1 - \widehat{P}_{k|l}} \right) + \ln(\widehat{P}_{j|l}) \tag{3.23}$$

where $\widehat{P}_{k|l}$ is the predicted probability of positive demand for asset combination k in cluster l, conditional on positive demand for cluster l (and respectively it is substituted here by $\widehat{P}_k$ at the upper stage of the 2SBM). Aggregating over all $2^{J_l}/2$ combinations of an asset in cluster l (as e. g. in Amemiya et al., 1993) results in one selection term for each asset, see Appendix 3.8 for an example. This term will be applied to correct for selection due to conditional estimation of the simplified demand system at the continuous asset choice. Conditional marginal demand probabilities for the assets can be derived in a similar manner by aggregating the $\widehat{P}_{j|l}$ over the alternatives for each asset. Together with marginal cluster demand probabilities, *unconditional* demand probabilities for the assets, $\widehat{P}_{jl}$, can be calculated, where the index $j = 1, \ldots, J$ from now on denotes a single asset again. Details are relegated to Appendix 3.8.

3.4.2 The Continuous Asset Choice

In the second step of the estimation, the focus is on the continuous asset choice in Eqs. (3.17) and (3.20), i. e. the decision of which share of the budget to allocate to an asset type, conditional on positive demand for the respective asset cluster. In order to account for cross-equation correlations due to spillover effects of demand for one asset on all other assets, conditional asset demand is estimated in a system of seemingly unrelated regressions (SUR) by feasible generalized least squares (FGLS), see Zellner (1962), correcting for selection into positive cluster demand from the discrete asset choice. For the estimation of the simplified model with selection correction, FGLS estimation in a SUR differs from ordinary least squares (OLS) estimation equation-by-equation, as the selection term differs over the equations *and* the covariance matrix of the errors in the demand system is not diagonal.[37] The demand system estimated for the structural model in Eq. (3.6) omitting selection is specified as follows:

$$s_{ij} = \alpha_{0j} + x_i' \alpha_j + \beta_{1j} \ln(\widetilde{A}_{il}) + \beta_{2j} \ln(\widetilde{A}_{il})^2 + \sum_{k=1}^{J} \gamma_{jk} \ln(p_{ik}) + \epsilon_j \tag{3.24}$$

for households $i = 1, \ldots, N$ and assets $j, k = 1, \ldots, J$ in cluster $l = 1, \ldots, L$.

[37] For the estimation of the *structural* model, where selection is omitted, the FGLS results for the SUR are identical to the OLS equation-by-equation results. Still, FGLS is preferable since it is as least as efficient as OLS if all covariates are exogenous and cross-equation hypotheses on parameters, like symmetry of price effects, can be tested.

s_{ij} is the asset share, $\widetilde{A}_{il}$ denotes household i's assets disposable for allocation in cluster l, $\ln(p_{ik})$ is the log-price of asset k as defined in Eq. (3.7), and ϵ_j is an i. i. d. error term. x_i is a $(K \times 1)$ vector of explanatory variables including the stock of total net wealth in quintiles, variables for household composition, for the age, the education, as well as the social status of the household head in groups, as well as dummy variables for residence in East-Germany, for seasonal effects, and for the year 2003. α_{0j} is an asset-specific constant, and α_j, β_{1j}, β_{2j}, and γ_{jk} are parameter vectors.

However, for the estimation of the simplified model in Eq. (3.14) with selection correction, asset demand is specified as follows:

$$s_{ij} = \alpha_{0j} + x_i' \alpha_j + \beta_{1j} \ln(\widetilde{A}_{il}) + \beta_{2j} \ln(\widetilde{A}_{il})^2 + \gamma_{jj} t_i + \theta_j \lambda_{ij|l} + \epsilon_j \tag{3.25}$$

where, besides the coefficients and variables from Eq. (3.24), t_i is household i's marginal tax rate, λ_{ij} is the selection term defined in Eq. (3.23). γ_{jj} and θ_j are parameter vectors. The household's marginal tax rate, t_i, enters the demand equations linearly by the approximation of the asset price in Eq. (3.13). This implies that the effect of the asset-invariant gross return, r, is swapped into α_{0j}.[38] In order to identify the selection effect, in addition to the non-linear relation between the λ_{ij} and the x_i, education, which is a control in the discrete choice in Eqs. (3.21) and (3.22), is left out in the estimation of the simplified demand equations as an exclusion restriction.[39] Moreover, social status is substituted by a dummy variable for self-employed heads in the estimation of the simplified model.

Conditional asset demand in Eqs. (3.24) and (3.25) is estimated in three separate demand systems: one within each of the two clusters and one among the clusters. As demand is considered conditional, each system is estimated only with observations that report positive cluster demand. By the adding-up restrictions from the QUAIDS demand system, $\sum_j^J s_{ij} = 1$, it follows that only $J - 1$ equations can be estimated in order to obtain non-singularity of the error covariance matrix. The results are invariant to the equation omitted, if the system is estimated by maximum likelihood *and* if the regressors are equal over the equations. The latter is not the case in the estimation of the *simplified* model, where the selection term differs over the equations. In this case, all J equations can however be estimated by iterated FGLS, which converges to the maximum likelihood estimates.

[38] Moreover, interaction effects of the tax rate with other controls were tested. They are not significantly different from zero for most of the controls. Only for the budget, the time dummy, and the self-employed dummy, significant interaction effects were found. Still, none of the interactions are significant in all demand equations. Thus, results for the significant interaction effects are left as a robustness check.

[39] The validity of this exclusion restriction can not be tested, but there is evidence in the literature that education fulfills the necessary conditions here. King and Leape (1998), for example, find evidence that education affects the probability of accumulating an asset, while they find no evidence for a significant effect of education on conditional asset demand.

For the estimation of the *structural* model, adding-up of predicted asset shares is guaranteed by definition of the QUAIDS. These systems are estimated by either imposing the theoretical constraints of homogeneity and symmetry, or by omitting the constraints.[40] In Section 3.6, results from iterated FGLS estimation are presented. Standard errors stem from maximum likelihood estimation and are robust to heteroskedasticity. Asset shares are predicted conditional on positive demand for the asset cluster l ($\widehat{s}_{j|l}$), and the $\widehat{\gamma}_{jj}$ are used to derive direct as well as total tax effects on the conditional, as well as the unconditional, shares.

Another econometric concern is the potential endogeneity of the budget, A_l, in Eqs. (3.24) and (3.25). In a decision to allocate, for example, financial assets between stocks and bonds, the budget for financial assets is itself likely a function of the demand for stocks and bonds. This endogeneity is usually dealt with in the literature by instrumental variables estimation, see Banks et al. (1997), Hochguertel et al. (1997), or Lang (1998), for example. The potentially endogenous budget is commonly instrumented by the respective "pre-stage" budget. That is, total disposable assets at the upper stage of the 2SBM are instrumented with disposable income (or here net savings), and at the lower stage, the housing budget and the financial budget are instrumented with total disposable assets from the upper stage. In the approach applied here, this endogeneity of the budget should already be mitigated by two factors. Firstly, by the selection correction, the decision to allocate financial assets between stocks and bonds is already adjusted for the decision to demand any financial assets at all. Secondly, asset demand is specified in Eqs. (3.24) and (3.25) as asset *shares*, where the budget appears in the denominator of the dependent variable, as opposed to other studies, where (log) asset levels are analyzed. For the estimation of the simplified model, the instrumental variables approach is conducted here on the conditional subsample of positive asset demand, instrumenting the budget with the respective pre-cluster budget and omitting the selection correction from the discrete asset choice. Results are presented in Section 3.6.2 and do not differ much from the main approach, where the budget is not instrumented.

3.4.3 Identification of the Tax Effects

As already mentioned in Section 3.3, the effects of differential income taxation on the structure of asset demand shall be measured by the household's marginal tax rate on income. As the marginal tax rate is not reported in the data, it is simulated in a module for income taxation. In order to identify tax effects in asset demand equations of the form in Eq. (3.14), the marginal

[40]However, as mentioned in Section 3.3.3, for the *simplified* model, homogeneity and symmetry can not be imposed. Rather, constraints on the parameters are imposed: $\sum_j^J \widehat{\beta}_j = 0$, and $\sum_j^J \widehat{\alpha}_{0j} = 1$. These constraints guarantee that adding-up holds approximately for the estimation of the simplified model.

tax rate applied should be exogenous to the asset allocation decision under analysis.[41] Taxable income for each household is thus simulated on the basis of exogenous capital income only and any income from other sources that is assumed exogenous here.[42] Capital income that accrues at the time when the asset allocation decision is taken (and is thus observed) can be assumed exogenous here, as it is related to the *stock* of capital, as well as to asset *sales*, which are themselves considered exogenous, see Section 3.3.1. It is further assumed that endogenous capital income, i. e. income that is related to the decision of asset *accumulations*, is not observed at the time of the decision, as it typically accrues in the future.[43]

Based on the simulated taxable income, a marginal tax rate is derived for each individual, by incrementing taxable income and assuming the increment is fully taxable and is not accompanied by any deductible expenses. Then, the individual marginal tax rates are aggregated to a household marginal tax rate (MTR), where all household members are considered who are old enough to be of influence for the household's allocation decision (see Appendix 3.9 for details). The result is one MTR on income in general for each household, which is assumed relevant for the household's asset allocation decision. See also Appendix 3.9 for details. Table 3.10 in Appendix 3.9 displays some descriptive statistics on the generated MTR.

Although, the MTR on income is asset invariant for the decision of *marginal* asset demand, there results between-household variation in the MTR from differential taxation of *prior* allocation decisions. On the one hand, for a given level of taxable income, the MTR varies with the structure of taxable income with respect to capital income and labor income.[44] On the other hand, for a given level of capital income, the MTR varies with the structure of exogenous capital income with respect to the asset types, as the rules of differential taxation of capital income from the various sources of asset types, is modeled in detail in the income taxation module (see Appendix 3.9). Additional variation in the MTR over time, from the first implementations of a major income tax reform in 2000/2001, is exploited here to identify the tax effects. This variation in the MTR becomes apparent from Table 3.10 in Appendix 3.9 when comparing the mean MTR in the tax brackets and the maximum MTR over all brackets

[41] The marginal tax is a (non-linear) function of taxable income. If taxable income includes capital income, and the latter depends on the asset allocation decision, then the marginal tax rate is in turn a function of the asset allocation decision and is not exogenous in an equation where asset allocation is to be explained.

[42] See Feldstein (1976), Agell and Edin (1990) or Poterba and Samwick (2002) for similar approaches of adjusting taxable income in order to account for potential endogeneity of capital income in portfolio choices.

[43] This assumption appears plausible, given that there usually is a time lag between investments and the flow of returns, *and* that revolving assets are excluded from analysis here.

[44] Since asset demand is modeled here as a function of several socio-demographic characteristics that are also highly correlated with the MTR, as for example the age of the household head and household composition, the identification of the tax effects on asset demand relies on this variation. As a support for the relevance of this variation, in a regression of the MTR on the ratio of capital income to gross household income, controlling for all other variables that are included in the asset demand equations, the coefficient for this ratio is found to be highly significant (t-statistic of 19.7).

for the two years. The income tax tariff was generally shifted downwards. Moreover, the taxation of dividends was changed, tax allowances for owner-occupied housing were adjusted, and the time frames for the tax-exemption of price arbitrage sales were altered. See Chapter 4 for details. In the next section, the data set and descriptive statistics on asset portfolios are presented.

3.5 Data and Household Asset Portfolios

3.5.1 Data

The data applied in this analysis stems 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 variables. The entire population covered by the EVS is restricted, as there are groups that are not covered: institutionalized people (i. e. military people in barracks, 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 for 1998 (18,000 euros for 2003). For the two cross sections applied here, the scientific use files contain 49,720 households for 1998 and 42,420 for 2003. For details on how the data has been manipulated, see Appendix 3.10.

For gross returns to assets, quarterly averages of aggregate monthly consumer price and interest rate data are generally applied. In general, gross returns are reduced by the marginal tax payment in case the respective capital income is taxable for the household. In order to determine whether capital income is taxable for the household, the income taxation module is applied (see Appendix 3.9). The amounts of tax-free allowances granted on financial assets for example, are reduced according to the – by assumption – exogenous stock of asset holdings and reported capital income from these holdings. Gross returns to financial assets are assumed taxable for the household only if the tax-free allowance is already fully exploited, otherwise gross returns are assumed to equal net returns. Net returns are reduced by inflation (measured by differences in the quarterly consumer price indices, differentiated by federal states) to obtain net real rates of return. For details on the proxies for gross returns in case of the various assets, see Appendix 3.10.

3.5.2 Household Asset Portfolios

Asset accumulations in the pooled sample are compiled in Table 3.1. Average probabilities of positive demand as well as average shares, conditional on the population with positive demand in the respective cluster, weighted by population weights and broken down by tax brackets, are presented. In the first column of the upper panel, the average demand probability ($P_j = Pr(a_j > 0)$) over all tax brackets ("Total") is displayed. Almost 90% of the households in the population report positive expenditures for any assets. While about 88% accumulate financial assets, only about 27% demand housing assets. The probability of buying a house for owner-occupational purposes is more than twice as great (6%) as the probability of buying one for rental purposes (3%). About 22% of all households repay mortgage loans. Among financial assets, bank deposits (56%), as well as capital insurances (48%), occur most frequently in portfolios, followed by building society deposits (33%) and consumer credits (26%). Stocks are demanded by some 12% and bonds by less than 2% of the population.

The structure of conditional asset demand ($\bar{s}_{j|l}$), presented in the lower panel of Table 3.1, is dominated by financial assets at the upper stage. Among households with positive expenditures for any assets, the average share of financial assets from total disposable assets (second column) is 87% and of housing assets 13%. In the population with positive demand for housing assets, the average share of mortgage repayments is 77%, the share of owner-occupied housing 17%, and the share of non-owner-occupied housing only 6%. Among the financial assets, the greatest average share is accumulated in bank deposits (48%). The average share of capital insurances is 20%, followed by building society deposits (14%), consumer credit repayments (11%), stocks (6%), and bonds (1%). These are average demand shares ($\bar{s}_{j|l}$), whereas the first column of Table 3.1 displays aggregate demand related to aggregate cluster budget ($\bar{A}_j/\bar{A}_l$). The latter is greater than the former in case the distribution of shares is highly skewed, as it is the case here, for example, for housing assets. Of all housing assets, only 35% are related to mortgage repayments (whereas $\bar{s}_{j|l}$ is 77%), 42% are invested in owner-occupied houses ($\bar{s}_{j|l} = 17\%$), and 23% in rented houses ($\bar{s}_{j|l} = 6\%$). Conditional asset shares are compared to unconditional shares in Table 3.11 in Appendix 3.10.

Breaking down average shares by tax brackets in the following columns of Table 3.1, it becomes apparent that the demand probability is steadily increasing in the MTR for most of the assets, except for building society deposits and consumer credits.[45] The increase is especially great for housing assets in general, where the probability increases from 11% in the lowest tax bracket to over 60% in the highest bracket, for mortgages (from 7% to 55%), and for stocks (from 5% to 36%). For building society deposits as well as for consumer credits,

[45] As the MTR is a non-linear function of income, this reflects a correlation between income and portfolio diversity. Goetzmann and Kumar (2008) find such evidence for diversification of stock portfolios.

Table 3.1: Asset Demand by Marginal Tax Rate

			Tax Brackets							
in percent	Total		0	0-20	20-25	25-30	30-35	35-40	40-45	>45
Demand Probability (P_j)										
Total disposable assets		89.8	79.7	88.0	93.6	94.9	97.0	98.2	98.5	98.7
Housing assets		26.9	11.0	20.0	29.5	33.3	38.0	46.9	52.7	60.9
Financial assets		88.1	77.7	86.5	92.0	93.3	95.7	96.5	96.6	96.7
Housing Assets:										
Own.-occ. housing		6.3	4.3	5.1	7.3	7.4	7.2	8.0	9.7	9.9
Non-own.occ. housing		2.5	1.0	1.8	2.4	2.5	3.1	4.9	7.1	11.9
Mortgage repayments		22.3	6.8	15.8	24.2	28.4	33.7	42.1	47.3	54.6
Financial Assets:										
Bank deposits		55.5	52.1	49.2	55.6	55.7	59.5	64.2	65.6	64.3
Building-society deposits		32.8	16.4	28.5	38.6	43.3	47.8	42.1	36.6	32.2
Stocks		12.4	4.5	8.4	11.5	13.5	19.7	25.5	31.0	35.6
Bonds		1.6	0.9	1.2	1.5	1.6	2.1	3.1	3.5	5.1
Life, prv.-pension insurances		47.9	29.5	47.3	53.8	58.0	60.4	61.6	61.4	64.1
Consumer credit repayments		25.5	13.3	30.0	28.9	31.6	34.6	32.9	32.4	29.2
Conditional Shares ($\bar{s}_{j\|l}$)	$\bar{A}_j/\bar{A}_l$	$\bar{s}_{j\|l}$								
Total disposable assets	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Housing assets	30.2	13.2	7.1	10.3	13.1	15.4	16.8	20.1	21.0	24.7
Financial assets	69.8	86.8	92.9	89.7	86.9	84.6	83.2	79.9	79.0	75.3
Housing Assets:										
Own.-occ. housing	41.9	17.0	35.0	19.4	17.9	15.5	12.2	10.7	10.6	9.3
Non-own.occ. housing	22.7	6.0	7.5	6.3	5.7	4.9	5.1	6.0	7.3	11.0
Mortgage repayments	35.4	77.1	57.5	74.3	76.4	79.5	82.7	83.3	82.1	79.7
Financial Assets:										
Bank deposits	56.4	47.7	57.5	42.6	45.0	42.1	42.5	46.8	48.2	46.7
Building-society deposits	10.6	14.2	11.2	13.4	15.5	17.2	17.1	12.5	10.0	7.4
Stocks	14.5	5.9	3.7	4.3	5.0	5.5	7.4	9.8	12.6	16.8
Bonds	2.4	0.8	0.7	0.5	0.7	0.7	0.8	1.1	1.0	2.3
Life, prv.-pension insurances	9.8	20.1	17.8	22.8	21.9	21.9	19.6	19.5	19.7	20.5
Consumer credit repayments	6.3	11.4	9.1	16.4	11.9	12.6	12.7	10.3	8.5	6.3
Unconditional:										
N (unweighted)	91,904	91,904	21,945	5,959	8,483	22,499	20,736	6,918	2,964	2,400
N (weighted, in 000s)	74,303	74,303	25,478	5,363	7,216	16,486	12,495	3,980	1,688	1,597

Notes: $\bar{A}_j/\bar{A}_l$ is the ratio of aggregate demand to aggregate budget, while $\bar{s}_{j|l}$ is the average demand share. Conditional shares refer to the subpopulation with positive demand in the corresponding asset cluster. Data weighted by population weights.
Reading example: In the population, 26.9% of all households demand any housing assets, 6.3% owner-occupied housing, 2.5% non-owner-occupied housing, and 22.3% mortgage repayments. Among households with demand for any assets, the average share of housing assets is 13.2%. Among households with demand for housing assets, the average share of owner-occupied housing is 17.0%. However, aggregate demand for the latter related to aggregate demand for housing assets is much greater (41.9%).
Source: Own calculations using the EVS data (1998, 2003).

the greatest demand probabilities occur in mid-level brackets. Variation in asset demand by the MTR can also be found in the structure of conditional asset demand. As the average conditional share ($\bar{s}_{j|l}$) of housing assets steadily increases from 7% in the lowest tax bracket to almost 25% in the highest, the share of financial assets decreases accordingly. Among housing assets, owner-occupied housing dominates rented housing (35% compared to 8%) in the lowest bracket, whereas in the highest bracket, this relation is turned around (9% compared to 11%). Mortgage repayments have a greater share in the highest bracket (80%) than in the lowest (58%). Among the financial assets, there is an increasing relevance of stocks and bonds over the tax brackets, while building society deposits and consumer credits are rather hump-shaped with a peak in the mid-level brackets. For bank deposits as well as for capital insurances, there is no clear descriptive pattern apparent, as their conditional shares are relatively constant over the tax brackets. This descriptive variation in asset demand over the tax brackets may though be overlaid by other effects, such as for example age effects, budget effects, or wealth effects. The focus of the next section shall therefore be on the estimation results, where other relevant effects are controlled for.

3.6 Results

Asset demand has been estimated in two models, the structural demand system as specified in Eq. (3.24) and the simplified model as specified in Eq. (3.25). In this section, first of all, results for the structural demand system are presented. Budget and rate-of-return elasticities are derived and interpreted with respect to relative price effects and resulting substitutive and complementary relations between the assets. Then, tax effects from the estimation of the simplified model are presented. Since asset demand is estimated conditional on positive cluster asset demand, the resulting tax effects are to be interpreted on conditional demand (in the following: conditional tax effects), i. e. for a fixed cluster budget. Considering additional tax effects on cluster asset demand, unconditional tax effects are derived (in the following: unconditional tax effects).

3.6.1 Rate-of-Return Effects in the Structural Model

Results for elasticities from the estimation of the structural demand system in the share equations, Eq. (3.24), are compiled in Appendix 3.11 in Table 3.12 for the upper stage and in Tables 3.13 and 3.14 for the lower stage. Conditional budget and rate-of-return elasticities are presented for both, the unconstrained estimation of the three demand systems, and the respective constrained estimation, where in all systems the estimation is constrained simultaneously for homogeneity and symmetry. As Tables 3.12 - 3.14 reveal, the unconditional budget elasticity is estimated significantly different from one at the 1%-level for all assets. It is significantly greater than one for housing assets in general, as well as owner-occupied housing, non-owner-occupied housing, bank deposits, stocks, and bonds, indicating that these assets are found to be luxuries. In turn, financial assets in general, mortgages, building-society deposits, insurances, and consumer credits are found to be necessities.

For all three demand systems, the theoretical constraints of homogeneity and symmetry must be rejected.[46] As Table 3.6 in Appendix 3.8 shows, homogeneity is rejected at the 10%-level for five of all eight equations at the two stages, though only for three equations at the 5%-level. In simultaneous tests for all equations of a system, homogeneity is rejected at the 10%-level for the housing cluster ($\chi^2_2 = 5.2$), at the 5%-level for the first-stage ($\chi^2_1 = 6.0$), and at the 1%-level for the financial cluster ($\chi^2_5 = 20.2$). Symmetry is rejected at the 5%-level for nine of the eleven constraints taking all systems together. It is also clearly rejected in simultaneous tests for all ten constraints in the financial system ($\chi^2_{10} = 405.3$). Thus, the results from the unconstrained estimation shall be applied here in the following to derive elasticities. Detailed results from the unconstrained demand system estimations are given in Appendix 3.11, in Table 3.15 for the upper stage, and in Tables 3.16 as well as 3.17 for the lower stage.

At the upper stage of the 2SBM, the allocation decision is conditioned on positive demand for total disposable assets. Thus, additional price and budget effects from the consumption-savings decision on the asset allocation decision shall be considered. If a general interest-rate increase induces households to shift current income from consumption to savings, then additional assets are disposable for allocation to financial and housing assets. These effects are estimated in Chapter 2 for the budget elasticity of savings (with respect to current income) to $\eta_{sav} = 1.84$, for the uncompensated interest rate elasticity of savings to $\varepsilon^{(r)u}_{sav} = 0.11$, and for the respective compensated elasticity to $\varepsilon^{(r)c}_{sav} = 0.55$.[47]

The resulting unconditional elasticities for asset demand levels considering the effects from the consumption-savings decision, together with the effects from the two-stage structure of the 2SBM, can be derived following Edgerton (1997) and Carpentier and Guyomard (2001), omitting household indices for simplicity here. The unconditional budget elasticity for asset j in cluster l corresponds to:

$$\eta_j \; = \; \eta_{j|l} \cdot \eta_l \cdot \eta_{sav} \tag{3.26}$$

The respective unconditional uncompensated rate-of-return elasticity for asset j in cluster l

[46] Homogeneity and symmetry are frequently rejected in the empirical literature on financial AIDS portfolio models. See for example Taylor and Clements (1983); Zietz and Weichert (1988); Barr and Cuthbertson (1991). In this literature, theoretically inconsistent parameters are often constrained to zero in order to approach homogeneity. This approach shall be targeted in further research here. See also the discussion about the negative estimate for the own-rate elasticity of stocks in Section 4.4 of Chapter 4.

[47] In Chapter 2, $\varepsilon^{(r)u}_{sav}$ and $\varepsilon^{(r)c}_{sav}$ are actually the estimated elasticities with respect to a change in the savings *price*. In this intertemporal consumption decision, a long-term interest rate effect affects all future periods through the discount factor. If the effect is assumed to last approximately $(1 + r)/r$ periods (≈ 50, for $r = 0.02$), the interest rate elasticity of savings is approximately equal to the price elasticity of savings, with signs reversed.

can be derived from:

$$\varepsilon_{jk}^{(r)u} \;=\; \delta_{lm}\,\varepsilon_{jk|l}^{(r)\,u} \;+\; \eta_{j|l}\,\bar{s}_{k|m}\left(\delta_{lm}+\varepsilon_{lm}^{(r)\,u}\right) \;+\; \eta_j\,\bar{s}_k\left(1+\varepsilon_{sav}^{(r)\,u}\right) \tag{3.27}$$

where δ_{lm} is the Kronecker delta, which is equal to one for identical clusters, $l = m$, and zero otherwise, $\varepsilon_{jk|l}^{(r)u}$ is the uncompensated elasticity for asset j conditional on cluster l with respect to the rate of return to asset k, $\eta_{j|l}$ is the conditional budget elasticity for asset j in cluster l, $\bar{s}_{k|m} = E[s_k \,|\, a_m > 0]$ is the mean conditional budget share of asset k in cluster m, $\varepsilon_{lm}^{(r)u}$ is the uncompensated elasticity of cluster l assets with respect to the rate of return to cluster m, η_j is defined in Eq. (3.26), $\bar{s}_k$ is the mean unconditional share of asset k from total assets, and $\varepsilon_{sav}^{(r)\,u}$ is the uncompensated interest rate elasticity of savings. The respective compensated rate-of-return elasticity for asset j in cluster l follows from:

$$\varepsilon_{jk}^{(r)c} \;=\; \delta_{lm}\,\varepsilon_{jk|l}^{(r)c} \;+\; \eta_{j|l}\,\bar{s}_{k|m}\,\varepsilon_{lm}^{(r)c} \;+\; \eta_{j|l}\,\eta_l\,\bar{s}_k\,\varepsilon_{sav}^{(r)\,c} \tag{3.28}$$

where $\varepsilon_{jk|l}^{(r)c}$ and $\varepsilon_{lm}^{(r)c}$ are the respective conditional compensated rate-of-return elasticities of asset j and cluster asset l and $\varepsilon_{sav}^{(r)\,c}$ is the compensated interest rate elasticity of savings. Conditional budget and rate-of-return elasticities are defined for the asset levels in the QUAIDS in Eqs. (3.8), (3.11), and (3.12).

Table 3.2 compiles the results for the unconditional budget and rate-of-return elasticities from the unconstrained demand system estimations of Eq. (3.24). The first panel of Table 3.2 presents the estimated unconditional budget elasticities for all assets, the second panel shows unconditional uncompensated rate-of-return elasticities, and the third panel displays the respective compensated rate-of-return elasticities. The unconditional budget elasticity turns out to be significantly different from one at the 1%-level for all assets, as a consequence of the significant estimates for the respective conditional elasticities. The unconditional budget elasticities result from an income elasticity for savings of 1.84 in conjunction with a budget elasticity for housing assets of 1.20 and for financial assets of 0.96, according to Eq. (3.26).

It can also be seen that demand for almost all assets is theoretically consistent concerning non-positive compensated own-price elasticities, as this restriction translates into non-negative rate-of-return elasticities. Demand increases for almost all assets if the own rate increases. Only for bonds, the compensated own-rate elasticity is not significantly different from zero, and for stocks it is slightly negative. Furthermore, demand is elastic with respect to the own rate for owner-occupied housing ($\widehat{\varepsilon}_{jj}^{(r)u}$=1.13), non-owner-occupied housing (1.20), mortgages (1.40), bank deposits (1.18), and insurances (1.27). This results from an uncompensated own-rate elasticity for housing assets of 0.56 and a relatively smaller own-rate elasticity for financial assets of 0.09 (Table 3.12). Demand is inelastic with respect to own rates for building society savings (0.38), stocks (-0.16), bonds (-0.57), and consumer credits (0.80).

Table 3.2: Rate-of-Return and Budget Elasticities on Unconditional Asset Demand Levels (from the Unconstrained Estimation)

on Levels		Owner	Non-O.	Mortg.	Bank D.	Building	Stocks	Bonds	Insur.	Credits
Budg. El. ($\widehat{\eta}_j$) [a]		2.716	3.077	2.037	2.294	1.320	2.639	3.341	0.784	1.453
		(0.146)***	(0.167)***	(0.109)***	(0.122)***	(0.071)***	(0.141)***	(0.184)***	(0.042)***	(0.078)***
Uncompens.	Own-Rate ($\widehat{\varepsilon}_{jj}^{(r)}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}_{jk}^{(r)}$)								
Owner Occ.	1.130	.	−0.244	1.480	−0.181	−0.067	−0.028	−0.004	−0.088	−0.045
	(0.096)***	.	(0.219)	(0.082)***	(0.150)	(0.045)	(0.021)	(0.003)	(0.059)	(0.034)
Non-Owner	1.201	0.690	.	1.155	−0.206	−0.076	−0.032	−0.004	−0.100	−0.050
	(0.380)***	(0.165)***	.	(0.112)***	(0.170)	(0.050)	(0.024)	(0.003)	(0.067)	(0.038)
Mortgages	1.397	0.085	0.092	.	−0.136	−0.050	−0.021	−0.003	−0.066	−0.033
	(0.051)***	(0.023)***	(0.046)**	.	(0.112)	(0.033)	(0.016)	(0.002)	(0.044)	(0.025)
Bank Deposits	1.180	−0.018	−0.007	−0.097	.	0.367	0.427	0.596	0.151	0.194
	(0.126)***	(0.010)*	(0.004)*	(0.040)**	.	(0.038)***	(0.028)***	(0.055)***	(0.050)***	(0.029)***
Build. S. Dep.	0.382	−0.010	−0.004	−0.056	0.655	.	0.186	0.175	0.051	0.106
	(0.024)***	(0.006)*	(0.002)**	(0.023)**	(0.073)***	.	(0.044)***	(0.111)	(0.032)	(0.017)***
Stocks	−0.155	−0.021	−0.008	−0.112	1.476	0.409	.	−0.712	0.309	0.203
	(0.077)**	(0.011)*	(0.004)**	(0.047)**	(0.146)***	(0.047)***	.	(0.195)***	(0.063)***	(0.034)***
Bonds	−0.573	−0.026	−0.010	−0.141	1.797	0.604	−0.323	.	0.485	0.223
	(0.581)	(0.014)*	(0.005)**	(0.059)**	(0.190)***	(0.077)***	(0.224)	.	(0.105)***	(0.049)***
Insurances	1.267	−0.006	−0.002	−0.033	0.418	0.089	−0.338	−0.728	.	0.039
	(0.020)***	(0.003)**	(0.001)**	(0.014)**	(0.044)***	(0.015)***	(0.033)***	(0.084)***	.	(0.010)***
Credits	0.798	−0.011	−0.004	−0.062	0.740	0.195	−0.020	−0.672	0.280	.
	(0.019)***	(0.006)*	(0.002)**	(0.026)**	(0.081)***	(0.027)***	(0.053)	(0.134)***	(0.036)***	.
Compensat.	Own-Rate ($\widehat{\varepsilon}_{jj}^{(r)}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}_{jk}^{(r)}$)								
Owner Occ.	0.965	.	−0.326	0.394	0.060	0.004	0.006	0.001	0.006	0.010
	(0.096)***	.	(0.219)	(0.081)***	(0.150)	(0.045)	(0.021)	(0.003)	(0.059)	(0.034)
Non-Owner	1.182	0.445	.	−0.076	0.068	0.004	0.007	0.001	0.006	0.011
	(0.380)***	(0.165)***	.	(0.110)	(0.170)	(0.050)	(0.024)	(0.003)	(0.067)	(0.038)
Mortgages	0.583	−0.077	0.104	.	0.045	0.003	0.005	0.001	0.004	0.007
	(0.051)***	(0.023)***	(0.046)**	.	(0.112)	(0.033)	(0.016)	(0.002)	(0.044)	(0.025)
Bank Deposits	0.323	−0.003	−0.001	−0.037	.	0.071	0.292	0.578	−0.300	−0.042
	(0.126)**	(0.010)	(0.004)	(0.040)	.	(0.038)*	(0.028)***	(0.055)***	(0.050)***	(0.029)
Build. S. Dep.	0.266	−0.002	−0.001	−0.021	0.159	.	0.109	0.165	−0.208	−0.030
	(0.024)***	(0.006)	(0.002)	(0.023)	(0.073)**	.	(0.044)**	(0.111)	(0.032)***	(0.017)*
Stocks	−0.231	−0.003	−0.001	−0.043	0.484	0.067	.	−0.731	−0.210	−0.069
	(0.077)***	(0.011)	(0.004)	(0.047)	(0.146)***	(0.047)	.	(0.195)***	(0.063)***	(0.034)**
Bonds	−0.560	−0.004	−0.002	−0.054	0.542	0.173	−0.519	.	−0.171	−0.121
	(0.581)	(0.014)	(0.005)	(0.059)	(0.189)***	(0.076)**	(0.224)**	.	(0.105)	(0.048)**
Insurances	1.165	−0.001	−0.000	−0.013	0.124	−0.013	−0.384	−0.734	.	−0.041
	(0.020)***	(0.003)	(0.001)	(0.014)	(0.044)***	(0.015)	(0.033)***	(0.084)***	.	(0.010)***
Credits	0.676	−0.002	−0.001	−0.024	0.194	0.007	−0.105	−0.683	−0.005	.
	(0.019)***	(0.006)	(0.002)	(0.026)	(0.081)**	(0.027)	(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. $\widehat{\eta}_j$ is the unconditional budget elasticity on asset levels, $\widehat{\varepsilon}_{jj}^{(r)}$ is the unconditional own-rate elasticity of asset j on asset levels. $\widehat{\varepsilon}_{jk}^{(r)}$ is the respective unconditional cross-rate elasticity.
[a]: Null hypothesis for the budget elasticities is $\widehat{\eta}_j = 1$.
Source: Own calculations using the EVS data (1998, 2003).

From the cross-rate elasticities, it can be seen that, on the one hand, most of the assets are found to be substitutes, as negative uncompensated cross-rate elasticities in the second panel of Table 3.2 indicate, though not all of them are significantly smaller than zero. On the other hand, there are also complementary relations found between some assets. In addition, as symmetry is rejected for most of the relations, effects are ambiguous in some cases. Generally, it appears that cross-rate effects are significantly different from zero in the financial asset equations, whereas most of them do not differ significantly from zero in the housing asset equations. Only the rates for owner-occupied housing and mortgages are relevant in all demand equations. Some relatively greater effects shall be interpreted in the following. Most of the other substitutive and complementary effects are found to be economically small.

If the net rate of return to owner-occupied housing increases by 1%-point, from an average of r_{own}^{net}=0.064 to 0.074, households increase unconditional demand for these assets on average by 18%, from a monthly average of 123 euros to 145 euros, and they increase unconditional demand for non-owner-occupied housing assets by 11% from 67 euros to 74 euros, as well as for mortgages by only 1%, from 104 euros to 105 euros. These effects are not symmetric, however. If the interest rate on mortgages increases by 1%-point, from an average of r_{mor}^{net}=0.046 to 0.056, unconditional demand increases elastically for owner-occupied housing by 32%, from 123 euros to 162 euros, and for non-owner-occupied housing by 25%, from 67 euros to 84 euros. Also demand for mortgages increases elastically by 30%, from 104 euros to 135 euros, in turn of a 1%-point increase in the own rate. These findings indicate a complementary relation between housing assets and mortgages. If the returns to housing assets increase, households take up more mortgages and start repaying them, or they speed up the repayment of mortgage holdings. In turn, they reduce demand for all financial assets. If the interest rate on mortgages increases by 1%-point, demand for stocks, for example, is reduced by 2%, from 99 euros to 97 euros, and for bonds by 3%, from 17 euros to 16 euros.

The rate of return to bank deposits only affects other *financial* assets significantly. Complementary relations are found with all other financial assets, while the substitutive relations to housing assets are not significant. If the interest rate on bank deposits increases by 0.5%-points, from an average of r_{dep}^{net}=0.015 to 0.020, demand for building society savings is increased by 22%, from 72 euros to 88 euros, demand for stocks is increased by 49%, from 99 euros to 148 euros, and demand for bonds is increased by 60%, from 17 euros to 27 euros. Substitutive effects between financial assets are found, for example, for bonds with stocks, for bonds with insurances, and for bonds with consumer credits. If the return to bonds increases by 1%-point, from an average of r_{bon}^{net}=0.050 to 0.060, demand for stocks is reduced by 14%, from 99 euros to 85 euros, demand for insurances is reduced by 15%, from 67 euros to 57 euros, and demand for consumer credits is reduced by 13%, from 43 euros to 37 euros.

The elasticities found here for *conditional* demand are comparable to budget and rate-of-return elasticities found in the literature. Zietz and Weichert (1988) estimate similar budget elasticities for bonds (2.00) and bank deposits (between 0.76 and 1.00, where the former relates to savings deposits and the latter to fixed deposits) compared to conditional elasticities found here (see Table 3.14 in Appendix 3.11). Uncompensated own-rate elasticities are estimated to between 0.54 and 2.89 for bank deposits, which is greater than found here, and not significantly different from zero for bonds, which is found here too. Most of the relative price effects are also found not significantly different from zero.

Taylor and Clements (1983) estimate budget elasticities for bank deposits at between 0.50 and 1.09 (where the former is for savings bank deposits and the latter for fixed deposits), for building society deposits at between 2.80 and 2.98 (depending on the specification), and for bonds at between 0.28 and 0.39. Uncompensated own-rate elasticities are estimated for bank deposits at between -0.17 and 1.09, for building society deposits at between 0.47 and 0.66, and for bonds at between 0.40 and 0.69.

3.6.2 Conditional Tax Effects

In the following, the focus shall be on the estimated tax effects from the estimation of the simplified model in Eq. (3.25). In this model, the complexity of the asset price function was reduced to the MTR, so that the hypothesis, whether households facing a higher MTR allocate a greater fraction of assets to tax-privileged assets than households with a lower MTR, can be tested. The conditional tax effects discussed in the following imply the effect of a shift in the MTR on the expected *conditional* asset demand share, where the condition is on a positive respective budget. Table 3.3 shows estimated conditional tax effects for various specifications. Marginal effects of a 10%-points increase in the MTR from the respective conditional mean[48] on conditional asset demand shares ($s_{j|l}$) are presented. Detailed results from the estimations of the continuous asset choice from the simplified model are given in Appendix 3.11, in Table 3.21 for the upper stage, and in Tables 3.22 as well as 3.23 for the lower stage. The estimation results for the demand probabilities from the discrete asset choice can be found in Tables 3.18, 3.19, and 3.20 in Appendix 3.11.

The focus here shall firstly be on the main approach, "SUR + Selection" in the "pooled" version in Table 3.3. For this specification, the estimated conditional tax effects are statistically highly significant, though economically most of them are not very large. While the effects are significant at the 0.1%-level for almost all assets, the size of a 10%-points increase in the MTR ranges in absolute terms from 0 to less than 5%-points shifts in the conditional asset shares

[48]The unweighted (conditional) mean MTR corresponds to: 22.4% (weighted 18.6%) in the unconditional sample, 23.3% (19.9%) at the upper stage, 28.1% (26.1%) in the housing cluster, and 23.4% (19.9%) in the financial cluster.

Table 3.3: Conditional Tax Effects on Conditional Asset Demand Shares

in %-points		**+ 10 %-points in MTR**						
		SUR	SUR+IV	SUR+Selection				
	$\bar{s}_{j\|l}$			pooled	1998	Δ_{03-98}	Δ_{East}	Δ_{Self}
Housing Assets	16.7	+0.3**	+3.5***	+0.3***	−0.1	+1.1***	−0.8***	+1.2***
Financial Assets	83.3	−0.3**	−3.5***	−0.3***	+0.1	−1.1***	+0.8***	−1.2***
Housing Assets:								
Owner-Occupied	15.3	−4.0***	−4.5***	−4.1***	−4.2***	+0.4	+0.2	+1.0*
Non-Owner-Occupied	5.7	+0.5***	+0.2	+0.4***	+0.4**	+0.0	−0.1	−0.9*
Mortgages	79.0	+3.5***	+4.3***	+3.7***	+3.8***	−0.4	−0.0	−0.1
Financial Assets:								
Bank Deposits	45.0	−3.4***	−2.7***	−3.4***	−3.3***	−0.3	−0.2	+0.4
Building-Society Dep.	15.7	+0.5***	+0.2	+0.5***	+0.5***	−0.1	+0.4	−1.5***
Stocks	6.8	+0.2‡	+0.0	+0.2‡	−0.0	+0.4**	+0.4*	−0.2
Bonds	0.9	−0.1*	−0.1***	−0.1*	−0.0*	−0.0	−0.0	−0.0
Insurances	20.8	+2.0***	+1.8***	+2.0***	+2.2***	−0.3	−0.2	+0.9*
Consumer Credits	10.8	+0.8***	+0.8***	+0.8***	+0.6***	+0.3	−0.3	+0.4

Notes: Significance levels: ‡ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, based on heteroskedasticity-robust standard errors from the SUR system estimations, see Tables 3.21 - 3.23 in Appendix 3.11. $\bar{s}_{j|l}$ is the mean unweighted share of asset j, conditional on a positive budget. Δ_{East} is the difference in tax effects in East-Germany compared to West-Germany, Δ_{Self} is the respective difference for the self-employed compared to others. Conditional tax effects are evaluated for a 10%-points increase in the MTR from the conditional mean MTR of 23.3% at the upper stage, 28.1% in the housing cluster, and 23.4% in the financial cluster.

Reading example: In the main approach, "SUR + Selection" in the "pooled" version, a 10%-points increase in the MTR from a conditional mean of 23.3% increases the share of total disposable assets allocated to housing assets, conditional on positive demand for total assets, by 0.3%-points. Conditional on positive demand for housing assets, the share of which is allocated to mortgages increases by 3.7%-points in turn of a 10%-points increase in the MTR from a conditional mean of 28.1%. When the "SUR + Selection" approach is estimated separately for the two cross-sections, the direct tax effect on housing assets is -0.1%-points for 1998, and it is 1.1%-points greater for 2003 than for 1998. This difference is significant at the 0.1%-level.

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

only.[49] The strongest effects are found for mortgages (+3.7%-points) and owner-occupied housing (-4.1%-points).

Most of the estimated conditional tax effects, however, point in the directions that one would expect given the theoretical asset classification into relatively more tax-privileged assets, less tax-privileged assets, and non-privileged assets (see Section 3.2). Among financial assets, there is a relatively strong negative tax effect on bank deposits, which are classified as non-privileged, and a relatively strong positive tax effect on insurances, which are classified as relatively more tax privileged. A 10%-points increase in the MTR from a conditional mean of

[49] Eicker-Huber-White heteroskedasticity-robust standard errors are generated from maximum likelihood estimation, see Tables 3.21 - 3.23 in Appendix 3.11. They can be regarded as a lower limit, as they are not adjusted for the fact that the discrete and the continuous choice have been estimated in two steps.

23.4% decreases the conditional share of bank deposits by 3.4%-points and raises the conditional share of insurances by 2.0%-points, from a mean conditional unweighted share ($\bar{s}_{j|l}$) for bank deposits of 45.0% and for insurances of 20.8%. There are moreover significantly positive conditional tax effects found on building society deposits, on stocks, and on consumer credit repayments, and significantly negative effects on bonds, but all these effects are relatively small.

The strongest conditional tax effects are estimated for the conditional allocation of housing assets to owner-occupied housing, non-owner-occupied housing, and mortgage repayments. A 10%-points increase in the MTR, from a conditional mean of 28.1%, shifts a share of 4.1%-points from owner-occupied housing assets ($\bar{s}_{j|l}$ = 15.3%) to non-owner-occupied housing assets (+0.4%-points from $\bar{s}_{j|l}$ = 5.7%) and to repayments of mortgage loans (+3.7%-points from $\bar{s}_{j|l}$ = 79.0%), for fixed housing assets.[50] These effects point in the expected directions, given the classification of owner-occupied housing assets as relatively less tax-privileged and the other two housing assets as more privileged. By the time of 1998 and 2003, tax allowances on owner-occupied housing were capped by income limitations, while expenses that are related to income from renting and leasing, for example operating and maintenance costs, as well as interest payments on mortgages for non-owner-occupied housing, could be deducted also by the high-income households.

The simplified demand systems have been re-estimated by instrumenting the potentially endogenous budget with its respective pre-cluster budget (specification "SUR + IV" in Table 3.3), while neglecting selection correction, based on observations with a positive budget only. As instruments for the upper stage, total assets, net savings, and the employment status of the household head are applied.[51] The results vary slightly from the main approach. Effects are stronger for bank deposits, owner-occupied housing, and mortgages. Furthermore, at the upper stage, the effects are much stronger. However, it shall be noted that net savings can be doubted as a good instrument for total assets, and thus, the "SUR + IV" results should be interpreted with caution, which is why, in the main approach, the budget is not instrumented.

As robustness checks for the main approach, other specifications have been estimated, which largely confirm the main results. The simplified demand systems have been re-estimated without any selection correction (specification "SUR" in Table 3.3). As far as the tax effects are concerned, selection appears to be relevant only in the housing cluster, where the effects differ slightly, whereas for financial assets, there is no evidence for selection effects, as the tax effects do not differ significantly between the "SUR" and the "SUR+Selection" specifications.[52]

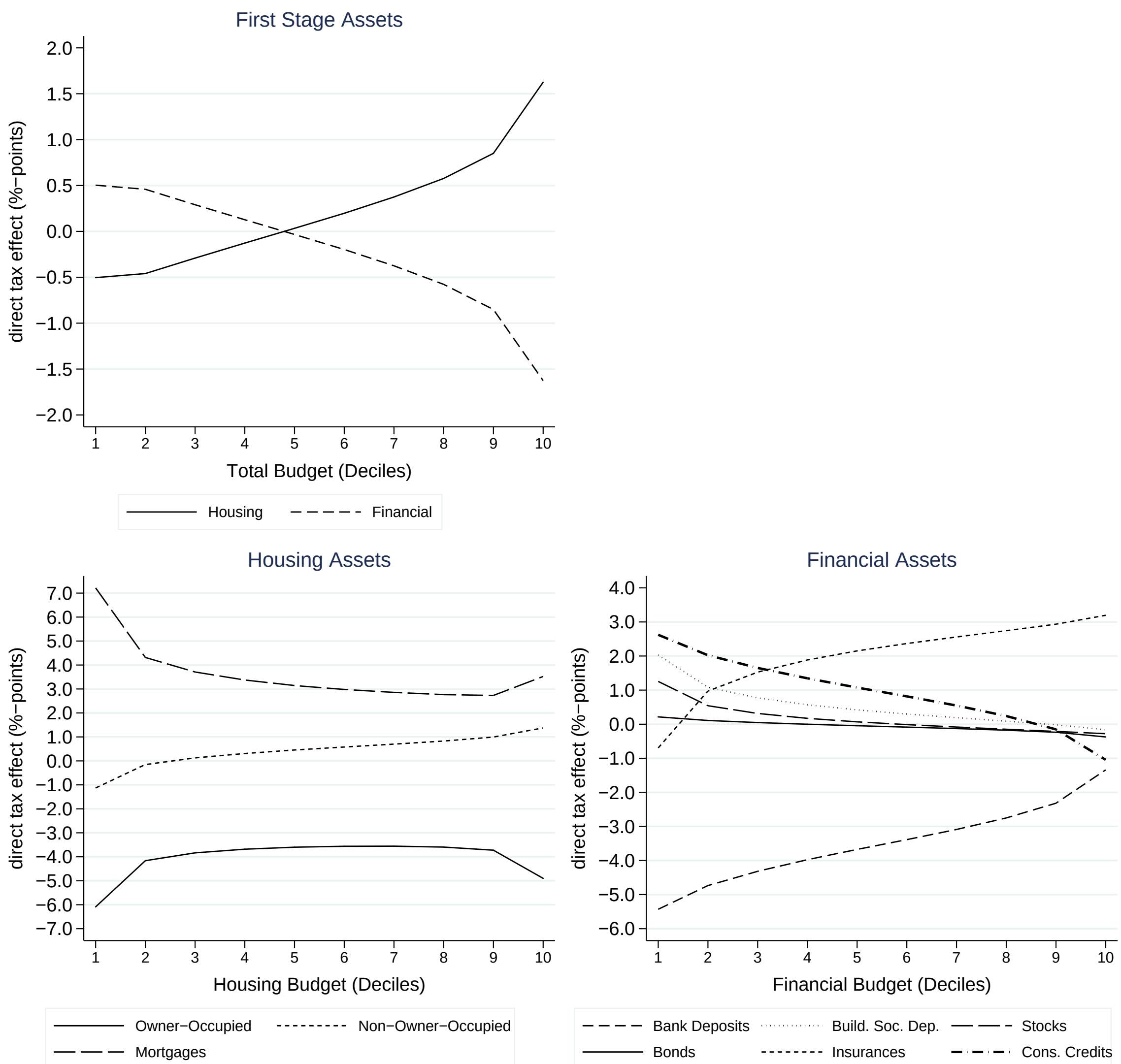
[50]Note that, as imposed by the demand model, the estimated tax effects sum to zero for each system.

[51]Net savings include asset sales that are assumed exogenous to asset demand. The labor supply decision is also assumed exogenous here, given that the test for separability could not be rejected, see fn. 10.

[52]This result appears plausible, as at the upper stage, only some 10% of all households select themselves

Estimating the demand systems separately for 1998 and 2003 reveals that the conditional tax effects only differ significantly at the upper stage between the years. In 2003, there is a stronger conditional tax effect on housing assets (+1.1%-points more than in 1998) and financial assets (-1.1%-points accordingly). For all other assets, the effects do not differ between 1998 and 2003, except slightly for stocks.

Figure 3.2: Conditional Tax Effects by Budget (on Conditional Share)



Notes: Direct tax effects of a 10%−points increase in the MTR − at the mean MTR of 18.6% − on the conditional asset share.
Source: Own calculations using the EVS data (1998,2003).

The only significant differences in the tax effects between East- and West-Germany ("SUR + Selection") can be found at the upper stage and for stocks. In East-Germany, the effects are lower for housing assets (0.8%-points lower) and greater for financial assets (0.8%-points

into demand for no assets, and only slightly more into no demand for financial assets, while almost 3/4 of all households do not demand any housing assets.

greater) than in West-Germany. Effectively, the results are actually reversed here for these two asset clusters. Tax effects are moreover slightly greater in East-Germany on stocks. For all other assets, there are no differences in the tax effects between the East and the West. Separate models have also been estimated for households with a self-employed head, allowing for different reactions to tax incentives compared to other households due to the presence of business assets, which are not modeled explicitly as an asset in this analysis. Conditional tax effects for the self-employed are a little more pronounced for asset demand at the upper stage, and the self-employed are found to shift an additional 1.5%-points from building society deposits to insurance assets and to consumer credits, compared to other households.[53]

In yet another specification, the estimated demand equations were augmented with interaction effects of the MTR with the log-budget and the log-budget squared, in order to allow tax effects to vary with the level of total disposable assets. Figure 3.2 plots estimated conditional tax effects over the distribution of the respective budget. At the upper stage, tax effects on demand for housing assets are negative for lower deciles, zero for the median, and positive for the higher deciles; accordingly, tax effects on financial assets decrease in the budget. In the housing cluster, conditional tax effects vary with housing budget for the 1st and the 10th decile. These households face stronger tax effects for owner-occupied housing and for mortgages. Furthermore, tax effects on non-owner-occupied housing, as well as on insurances, are negative for the 1st decile and then steadily increase in the respective budget. For bank deposits, tax effects steadily rise from -5.5% in the lowest decile to -1.5% in the highest. For all other financial assets, tax effects continuously decrease in the budget.

3.6.3 Unconditional Tax Effects

Unconditional tax effects result if the conditional tax effects discussed so far are adjusted for additional effects on the cluster budget through the two-stage structure of the 2SBM. Following Edgerton (1997) and Carpentier and Guyomard (2001), Eq. (3.27) can be applied to derive the unconditional uncompensated own-price elasticity for asset j in cluster l as:

$$\varepsilon_j = \varepsilon_{j|l} + \eta_{j|l}\,\bar{s}_{j|l}\,(1+\varepsilon_l) \tag{3.29}$$

where $\varepsilon_{j|l}$ is the conditional uncompensated own-price elasticity for asset j in cluster l, $\eta_{j|l}$ is the conditional budget elasticity for asset j in cluster l, $\bar{s}_{j|l}$ is the mean conditional budget share of asset j in cluster l, and ε_l is the unconditional uncompensated own-price elasticity of

[53] It shall be noted that these effects for the self-employed imply the assumption that, for them, the effects on the consumption-savings decision are the same as for the rest of the population, given that the self-employed are not included in the analysis in Chapter 2, from which effects are applied here. It is clearly debatable whether this is a reasonable assumption. This issue shall be investigated in future research.

cluster l assets. Conditional budget and own-price elasticities are defined for the asset shares in the simplified QUAIDS in Eqs. (3.15) and (3.16).[54]

The unconditional uncompensated own-price elasticity (in the following also: tax elasticity) of cluster l assets (ε_l) is determined at the upper stage, which is estimated conditionally on positive demand for total assets, so that tax effects occur at the intensive, as well as at the extensive margin. The unconditional expected value of demand for cluster l assets can thus be written: $E[s_l] = Pr[a_{tot} > 0] * E[s_l|a_{tot} > 0]$, where $E[s_l]$ is the unconditional expected value of the demand share for cluster l, $E[s_l|a_{tot} > 0]$ is the respective share conditional on positive demand for total assets, and $Pr[a_{tot} > 0]$ is the probability of positive total asset demand. The marginal effect of the tax rate on the unconditional demand share for assets in cluster l results as:[55]

$$\frac{\partial E[s_l]}{\partial t} = \frac{\partial Pr[a_{tot} > 0]}{\partial t} E[s_l|a_{tot} > 0] + \frac{\partial E[s_l|a_{tot} > 0]}{\partial t} Pr[a_{tot} > 0] \tag{3.30}$$

From Eq. (3.30), it follows for the total tax elasticity of asset demand for cluster l:

$$\begin{aligned} \varepsilon_{E[s_l],\,t} &= \frac{\partial E[s_l]}{\partial t} \frac{t}{E[s_l]} \\ &= \frac{\partial Pr[a_{tot} > 0]}{\partial t} \frac{t}{E[s_l]} E[s_l|a_{tot} > 0] \; + \; \frac{\partial E[s_l|a_{tot} > 0]}{\partial t} \frac{t}{E[s_l]} Pr[a_{tot} > 0] \end{aligned} \tag{3.31}$$

and finally

$$\varepsilon_{E[s_l],\,t} = \left(\varepsilon_{E[s_l|a_{tot}>0],\,t} + \varepsilon_{Pr[a_{tot}>0],\,t} \right) \frac{E[s_l|a_{tot} > 0] * Pr[a_{tot} > 0]}{E[s_l]} \tag{3.32}$$

where $\varepsilon_{E[s_l|a_{tot}>0],\,t}$ and $\varepsilon_{Pr[a_{tot}>0],\,t}$ are the tax elasticity of conditional asset demand for cluster l and the tax elasticity of the probability of positive asset demand, respectively. It follows that the tax elasticity (ε_l) is a function of both, the conditional elasticity and the elasticity of the probability of positive total asset demand. The resulting unconditional tax effects for cluster asset demand are presented in Table 3.4.

As Table 3.4 reveals, the estimated marginal tax effect on the probability of positive demand for total assets at the mean of all covariates is very little ($\text{Mfx}_{P_{a_{tot}}}$): a 10%-points increase in the MTR, from an unconditional mean of 22.4%, increases the probability of

[54] It should though be noted, that the own-price effects do not have a structural interpretation in the *simplified* model, as the price effect on the budget, $\tilde{A}_{il} = A_{il}/P$, is neglected. They should rather be interpreted as empirical tax elasticities. If the effect on the budget was considered, the corresponding *compensated* own-price elasticities would follow from the Slutsky equation: $\varepsilon_j^* = \varepsilon_j + \eta_j \bar{s}_{j|l}$, where the unconditional income effect in the 2SBM is calculated from: $\eta_j \bar{s}_j = \eta_{j|l} \bar{s}_{j|l} \, \eta_l \bar{s}_l$ (Edgerton, 1997).

[55] For calculations of total marginal tax effects in similar settings, see Agell and Edin (1990), or King and Leape (1998), or Dubin and McFadden (1984).

Table 3.4: Conditional and Unconditional Tax Effects on Cluster Asset Demand Shares

	$\bar{s}_l$	$\bar{s}_{l\|a}$	$\text{Mfx}_{s_{l\|a}}$	$P_{a_{tot}}$	$\text{Mfx}_{P_{a_{tot}}}$	Mfx_{s_l}	ε_l	η_l
Housing Assets	15.5	16.7	0.030***	0.932	−0.00001	0.028***	0.040***	0.130***
	(27.9)	(12.2)	(0.007)	(0.246)	(0.00002)	(0.007)	(0.009)	(0.029)
Financial Assets	77.7	83.3	−0.030***	0.932	−0.00001	−0.029**	−0.008**	−0.078***
	(34.6)	(11.3)	(0.010)	(0.246)	(0.00002)	(0.009)	(0.003)	(0.007)

Notes: Standard errors computed by the delta method or standard deviations in parentheses. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Marginal effects computed at the mean of all covariates. $\bar{s}_l$ is the (unweighted) unconditional share of cluster l assets. $\sum_l \bar{s}_l = 93.2$, which is the (unweighted) share of households with positive demand for any assets. $\bar{s}_{l|a}$ is the (unweighted) share of cluster l assets, conditional on positive total asset demand, and $\text{Mfx}_{s_{l|a}} = \partial E[s_l \,|\, a_{tot} > 0]/\partial t$ is the marginal tax effect on this share. $P_{a_{tot}}$ is the (unweighted) probability of positive demand for any assets, and $\text{Mfx}_{P_{a_{tot}}} = \partial Pr[a_{tot} > 0]/\partial t$ is the marginal tax effect on this probability. $\text{Mfx}_{s_l} = \partial E[s_l]/\partial t$ is the marginal tax effect on the unconditional share of cluster l assets. ε_l is the corresponding tax elasticity, and η_l the budget elasticity, where for t and a_{tot} conditional means are applied.

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

positive demand for any assets by 0.01%-points, which is statistically not different from zero. Thus, the resulting marginal tax effects on the unconditional cluster asset share (Mfx_{s_l}) do not vary much from the respective conditional effects ($\text{Mfx}_{s_{l|a}}$). A 10%-points increase in the MTR increases the unconditional share of housing assets by 0.28%-points and decreases the unconditional share of financial assets by 0.29%-points. Thus, total asset demand is slightly decreased. The corresponding tax elasticities (ε_l) and budget elasticities (η_l) on the unconditional cluster demand shares are applied to derive unconditional tax effects on assets at the lower stage of the 2SBM in the following.

Table 3.5 displays the point estimates and standard errors for the elements of the formula for the tax elasticity in Eq. (3.29). The conditional tax effects ($\text{Mfx}^{con}_{s_{j|l}}$) and the corresponding elasticities on the conditional share ($\varepsilon_{j|l}$) are presented in the first two columns. These are then adjusted by the conditional budget elasticity ($\eta_{j|l}$), the unconditional cluster asset tax elasticity (ε_l), and weighted by the conditional asset share ($\bar{s}_{j|l}$), according to Eq. (3.29).[56] The result is the unconditional tax elasticity for the share of asset j, ε_j. Relating this elasticity either to the conditional share ($\bar{s}_{j|l}$) or to the unconditional share ($\bar{s}_j$), gives the unconditional marginal tax effect on the conditional ($\text{Mfx}^{unc}_{s_{j|l}}$) and respectively unconditional share ($\text{Mfx}^{unc}_{s_j}$).

In more detail, budget effects on the shares ($\eta_{j|l}$) are slightly negative for mortgages as well as consumer credits, while they are stronger for building society deposits as well as insurances. These asset shares are thus reduced with increasing budget, while all other asset shares are increased.[57] The resulting unconditional tax elasticities on the shares (ε_j) do not differ much

[56]Note that the conditional budget elasticities for the shares weighted by the conditional shares sum up to zero for each cluster as a consequence of adding-up: $\sum_j^{J_l} \bar{s}_{j|l}\, \eta_{j|l} = 0$.

[57]All elasticities presented here refer to the asset *shares*. The corresponding budget elasticities on the *levels*

Table 3.5: Budget Effects and Unconditional Tax Effects on (Un-)Conditional Asset Shares

	$\text{Mfx}^{con}_{s_{j\|l}}$	$\varepsilon_{j\|l}$	$\eta_{j\|l}$	ε_l	ε_j	$\bar{s}_{j\|l}$	$\text{Mfx}^{unc}_{s_{j\|l}}$	$\bar{s}_j$	$\text{Mfx}^{unc}_{s_j}$
Own.-Occ.	−0.411***	−0.754***	0.226**	0.040***	−0.718***	15.3	−0.391***	3.1	−0.098***
	(0.017)	(0.030)	(0.066)	(0.009)	(0.032)	(13.8)	(0.017)	(21.6)	(0.004)
Non-O.-Occ.	0.039***	0.194***	0.330***	0.040***	0.213***	5.7	0.043***	1.1	0.011***
	(0.010)	(0.049)	(0.073)	(0.009)	(0.049)	(7.1)	(0.010)	(13.2)	(0.003)
Mortgages	0.372***	0.132***	−0.068**	0.040***	0.077***	79.0	0.215***	12.5	0.043***
	(0.058)	(0.009)	(0.023)	(0.009)	(0.021)	(22.2)	(0.058)	(44.2)	(0.012)
Bank Dep.	−0.340***	−0.177***	0.291***	−0.008**	−0.047***	45.0	−0.090***	40.1	−0.084***
	(0.020)	(0.007)	(0.017)	(0.003)	(0.011)	(18.2)	(0.020)	(41.8)	(0.019)
Build.-S. D.	0.050***	0.075***	−0.276***	−0.008**	0.032*	15.7	0.021*	11.9	0.017*
	(0.010)	(0.014)	(0.023)	(0.003)	(0.015)	(7.8)	(0.010)	(26.4)	(0.008)
Stocks	0.015‡	0.050‡	0.478***	−0.008**	0.083**	6.8	0.024**	5.7	0.021**
	(0.008)	(0.026)	(0.057)	(0.003)	(0.027)	(5.2)	(0.008)	(19.7)	(0.007)
Bonds	−0.008*	−0.215*	0.909***	−0.008**	−0.207*	0.9	−0.008*	0.8	−0.007*
	(0.003)	(0.085)	(0.202)	(0.003)	(0.085)	(1.1)	(0.003)	(7.4)	(0.003)
Insurances	0.201***	0.226***	−0.537***	−0.008**	0.115***	20.8	0.102***	15.8	0.081***
	(0.012)	(0.012)	(0.034)	(0.003)	(0.014)	(14.3)	(0.012)	(30.2)	(0.010)
Con. Cred.	0.082***	0.178***	−0.150*	−0.008**	0.162***	10.8	0.075***	9.1	0.065***
	(0.009)	(0.019)	(0.061)	(0.003)	(0.020)	(9.3)	(0.009)	(23.9)	(0.008)

Notes: Standard errors computed by the delta method or standard deviations in parentheses. Significance levels: ‡ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Marginal effects are computed at the mean of all covariates. $\text{Mfx}^{con}_{s_{j|l}} = \partial E[s_j \mid a_l]/\partial t$ is the marginal tax effect on asset share j, conditional on the budget in cluster l. $\varepsilon_{j|l}$ is the corresponding tax elasticity, and $\eta_{j|l}$ the corresponding budget elasticity, where for t and a_l conditional means are applied. ε_l is the unconditional tax elasticity of cluster asset l. ε_j is the resulting tax elasticity on the unconditional share of asset j. $\bar{s}_{j|l}$ is the (unweighted) share of asset j, conditional on cluster l budget. $\text{Mfx}^{unc}_{s_{j|l}}$ is the total marginal tax effect on the *conditional* share. $\bar{s}_j$ is the (unweighted) unconditional share of asset j. $\sum_j \bar{s}_j = 93.2$ which equals the (unweighted) share of households with positive demand for total assets. $\text{Mfx}^{unc}_{s_j}$ is the resulting total marginal tax effect on the unconditional share.

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

from the respective conditional elasticities ($\varepsilon_{j|l}$) for owner-occupied housing ($\varepsilon_j = -0.72$), non-owner-occupied housing (0.21), building society deposits (0.03), stocks (0.08), bonds (-0.21), and consumer credits (0.16). This is due, either to a relatively low budget elasticity, or to a relatively little conditional share, as a result of which unconditional demand is relatively

follow from: $\eta^{lev}_{j|l} = 1 + \eta_{j|l}$. They allow the interpretation that owner-occupied housing, non-owner-occupied housing, bank deposits, stocks, and bonds are superior goods (or luxuries, $\eta^{lev}_{j|l} > 1$), while all other assets are relatively inferior goods (or necessities, $0 < \eta^{lev}_{j|l} < 1$). This is also found for the structural demand model, see Section 3.6.1. Furthermore, in the structural demand system, the uncompensated own-price elasticities for the levels would follow from $\varepsilon^{lev}_j = \varepsilon_j - 1$, implying the price effect on the budget. This effect is though neglected in the simplified model, as simple empirical tax elasticities are computed. If assumed the effect was zero, the *compensated* own-price elasticities for the levels, following from $\varepsilon^{lev*}_j = \varepsilon_j - 1 + \eta_{j|l}\, \bar{s}_{j|l}\, \eta_l\, \bar{s}_l$ (Edgerton, 1997), would be non-positive for all assets here and thus theoretically consistent with a negative semidefinite Slutsky matrix.

unaffected by budget effects. However, for mortgages ($\varepsilon_j = 0.08$), for bank deposits (-0.05), and for insurances (0.12), unconditional elasticities are much lower in absolute terms than the respective conditional ones. For insurances, this is due to a relatively great budget elasticity ($\eta_{j|l}$) that goes in the opposite direction of the tax effect and thus reduces the unconditional elasticity. For mortgages and for bank deposits, a budget effect in the opposite direction of the tax effect, together with a relatively great conditional share, reduces the unconditional tax effect.

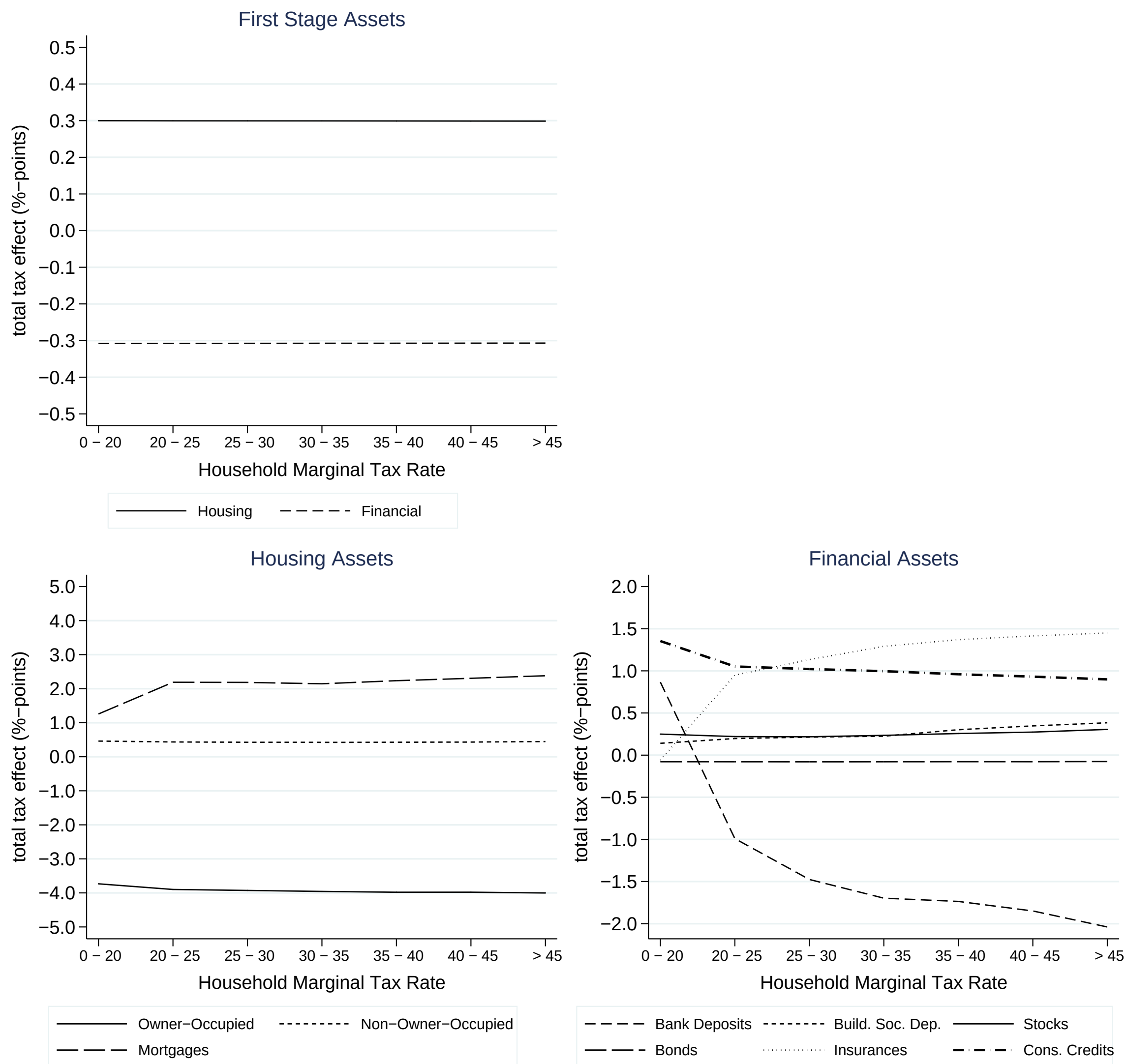
If the unconditional tax elasticity (ε_j) is related to the *conditional* asset share ($\bar{s}_{j|l}$), the resulting marginal tax effects can be interpreted as unconditional tax effects on the conditional share ($\text{Mfx}^{unc}_{s_{j|l}}$). These could then be compared to the corresponding conditional tax effects ($\text{Mfx}^{con}_{s_{j|l}}$). It becomes apparent that the unconditional tax effects on the conditional share are still the greatest, in absolute terms, for owner-occupied housing (conditional share is reduced by 3.9%-points if the MTR increases by 10%-points), mortgage repayments (+2.2%-points), and insurances (+1.0%-points). These results ($\text{Mfx}^{unc}_{s_{j|l}}$) may then be compared to the relevant literature, where usually unconditional tax effects on *conditional* asset shares are evaluated (Feldstein, 1976; Hubbard, 1985; King and Leape, 1998), also see Section 3.1. While the results found here generally fit by size in the range of the results found in this literature (from 1%-points to 9%-points in absolute terms), they are located rather at the lower end of this bound for most of the assets.[58]

Finally, the results for ε_j shall be related to $\bar{s}_j$ in order to derive unconditional tax effects for the *unconditional* asset share ($\text{Mfx}^{unc}_{s_j}$). As a result of this interpretation on the unconditional shares, the effects in the range of 0.1-0.8%-points in absolute terms appear rather small. Nevertheless, as the estimates for ε_j already show, some relatively strong results remain. Generally, the main result still holds: the higher the MTR, the greater demand is for tax-privileged assets and the lower it is for some less privileged or not privileged assets. Demand for tax-privileged assets is increased: the unconditional share of non-owner-occupied housing increases, from a mean share of 1.1% from total assets to 1.2%, when the MTR is increased by 10%-points, from an unconditional mean of 22.4%. Mortgages are increased from 12.5% to 12.9%, and insurance contributions from 15.8% to 16.6%. Demand for some less privileged assets is reduced, for owner-occupied housing greatly from 3.1% to 2.1%, and for bonds from 0.8% to 0.7%, while it is increased for other less privileged assets, as for stocks from 5.7% to 5.9%. Demand effects for assets that are not privileged in the tax system are ambiguous: while demand is reduced for bank deposits, from 40.1% to 39.3%, it is increased for consumer

[58]Still, comparability of the results with the tax effects found in this literature is limited for two reasons. Firstly, in the literature, the condition for conditional shares is on positive demand for the *asset*, not the asset cluster as it is the case here. Secondly, the comparability of the asset types is limited, as the underlying tax incentives may differ for the various tax systems.

credits, from 9.1% to 9.8%, and for building society deposits, from 11.9% to 12.1%.

Figure 3.3: Unconditional Tax Effects by Marginal Tax Rate (on Conditional Share)



Notes: Total tax effects of a 10%−points increase in the MTR − at the mean MTR of 18.6% − on the conditional asset share.
Source: Own calculations using the EVS data (1998,2003).

All unconditional tax effects have been evaluated for an average household, with an average conditional MTR. The effects though may vary over the distribution of the MTR, as the probability of asset demand is modeled as a non-linear function of the MTR and conditional asset demand is a non-linear function of the probability by the selection correction. Figure 3.3 reveals that the tax effects vary over the distribution of the MTR only for bank deposits, insurances, mortgages, and consumer credits. For bank deposits, the unconditional tax effects on the *conditional* asset share range from +0.9%-points in the lowest tax bracket to -2.0%-points in the highest (for insurances from -0.1 to +1.4, for mortgages from +1.2 to +2.3, and for consumer credits from +1.4 to +0.8%). At the upper stage, tax effects are constant over the distribution of the MTR.

As already concluded earlier from the results for conditional tax effects, there are effects of differential income taxation found on the asset allocation decision of private households in Germany. These effects point in the same direction as the conditional tax effects when indirect budget effects from the upper stage of the 2SBM are accounted for and unconditional tax effects are derived. The structure of the unconditional portfolio is shifted towards assets that are relatively more tax privileged, as demand for non-owner-occupied housing, insurances, and mortgages increases when the MTR rises, and in turn demand for relatively less tax-privileged assets, as owner-occupied housing, and non-privileged assets, as bank deposits, is reduced. The size of these effects should though be interpreted as rather limited for most of the assets and especially lower than found in the relevant literature.

3.7 Conclusion

Effects of differential taxation of capital income on households' portfolio choice and asset allocation decision have been investigated. A structural two-stage budgeting model of asset demand has been constructed and applied to German survey data for a time frame where first implementations of a major income tax reform in Germany significantly altered the tax tariff. In a simplified form of the model, the presence of incomplete portfolios was accounted for by structuring the model into the discrete asset choice and the continuous asset choice. An income taxation module was constructed to simulate a marginal tax rate at the household level. Rate-of-return elasticities, as well as conditional and unconditional tax effects for various asset types, were estimated and interpreted.

Households facing higher marginal income tax rates are found to have relatively greater demand for tax-privileged assets than households in the lower tax brackets. The higher the marginal tax rate the greater demand is for assets that are relatively more tax privileged in German tax law. A 10%-points increase in the household's marginal tax rate (from a mean of 22.4%) increases the unconditional demand for non-owner-occupied housing assets (from a share of 1.1% from total disposable assets to 1.2%), for mortgage repayments (from 12.5% to 12.9%), and for capital and private old-age pension insurance assets (from 15.8% to 16.6%). Demand for some less privileged assets is reduced, as for bonds (from 0.8% to 0.7%) and especially for owner-occupied housing (from 3.1% to 2.3%), while it is increased for other less privileged assets, as for stocks (from 5.7% to 5.9%). Demand effects for assets that are not privileged in the tax system are ambiguous: while demand is reduced for bank deposits (from 40.1% to 39.3%), it is increased for consumer credit repayments (from 9.1% to 9.8%) and for building society deposits (from 11.9% to 12.1%).

These results suggest that households in Germany structure their asset portfolios according to incentives that are related to the assets' after-tax rates of return, at least as far as differential taxation of asset returns and other income is concerned. Subsidization of a specific asset type, in the form of a reduced tax rate, or increased deductibility, is expected to have an impact on the households' asset allocation and portfolio choice. These effects can be far-reaching. In case of subsidizing contributions to private pension plans, effects may well occur on all other financial assets, as well as on housing assets and mortgage repayments.

The open issue remains, as to which extent these effects are actually related to tax incentives, or rather to the presence of other subsidies and state grants, that are not subject to taxation, but that affect the after-tax return on assets. For Germany at that time, for example, there was a home-building allowance ("Eigenheimzulage") granted on owner-occupied housing, and there are still building society premiums ("Wohnungsbauprämie") today, which are paid for building society deposits. There are savings bonuses for employees ("Arbeitnehmersparzulage"), which are granted on contributions to capital formation that are directly invested by the employer out of basic salaries ("vermögenswirksame Leistungen"). Asset accumulations for old-age pension income are subsidized in the framework of the so called Riester-scheme. The effects of all such subsidies on asset allocation are not yet disentangled here from the tax effects. This shall be subject to further research in evaluation of specific policy reforms, as it is undertaken, for example, in the case of Germany's year 2000 income tax reform in the next chapter.

3.8 Appendix - Estimation

Tests for the Demand System

Table 3.6: Tests for Homogeneity and Symmetry in the Asset Demand Systems

	Homogeneity		Symmetry							
			Housing		Financial					
	χ^2_c	p-value	χ^2_c	p-value	χ^2_c	p-value				
Housing Assets	6.0	0.015	.	.	.	.				
Financial Assets	.	.	.	.	.	.				
			Owner-Occ.		Non-Own. O.		Mortgages			
	χ^2_c	p-value	χ^2_c	p-value	χ^2_c	p-value	χ^2_c	p-value		
Owner-Occ.	3.7	0.053	5.4	0.020	.	.	.	.		
Non-Owner O.	0.7	0.430	.	.	.	.	.	.		
Mortgages	.	.	.	.	.	.	.	.		
All	5.2	0.073	.	.	.	.				
			Building S.		Stocks		Bonds		Insurances	
	χ^2_c	p-value	χ^2_c	p-value	χ^2_c	p-value	χ^2_c	p-value	χ^2_c	p-value
Bank Deposits	18.3	0.000	8.3	0.004	0.9	0.342	105.9	0.000	158.1	0.000
Building Soc. S.	3.2	0.073	.	.	6.6	0.010	2.1	0.147	118.7	0.000
Stocks	5.3	0.021	.	.	.	.	12.9	0.000	54.2	0.000
Bonds	2.2	0.138	.	.	.	.	.	.	75.7	0.000
Insurances	2.5	0.114	.	.	.	.	.	.	.	.
Cons. Credits	.	.	.	.	.	.	.	.	.	.
All	20.2	0.001	405.3	0.000	.	.	.	.	.	.

Notes: Tests for homogeneity and symmetry are Wald tests with the number of constraints as degrees of freedom (c). At the first-stage demand system with two assets, testing for homogeneity and symmetry reduces to a test for a single constraint.

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

Testing the Nested Structure

In order to test the nested structure, the MNL at the upper stage in Eq. (3.22) can be augmented with inclusive values from the within-cluster MNLs:

$$U_j = x'\delta_j + \sum_l \tau_{l,j}\widehat{I}_l + \eta_j \tag{3.33}$$

where $\sum_l \tau_{l,j}\widehat{I}_l = \tau_{hou,j}\widehat{I}_{hou} + \tau_{fin,j}\widehat{I}_{fin}$, and $\widehat{I}_l = ln\left(\sum_{j=1}^{J_l} e^{x'_{j|l}\widehat{\delta_{j|l}}}\right)$ is the inclusive value of cluster l, which is computed with the $\widehat{\delta}_{j|l}$ from the MNLs for cluster l, see Greene (2003, pp. 725-726), and Cameron and Trivedi (2005, pp. 507-512).

Then, the nesting structure can be tested against a single MNL by a Wald test on the joint hypothesis that all parameters on the inclusive values are equal to unity, for each alternative (except for the zero portfolio, which is the base alternative) at the upper stage, $\widehat{\tau}_{hou,j} = \widehat{\tau}_{fin,j} = 1 \ \ \forall j = 1, \dots, J_1 - 1$. For all of these three tests, this hypothesis is rejected at the 1%-level, providing further arguments for maintaining the nested structure of the 2SBM.

Table 3.7: Wald Test on Inclusive Values in NLM

$H_0 : \widehat{\tau}_{hou,j} = \widehat{\tau}_{fin,j} = \widehat{\tau}_{loa,j} = 1$			
Alternative	χ^2	df	$P > \chi^2$
001	18.97	3	0.000
010	82.84	3	0.000
011	35.10	3	0.000
100	191.18	3	0.000
101	124.77	3	0.000
110	136.51	3	0.000
111	92.81	3	0.000

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

To further test the nested structure of the NLM for the discrete asset choice, tests for the assumption of independence of irrelevant alternatives (IIA) are conducted. The IIA assumption implies that the odds of the categories do not depend on other available categories. The MNL relies on this assumption. It can be tested by the Hausman-McFadden test. This test compares the full MNL model (i. e. with all categories) to restricted MNL models, where each model exhibits one of the available categories (c. f. Hausman and McFadden, 1984). So, for J available categories, the test returns J test statistics, each with a null hypothesis of no systematic difference in the coefficients of the full and the restricted model (i. e. the IIA assumption). The resulting restricted models are estimated simultaneously here. In addition, the alternative Small-Hsiao test is undertaken (see Small and Hsiao (1985)).

Both tests for the IIA assumption are performed on a multinomial logit model for discrete asset choice on a single stage. One multinomial model for all $J = 9$ assets, resulting in $2^9 = 512$ distinct combinations, would be computationally very challenging to estimate. Alternatively, the IIA assumption is tested for a single-stage MNL of eight combinations resulting from the restricted set of three assets: owner-occupied housing, mortgage repayments, and consumer credit repayments. Table 3.8 provides evidence that the null hypothesis of no systematic differences between the coefficients must be rejected for this single-stage MNL, i. e. the IIA assumption does not hold. This shall be interpreted as an argument to apply the nested structure of the NLM. While the NLM relaxes the IIA assumption among the clusters, it is maintained *within* the clusters. To test the latter, the Hausman-McFadden test and the Small-Hsiao test were conducted on the MNLs within the housing cluster, and evidence was found that the IIA assumption can be maintained for most of the alternatives within the housing cluster. For the financial cluster, these tests could however not have been computed within reasonable time.

Table 3.8: Tests for IIA Assumption in a Single-Stage MNL

	Hausman Test			Small-Hsiao Test		
H_0: difference in coefficients not systematic (i.e. IIA holds)						
Omitted Alt.	χ^2	df	$P > \chi^2$	χ^2	df	$P > \chi^2$
Single-stage MNL:						
001	1271.397	180	0.000	466.982	180	0.000
010	880.109	180	0.000	522.341	180	0.000
011	431.961	180	0.000	359.935	180	0.000
100	1804.549	180	0.000	530.578	180	0.000
101	259.903	180	0.000	352.239	180	0.000
110	247.968	180	0.001	365.062	180	0.000
111	160.643	180	0.847	199.352	180	0.154
000	178.535	180	0.517	388.538	180	0.000

Notes: Results of Hausman test based on simultaneous estimation. The single-stage MNL includes combinations of owner-occupied housing, mortgage, and consumer credit.

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

Taking together the tests on the inclusive values and on the IIA assumption, the results suggest that the nested structure of the 2SBM, as described in Section 3.3.1, is appropriate for the estimation of the discrete asset choice in Eq. (3.19). Moreover, Bourguignon et al. (2007) find in simulations that selection estimation based on the MNL in general can provide fairly good adjustment for the outcome equation, even if the IIA assumption is violated.

Selection Correction

From the estimated conditional probabilities of positive demand for asset combination j in cluster l ($\widehat{P}_{j|l}$), a selection term is generated for each asset in Eq. (3.23) by aggregating over all $2^{J_l}/2$ combinations of an asset. This term corrects for conditional estimation of the continuous asset choice. For example, the conditional demand equation for owner-occupied housing assets in the within-cluster MNL is augmented by

$$\begin{aligned}\lambda_{hou} = &\left(\frac{\widehat{P_{101}}\ \ln(\widehat{P_{101}})}{1-\widehat{P_{101}}} + \frac{\widehat{P_{110}}\ \ln(\widehat{P_{110}})}{1-\widehat{P_{110}}} + \frac{\widehat{P_{111}}\ \ln(\widehat{P_{111}})}{1-\widehat{P_{111}}} - \ln(\widehat{P_{100}})\right) * \theta_{100}\\ + &\left(\frac{\widehat{P_{100}}\ \ln(\widehat{P_{100}})}{1-\widehat{P_{100}}} + \frac{\widehat{P_{110}}\ \ln(\widehat{P_{110}})}{1-\widehat{P_{110}}} + \frac{\widehat{P_{111}}\ \ln(\widehat{P_{111}})}{1-\widehat{P_{111}}} - \ln(\widehat{P_{101}})\right) * \theta_{101}\\ + &\left(\frac{\widehat{P_{100}}\ \ln(\widehat{P_{100}})}{1-\widehat{P_{100}}} + \frac{\widehat{P_{101}}\ \ln(\widehat{P_{101}})}{1-\widehat{P_{101}}} + \frac{\widehat{P_{111}}\ \ln(\widehat{P_{111}})}{1-\widehat{P_{111}}} - \ln(\widehat{P_{110}})\right) * \theta_{110}\\ + &\left(\frac{\widehat{P_{100}}\ \ln(\widehat{P_{100}})}{1-\widehat{P_{100}}} + \frac{\widehat{P_{101}}\ \ln(\widehat{P_{101}})}{1-\widehat{P_{101}}} + \frac{\widehat{P_{110}}\ \ln(\widehat{P_{110}})}{1-\widehat{P_{110}}} - \ln(\widehat{P_{111}})\right) * \theta_{111}\end{aligned}$$

where $\theta_{kl} = 1$ if asset combination k is chosen in cluster l (Amemiya et al., 1993).

Aggregating conditional probabilities over the combinations for each asset, yields unconditional probabilities for the assets.[59] Likewise, from the MNL among the clusters in Eq. (3.22), unconditional probabilities for the two clusters can be derived by aggregating the predicted probabilities over the alternatives to marginal probabilities: $\widehat{P_l}$, $l \in \{fin, hou\}$. Together with the conditional probabilities, unconditional probabilities for the assets follow from: $\widehat{P}_{jl} = \widehat{P}_{j|l} * \widehat{P}_l$.

[59]For stocks, e. g.: Prob [stocks= $1|c_{fin} = 1$] $= \sum_{j=1}^{16}$ Prob [comb. other fin. assets= j, stocks= $1|c_{fin} = 1$].

3.9 Appendix - A Simulation Module of Income Taxation

An individual marginal tax rate is derived in a module of capital income taxation that implements German income tax law as of the time of 1998 and 2003. This is necessary, since the actual assessed income tax burden is not observed in the EVS data, as for the LWR data (see Chapter 2). Households only report tax prepayments based on the current income from dependent employment in the respective three months period. Thus, the observed quarterly income and expenditure components need to be aggregated to an entire year. Generally, this is done, as in Chapter 2, assuming the quarterly observation is representative for the entire year. Deviations from this procedure, in case of strong irregularities or seasonal patterns observed, are explicitly stated in the following. In case income or expenditure components are only observed at the aggregate household level, they are distributed equally over all relevant members of the household. A household member is regarded relevant in the context of taxable income if she reports some positive income for any income component at the individual level.

Table 3.9: Derivation of Taxable Income According to German Income Tax Law (EStG)

	Single income components:
	income from agriculture and forestry
+	income from trade or business
+	income from self-employment
+	income from dependent employment
+	income from investment of capital
+	income from renting and leasing
+	other income
=	**sum of all forms of income**
-	allowance for agriculture and forestry
-	relief for elderly retired people
=	**adjusted sum of all forms of income**
-	special expenses
-	extraordinary financial burden
-	tax shields for owner-occupied housing
-	loss deductions
=	**income**
-	child allowances
-	household allowance for single parents
=	**taxable income**

Source: § 2 German income tax law (EStG).

Generally, taxable income at the individual level is derived according to the scheme that is presented in Table 3.9. The single income components are described in the following in further detail with respect to its subcomponents, with respect to specific regulations on eligibility, maximum amounts, lump-sum amounts, and application, and with respect to the implementation in the module of capital income taxation. This simulation module considers all income components that are observed in the EVS data; assumptions on components that are not observed are explicitly stated in the following.

Income from agriculture and forestry, **income from trade or business**, as well as **income from self-employment** are aggregated as observed from quarterly values to annual values, assuming they are constant over the quarters. **Income from dependent employment**, as considered in the taxation module, includes basic salaries, contributions to capital formation, gross income from part-time work, in-kind transfers, retirement pensions for public servants from own occupation or as a surviving relative. These income components are aggregated, as observed, from quarterly values to annual values. Moreover, irregular components are included: compensations for early termination of a contract, bridge money, income from employee profit sharing, gratifications. For those, the quarterly value is assumed to equal the annual one. Furthermore, Christmas bonuses, vacation bonuses, extra month's pay and other extra payments are included. For those, a seasonality is observed, as they occur more often in the 4th quarter than in all others. This seasonality effect is estimated on the basis of employment status and employment level, and is eliminated from the respective income components. For compensations for early termination of a contract, there is an allowance dependent on age granted: in 1998, generally up to 24,000 DM were tax-exempt, for age 50 plus, 30,000 DM, and for age 55 plus, 36,000 DM were tax exempt. In 2003, 8,181 euros were generally deductible, 10,226 for age 50 plus, and 12,271 for age 55 plus. For retirement pensions for public servants, there is also an allowance granted: 40% of the pensions, a maximum of 6,000 DM in 1998 and 3,072 euros in 2003, were tax exempt. Generally, income from dependent employment can be reduced by income-related expenses, where for every individual, the lump-sum allowance of 2,000 DM in 1998 and 1,044 euros in 2003 is applied.

Income from investment of capital is observed differentiated by dividends, interests, and other payouts, such as those from mutual funds. It is assumed that all taxable income from exogenous investment of capital is captured by these components.[60] The single income components are reported net of withholding tax on capital income ("Kapitalertragsteuer", KEST), a prepayment on income tax. The KEST payment is not observed, it is inferred here from the sum of all income from investment of capital. An allowance is granted on income from investment of capital, 6,000 DM in 1998 and 1,550 euros in 2003 for each individual.

[60] See Section 3.10 on how these income components are aggregated from quarterly to annual values.

It is assumed that this allowance is firstly applied to income from interests, then to income from other payouts, and a remaining rest to income from dividends. Income that exceeds the allowance is assumed to be subject to KEST, plus solidarity surcharge of 5.5% on the tax burden. KEST was 30% on income from interests and presumably 25% on income from other payouts, as the exact source of the payout is unknown. Income from dividends was treated differently in 1998 and 2003, with respect to the treatment of corporate taxes paid at the company level. In 1998, *gross* dividends at the shareholder level were subject to the personal tax rate, while the corporate tax payment was considered as a tax credit (the so called "Anrechnungsverfahren").[61] In 2003, *net* dividends were subject to personal income taxation, where only 50% of the net dividend are taxable (the so called "Halbeinkünfteverfahren"). Gross dividends include the corporate tax payment, while net dividends exclude it and are moreover net of KEST at the shareholder level. KEST on income from dividends was 25% in 1998 and 20% in 2003. The KEST payments can be credited against the income tax liability as a tax credit. Generally, income from investment of capital can be reduced by income-related expenses, where for every individual, the greater of reported expenses for financial services and a lump-sum of 100 DM (51 euros) is applied. Income from interest payments included in premiums to capital wholesale and private old-age pension insurances were tax exempt before 2005, if there were contributions paid for at least five years, and the entire contract duration is at least twelve years. This is assumed here for any income from selling insurance assets.

Income from renting and leasing is observed as income from renting and income from subleasing. These components are reported as net of income-related expenses, such as depreciation, interest payments, maintenance costs, insurances, administration costs. The sum of these net income components is applied here as income from renting and leasing. **Other income** is observed as income from old-age and other pensions, income from speculative trading, and income from alimony.[62] Income from any pensions is applied with a taxable fraction of 27%.[63] Income from speculative trading occurs if households sell certain assets in a specific time frame from the point of acquisition.[64] If equities (i. e., stocks and bonds here) are sold within 6 months from acquisition in 1998 (12 months in 2003) net profits generated (i. e., income from selling less costs of acquisition) are applied here as income from speculative trading.[65] If housing assets are sold within two years from acquisition in 1998, net

[61] A corporate tax rate of 45% ("Körperschaftsteuer") is applied here, and it is assumed that no capital gains are paid at the company level.

[62] Income from pensions includes income from private pension insurances, which are assumed to be related to the exogenous stock of assets here.

[63] Since there is no information on the age, at which income from old-age pensions was received for the first time, the statutory retirement age of 65 years is assumed here for all income from pensions.

[64] Note that income from selling assets is considered here exogenous to the asset allocation decision, as only expenditures for asset accumulations are to be allocated here, see Section 3.3.1.

[65] Generally, losses from speculative trading can occur. These may be deducted from any profits from

profits generated are taxable as income from speculative trading. In 2003, housing assets were differentiated by owner-occupation. While income from selling owner-occupied housing was tax exempt, income from selling non-owner-occupied housing is tax exempt iff there are at least 10 years between acquisition and realization, otherwise net profits are fully taxable. Generally, income from speculative trading was only taxable where net profits generated exceeded 1,000 DM in 1998 and 512 euros in 2003, but in this case, the entire net profits were taxable.[66] Income from alimony is assumed taxable here, upon approval of the recipient.[67]

The **sum of all forms of income** is reduced by two allowances: An **allowance for agriculture and forestry** is granted up to 2,000 DM in 1998 if income from agriculture and forestry is not more than than 50,000 DM, and up to 670 euros in 2003 if income from agriculture and forestry is not more than 30,700 euros. A **relief for elderly retired people** is granted, 40% of income from dependent employment less income-related expenses, up to a maximum of 3,720 DM in 1998 and 1,908 euros in 2003, are tax exempt. The result is the adjusted sum of all forms of income. Further deductions are granted in the form of **special expenses**, such as alimony payments, donations and membership fees devoted to certain public institutions, church tax payments, and expenses for insurance premiums with provisional character. **Alimony payments** are deductible (given the assumed approval of the recipient) up to a maximum of 27,000 DM in 1998 and 13,805 euros in 2003. The sum of **donations and membership fees devoted to certain public institutions** is deducted, as long as it does not exceed 5% of the adjusted sum of all forms of income.[68] **Church tax payments** are deducted as reported, aggregated to the year.

Expenses for insurance premiums with provisional character, that are applied here as special expenses, are only those expenses that can be considered "inevitable" for the individual. These are compulsory, as well as voluntary, contributions to the statutory pension insurance, to the statutory health insurance, and to the social long-term care insurance, contributions to private health and long term care insurances, contributions to the unemployment insurance, premiums to personal liability insurances, and premiums to casualty insurances.[69] The greater of actual expenses and a lump-sum allowance for provisional expenses is applied,

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speculative trading. Such losses are not reported, so that they are assumed to be zero here.

[66] Assigning income from selling assets to income from speculative trading and to tax-exempt income according to the tax regulations, is not straight forward here, as the time of acquisition of the assets is not observed. See Section 3.10 on how the time of acquisition is inferred. For income from selling business assets, the time of acquisition can not be inferred, it is assumed tax exempt here.

[67] In this case, the payer may deduct the alimony payments as special expenses.

[68] Donations as well as membership fees devoted to certain public institutions are only observed for 2003. For 1998, they are estimated based on the expenses reported for 2003 and a set of household-related characteristics in a low-limit tobit regression, censoring at zero.

[69] Premiums to personal liability insurances could not be distinguished in the data for 1998 from premiums to liability insurances for cars.

where the lump-sum allowance is a stepwise function of income from dependent employment reduced by the relief for elderly retired people and the allowance for retirement pensions for public servants (§ 10c EStG). There is a section for low incomes, one for mid-level incomes, and one for high incomes. For pensioners and employees who do not contribute to the statutory pension insurance, there is an alternative lump-sum allowance. The resulting expenses can only be deducted up to a maximum allowance for provisional expenses, which is a function of income from dependent employment, reduced by income from retirement pensions for public servants. Again, there are three sections by level of applied income. The result are actually deductible expenses for insurance premiums with provisional character. The greater of the sum of all special expenses and a lump-sum allowance of 108 DM (36 euros) is deducted.

Further deductions are granted for expenses due to **extraordinary financial burden**. These may be related to disability, to the death of relatives, or to the presence of household members in need for care. Households report expenses for services related to assistance for old people, disabled people, and people in need for care. Since neither the degree of disability, nor the degree of need for care are observed, it is assumed that all expenses reported can be deducted up to a maximum of 1,800 DM in 1998 and 924 euros in 2003 per individual. In addition, there is an allowance for the education of children. In 1998, there were 2,400 DM deductible for each child aged 18 or older, that is a member of the household and eligible for child benefit ("Kindergeld") or child allowance ("Kinderfreibetrag"). In 2003, such expenses were assigned to the child allowance, see below. Expenses for children that are not members of the household are assumed to be reported as alimony payments and are thus already deducted as special expenses. Other extraordinary financial burdens may result from occupation of domestic help, for which households report expenses. They are deductible up to 1,200 DM (624 euros) for individuals aged 60 or older. Moreover, expenses for childcare may be deducted, as far as they exceed a reasonable amount. For 1998, the amount considered reasonable is a function of the adjusted sum of all forms of income and the number of children below the age of 18. Expenses may be deducted for each child that belongs to the household and is younger than 16, if the individual is working and not married. In 2003, expenses may be deducted for each child that belongs to the household and is younger than 14 if the individual is either working or in education. The reasonable amount is 1,548 euros for each child. The maximum deduction is 4,000 DM for the first child. It is 2,000 DM for each following child in 1998, and 750 euros for each child in 2003.

Further deductions are granted in the form of **tax shields for owner-occupied housing**. The relevant tax shield regulations for 1998 and 2003 are found in § 10e, § 10h, and § 10i EStG.[70] § 10e and § 10h EStG are relevant in case construction of the building was started

[70]It is assumed that there are no old cases remaining from the tax shields in § 7b and § 7c EStG, which were

before 01.01.1996, § 10i EStG in case it was started after this date. Matching the households' expenses for the stock of housing assets to the respective regulations is not straight forward here, since it is not observed at what time the construction of the building was started. However, this information can be inferred with the help of reasonable assumptions. Households report expenses for repayment of housing-related loans, related interest payments, as well as the remaining level of debt. Assuming a long-term fixed-rate annuity loan with a constant rate of repayment added interest (i. e. the annuity) which is paid monthly,[71] an overall time frame for repayment of 30 years and an interest rate of 8% in 1998 and 7% in 2003, the initial loan amount, as well as the time it was taken up, can be calculated. Assuming further, that 80% of the total expenses for housing assets are financed by debt, the initial costs of purchasing result.[72]

According to **§ 10e and § 10h EStG**, if construction was started before 01.01.1996, 6% of the costs of purchasing the building (a maximum of 19,800 DM in 1998 and 10,124 euros in 2003) may be deducted each year in the first four years, and another 5% in the following four years (a maximum of 16,500 DM in 1998 and 8,437 euros in 2003). The building needs to be occupied by the owner and may not be occupied for weekends or holidays only.[73] The adjusted sum of all forms of income of the owner may not exceed 120,000 DM (61,355 euros). If construction was started after 01.01.1996, but before 01.01.1999, expenses can be deducted according to **§ 10i EStG** as initial costs in line with the home-building allowance ("Eigenheimzulage", EHZ). In the year of the purchase, an owner buying a house who is eligible for the EHZ may deduct a lump-sum 3,500 DM for purchasing costs, and a former tenant buying the occupied flat up to 22,500 DM of maintenance costs that do not belong to purchasing costs. Maintenance costs for owner-occupied housing are deducted here, as observed for the quarter, up to 22,500 DM if construction was started between 01.01.1996 and 01.01.1999. For purchasing costs, lump-sum 3,500 DM are deducted in case of eligibility for EHZ and in case construction was started between 01.01.1996 and 01.01.1999. Eligibility for the EHZ demands that the adjusted sum of all forms of income in the year of the purchase, and the year before, do not exceed 160,000 DM, with 60,000 DM added for each child eligible for child benefit.[74]

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abolished in 1987.

[71] Assuming monthly repayment, the annuity is inferred multiplying observed quarterly interest and repayment by four.

[72] This procedure assumes that the construction of the building did not start later than the loan was taken up. A further assumption, which is probably more severe, is that only households that report remaining debts on housing to be repaid deduct housing-related expenses from income.

[73] Expenses for repayment of housing-related loans and remaining level of debt are only observed pooled for all real estates the household owns, occupied by household members or not. The fraction that is related to owner-occupied housing assets can though be estimated by information on various expenses related to operation and maintenance of the houses. See Section 3.10 for further details.

[74] Income of the previous year is not observed in the EVS for 1998 and 2003. For the income limit, it is assumed that the adjusted sum of all forms of income in the previous year equals the one for the year of

There is no information observed on **loss deductions**. It is assumed that households do not deduct any losses that emerged in the current year or in any previous years. Reducing the adjusted sum of all forms of income by special expenses, expenses due to extraordinary financial burden, and tax shields for owner-occupied housing, results in **income** according to tax law. Income may be reduced by a child allowance as well as a household allowance for single parents. For 1998 and 2003, either a **child allowance** is deducted or households keep the child benefits they received. There is a check undertaken here for which variant is the more favorable for the household, a so called higher-yield test. If it is the child allowance that results in a lower tax burden, the child allowance is deducted and the received child benefits are added to the resulting tax burden. In case the child benefits are more favorable, child allowance is not applied and households keep the received child benefits. The child allowance applied amounts to 3,456 DM in 1998 and 2,904 euros in 2003.[75] It is deducted for both the household head and its partner. In case spouses choose joint assessment,[76] the child allowance is doubled and deducted solely for the household head. Children are eligible for child allowance if they are aged below 18, or if they are aged between 18 and 21 and searching for a job, while unemployed, or if they are younger than 27 and in education. Furthermore, a **household allowance for single parents** is granted for individuals who are not married and are either eligible for the child allowance or live in a household with children that are eligible for child benefits. This allowance amounts to 5,616 DM for 1998 and 2,340 euros for 2003.

Deducting the household allowance for single parents and the child allowance in case it is more favorable than child benefits, results in **taxable income**. There remain some income components which are not taxable, but which affect **progressive taxation** ("Progressionsvorbehalt"). For 1998 and 2003, the following ones are observed: unemployment benefits, unemployment assistance, transfers related to employment promotions, compensations for short-time work, benefits for part-time retirement, benefits for maternity leave, sickness benefits and other transfers from the statutory health insurance, and transfers from the European Social Fund. The relevant tax rate is derived by adding these income components to taxable income and applying the tax tariff according to § 32a EStG to this sum. The resulting tax rate is then applied to taxable income and the tax burden results.

Married couples are assumed to choose joint assessment.[77] For them, individual taxable incomes are added up, as are the non-taxable income components affecting progressive taxation,

interview.

[75]For 2003, this includes the allowance for the education of children of 1,824 euros, which was in 1998 separately deductible as extraordinary financial burden, see above.

[76]Spouses are assumed to choose joint assessment for taxation iff they are married.

[77]In the data, for every household with a married household head, the second individual is also married. For exactly these couples, joint assessment is applied. Only for 0.5% of the sample, there appear married individuals together with an unmarried household head.

the tax tariff is applied to half of this sum, and the resulting tax burden is doubled.

Table 3.10: Distribution of Household Marginal Tax Rate

1998					2003				
Taxable Income in 000 DM	**Mean**	**Sd** in percent	**Min**	**Max**	**Taxable Income** in 000 Euro	**Mean**	**Sd** in percent	**Min**	**Max**
0	1.8	3.6	0.0	24.5	0	2.0	4.3	0.0	31.0
0 - 20	6.4	10.4	0.0	27.3	0 - 10	3.9	7.7	0.0	30.0
20 - 25	26.3	2.9	13.6	28.2	10 - 12.5	22.8	2.7	6.7	32.3
25 - 30	27.4	2.6	13.4	29.1	12.5 - 15	24.5	2.3	13.8	29.5
30 - 35	28.5	2.3	15.5	31.3	15 - 17.5	26.1	2.1	15.0	32.2
35 - 40	29.7	2.0	18.1	31.2	17.5 - 20	27.6	1.8	17.0	31.5
40 - 50	31.2	1.8	18.8	35.0	20 - 25	29.8	1.8	18.6	38.2
50 - 60	33.2	1.4	22.5	36.5	25 - 30	32.6	1.6	21.1	37.3
60 - 70	35.9	1.4	24.9	41.8	30 - 35	35.5	1.6	19.4	41.5
70 - 80	38.9	1.5	26.5	43.3	35 - 40	38.4	1.4	24.3	42.5
80 - 100	43.1	2.0	26.5	48.6	40 - 50	42.2	2.1	24.2	46.5
$>$ 100	50.4	3.5	21.2	53.1	$>$ 50	47.3	2.8	24.2	48.5
Total	19.3	15.0	0.0	53.1	**Total**	18.0	15.1	0.0	48.5

Notes: Data weighted by population weights.

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

Individual marginal tax rates are generated by incrementing taxable income, assuming the increment is fully taxable and is not accompanied by any deductible expenses. The difference in tax burdens resulting from the increment is applied as a general marginal tax rate on income. Individual marginal tax rates are aggregated to a marginal tax rate at the household level by a weighted average. The weighting scheme generally assumes, that the tax rates of the household head and a second adult individual have the greatest relevance concerning asset allocation decisions, that tax rates of other adult household members are less relevant, and that children's tax rates are irrelevant. Thus, here only individuals aged 18 or older are considered as household members. In case of a single-member household, the individual's tax rate equals the household's tax rate. For two-member households, equal weighting is applied if members are head and partner, otherwise the head's tax rate gets a weight of 0.8 and the other member's one 0.2. For three-member households, head and partner get equal weights of 0.4 each, and the third member 0.2. If the head does not have a partner in the household, he gets 0.8, and the other two members get equal weights of 0.1 each. In a four-person household, head and partner share the weight 0.8 equally, while a weight of 0.2 is shared equally by the other two members. A head without a partner gets 0.8, while the three other members share the remaining weight of 0.2 equally. This approach is applied accordingly to five- and six-person households. The result is one **general marginal tax rate on income at the household level** for each household.

3.10 Appendix - Data and Household Asset Portfolios

Data

The data applied stems 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 for reports 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 variables. Participation is not mandatory, it is voluntary. Due to voluntary participation, the EVS is not a random sample from the entire population. Generally underrepresented are self-employed, farmers, workers, foreigners, single-person households, and households at the bottom and the top of the income distribution. Although quota are attempted to be fulfilled and population weights applied, there remains a selection bias towards the middle income groups in the EVS samples, see Becker and Hauser (2004). If this bias is similar in the two cross-sections under consideration it should not be too problematic for comparisons between these points in time. However, this restriction with respect to the represented population should be kept in mind when making comparisons of aggregations from the sample with aggregates from other official statistics. The entire population covered by the EVS is furthermore restricted. Not covered are: institutionalized people (i. e. military people in barracks, 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 for 1998 (18,000 euros for 2003).

When households report income and expenditures by single components, this information does not always exactly balance out. Thus, the StaBu generates a so called "statistical difference" in order to even out households' balance sheets. This statistical difference is redefined here, such that it balances the two ways of deriving savings in Eq. (3.2).

The sample of the two cross sections for 1998 and 2003 is reduced with respect to outliers and implausible observations. In particular, observations are dropped if:

1. monthly disposable household income, weighted by the modified OECD equivalence scale is below 300 euros (in prices of 2003) (drops 23 observations), or if

2. the statistical difference in absolute terms is more than double the disposable household income (drops 174 observations), or if

3. consumption (adjusted for redistributions of durable goods expenditures) is more than double the disposable household income (drops 321 observations), or if

4. other expenditures (not attributed to any category of consumption) are more than double the disposable household income (drops 42 observations)

This reduces the overall sample size from 92,464 observations by 560 (about 0.6 percent) to 91,904 observations. This reduction appears to be within the range of usual procedure.

Household information in this analysis is weighted by population weights. Household weights are constructed according to the relation of the number of observations in the sample to the number of households in the population. For 1998, the population is stratified by: location in federal states, household type, social status, and household net income. For 2003, the population is stratified by: location in federal states, household type, social status, household net income, and additionally by age of household head.[78] According to its stratification, the sample is aggregated to the population, see Statistisches Bundesamt (2005) for methodological details. The household weights in the scientific use file (SUF) are incorrect for 2003. They have been regenerated so that the weighted sample units match the population sizes in each strata (c. f. Buslei et al. (2007)).

Expenditures for housing assets are not reported separately for owner-occupied (OO) housing and non-owner-occupied (NOO) housing. The allocation of housing expenditures at the household level to these asset types is thus estimated exploiting reported information on the following items: total number of real estates holding in stock, status of living, income from renting, expenditures for housing maintenance (reported by OO and NOO housing), reserves for maintenance (reported by OO and NOO housing), current expenditures for utilities (reported by OO and NOO housing).

Income from selling equities is not reported separately for stocks and bonds, only expenditures for buying them. In order to detect income from speculative trading, sales are however needed separately for stocks and bonds. This allocation is estimated by asset holdings for stocks and bonds.

When the quarterly data is aggregated to annual data, for certain income components, seasonal effects are estimated and eliminated; Christmas bonuses, vacation bonuses, extra month's pay and other extra payments, for example. In addition, for income from investment of capital, such as interest payments and dividends, seasonality is observed and eliminated, as interest on investment of capital is more often paid in the first and in the fourth quarter, and dividends are more often paid in the second quarter.

When deriving taxable income, other income from speculative trading is not directly observed, as the time of acquisition of the assets is not observed. This point in time has been approximated from the respective stock of asset holdings. For 2003, additionally interest income from bonds and other deposits as well as dividends aggregated for the entire previous

[78] Household head is defined as the person with the highest income in the household.

year is applied. For 1998, this is however not reported.

Insurance asset holdings are derived from reported cash values of insurances or, in case of item non-response, cash values are estimated with information on the contribution rate, the duration of the insurance contract, and commission fees as well as profit participation rates, which households are ask to report in case they do not report the cash value of an insurance, which are though not available in the scientific use files of the data.

From Eqs. (3.3) and (3.4), it follows that total disposable assets can be decomposed into accumulations in the J asset classes that are considered here:

	Expenditures for housing assets (gross, including loans raised to buy a house)	
+	Expenditures for financial assets	
+	Expenditures for loan repayments	
-	Revolving assets	
=	Total assets disposable for allocation	
=	Expenditures for owner-occupied housing	
+	Expenditures for non-owner-occupied housing	
+	Repayments of housing-related loans (mortgages)	(3.34)
+	Assets accumulated in savings accounts and fixed deposits	
+	Assets accumulated in building society deposits	
+	Assets accumulated in stocks	
+	Assets accumulated in bonds	
+	Assets accumulated in (life and private pension) insurances	
+	Repayments of consumption loans	
-	Revolving assets	

Concerning the definition of total disposable assets, an example may help understand the setting. Consider a household with current disposable income $Y = 1,000$ that decided to consume $C = 2,000$, liquidate stock holdings of $A^-_{STO} = 5,000$, and take up a loan of $L^-_{HOU} = 8,000$ to finance a house purchase for own occupation, $A^+_{OOH} = 10,000$. In addition, a consumer loan is repaid, $L^+_{FIN} = 1,000$, and stocks are purchased, $A^+_{STO} = 1,000$. This household's net savings are negative: $S = Y - C = L^+_{FIN} + A^+_{STO} + A^+_{OOH} - A^-_{STO} - L^-_{HOU} = -1,000$. With Y, C, A^-_{STO}, and L^-_{HOU} exogenous, total assets disposable for allocation result in:

$$A = L^+_{FIN} + A^+_{STO} + A^+_{OOH} - min(A^+_{STO}, A^-_{STO}) = 11,000$$

This is the total budget under analysis here, i. e. only the decision to allocate A to L^+_{FIN}, A^+_{OOH}, and to $A^+_{STO} - min(A^+_{STO}, A^-_{STO})$ is endogenous.

Rates of Return

Generally, pre-tax rates of return to assets are generated as quarterly averages of aggregate monthly rates of return published by Germany's national bank. Their generation for the various types of assets under consideration here is described in the following in detail.

For **owner-occupied housing assets**, average rates of return to owner-occupied housing are adjusted by current shifts in the prices for construction of new houses and purchase of land, differentiated by type of house and by East- and West-Germany. In addition, the rate of return is increased by an estimated rate of return to the home-building allowance ("Eigenheimzulage") for eligible households. For **non-owner-occupied housing assets**, first of all, average rates of return to non-owner-occupied housing are adjusted by current shifts in the prices for construction of new houses and purchase of land, differentiated by type of house and by East- and West-Germany, similarly to owner-occupied housing assets. Then, gross returns are differentiated by returns that are related to income from renting and leasing, and returns that are related to income from speculative trading of rented housing assets. The latter was tax exempt if there were at least two years between buying and selling the asset in 1998, which was increased to ten years in 2003. It is assumed that the part of the total returns that is related to speculative trading is thereby reduced. This reduction is further differentiated by the exogenous income from renting and leasing that the household already earned from housing asset holdings. As *net* income from renting and leasing is taxable, which is typically negative, it can actually reduce the tax burden.

For **mortgages repayments**, average interest rates for mortgage loans on residential housing fixed for ten years, that were valid at the time the loan was contracted, are applied. The time the loan was contracted is estimated. Together with the average interest rates, assuming a long-term fixed-rate annuity loan with a constant rate of monthly repayment added interest (i. e. the annuity), and an overall time frame for repayment of 30 years, the initial loan amount, as well as the time it was taken up, can be inferred. The structure of mortgage repayments with respect to owner-occupied housing and non-owner-occupied housing is further assumed to be determined by the respective structure of housing asset holdings. It is considered that mortgage repayments to loans that are related to rented housing are tax deductible, while such that are related to owner-occupied housing are not. For households that have zero housing asset holdings and thus do not currently hold a mortgage, a ten-year average of rates on mortgage loans is applied. As with consumer credits (see below), the asset under consideration is mortgage *repayments*, so that the resulting rates are applied in positive terms in the price function, as it is done with any other asset under consideration here.

For **bank deposits**, a weighted average of the rates of return to short-term savings, to one-month fixed deposits differentiated by face value, and to sight deposits, is applied, where the weights are a function of the structure of deposit holdings with respect to savings deposits and fixed deposits. For **building society deposits**, the rate of return is fixed when the contract is signed. This information is not reported, but it can be estimated given the stock of deposit holdings and an assumption on average contributions. As a proxy for the actual return, the rate for short-term bank deposits at the estimated time of contract initiation is applied. Additionally, building society premiums (“Wohnungsbauprämie”) are considered.

For **stocks**, average total returns to German stocks for the last 20 years are applied, additionally averaged over various time frames of investment horizon. Total returns are further differentiated by dividend-related returns and residual price-related trade returns. Only the dividend-related returns are assumed generally taxable. Average dividend-related returns to stocks from companies listed in Germany’s blue-ship stock index (DAX) are applied. Furthermore, taxation of dividends is implemented, which was changed in 2000/2001 from the “Anrechnungsverfahren” to the “Halbeinkünfteverfahren”, see Section 3.9. It is assumed that this shift reduces the long-term total rate of return to stocks by 25%, as the corporate tax payment can not be considered as a tax credit anymore.[79] For **bonds**, the current yield on domestic private and public securities is applied. Additionally, net profits generated from speculative trading are considered as a potential increase in the rate of return to bonds, especially when the tax-free allowance for interest income is already exploited.

For **life and private pension insurances**, as a proxy, the rate of returns to bank deposits which are fixed for more than four years for the time of contract initiation is applied. Contract initiation is estimated with the stock of asset holdings in insurance contracts and an assumption on average contributions. The fact that contributions to life and private pension insurances, for the purpose of old-age income, were fully deductible from taxable income, up to a cap until 2005, was considered as a mark-up on the rate of return depending on the marginal tax rate. For **consumer credit repayments**, the average interest rate on consumer credits from banks for the time of contract initiation is applied. The time of contract initiation is estimated with an average time for repayment of a loan, and the latter in turn is estimated with average observed loan repayments and average observed loans outstanding, together with current interest rates. Rates are further differentiated by the loan volume taken up and by the actual opportunity costs of repaying a loan. For households that do not currently hold a loan, a four-year average of the interest rate on consumer credits is applied. As the asset under consideration is loan *repayments*, the resulting rates are applied in positive terms in the price function, as opposed to loan *take-up*, where the price would rather depend negatively on the interest rate.

[79] 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.

Rates of return for assets at the first stage of the 2SBM, i. e. for housing assets and financial assets in general, are computed as weighted averages from the rates for single asset types at the household level. The weights are sample-average shares of the portfolio of asset holdings which are exogenous to the asset allocation decision. The return to housing assets, for example, is an average of the returns to owner-occupied housing, non-owner-occupied housing, and mortgage repayments, weighted by the average portfolio structure of housing asset holdings in the sample. The return to savings in general follows analogously as a weighted average of the return to housing assets and the return to financial assets, with an average share for housing asset holdings of 47% and for financial assets of 53%.

Household Asset Portfolios

Table 3.11: Household Asset Demand

	Conditional Shares ($\bar{s}_{j\|l}$)			Unconditional Shares ($\bar{s}_j$)		
in percent	$\bar{A}_j/\bar{A}_l$	$\bar{s}_{j\|l}$	$sd(\bar{s}_{j\|l})$	$\bar{A}_j/\bar{A}_l$	$\bar{s}_j$	$sd(\bar{s}_j)$
Total disposable assets	100.0	100.0	0.0	100.0	100.0	0.0
Housing assets	30.2	13.2	26.6	30.2	13.2	26.6
Financial assets	69.8	86.8	26.6	69.8	86.8	26.6
Housing Assets:						
Owner-occupied housing	41.9	17.0	35.6	12.6	2.6	13.5
Non-owner-occupied housing	22.7	6.0	22.1	6.8	0.9	8.0
Mortgage repayments	35.4	77.1	39.6	10.7	9.6	22.1
Financial Assets:						
Bank deposits	56.4	47.7	42.7	39.4	43.7	41.6
Building-society deposits	10.6	14.2	26.8	7.4	11.3	23.1
Stocks	14.5	5.9	19.4	10.1	5.1	17.7
Bonds	2.4	0.8	7.3	1.7	0.7	6.8
Life and private pension insurances	9.8	20.1	31.5	6.8	16.2	27.9
Consumer credit repayments	6.3	11.4	26.2	4.4	9.9	24.3
N_{tot} (unweighted)					85,699	
N_{tot} (weighted, in 000s)				66,703		
N_{hou} (unweighted)		32,961				
N_{hou} (weighted, in 000s)	19,984					
N_{fin} (unweighted)		84,046				
N_{fin} (weighted, in 000s)	65,437					

Notes: $\bar{A}_j/\bar{A}_l$ is the ratio of aggregate demand to aggregate budget, while $\bar{s}_{j|l}$ is the average demand share. Conditional shares refer to the subpopulation with positive demand in the corresponding asset cluster. Data weighted by population weights.
Reading example: Among households with demand for any assets, the average share of housing assets is 13.2%. Among households with demand for housing assets, the average share of owner-occupied housing is 17.0%. However, aggregate demand for the latter related to aggregate demand for housing assets, is much greater (41.9%).

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

3.11 Appendix - Results

Results - Rate-of-Return Elasticities

Table 3.12: Rate-of-Return and Budget Elasticities on Conditional First-Stage Asset Demand Levels

on Asset Levels		Housing Assets	Financial Assets
		Unconstrained	
Budget El. ($\widehat{\eta}_{j\vert l}$)[a]		1.195	0.961
		(0.005)***	(0.001)***
Uncompensated	Own-Rate ($\widehat{\varepsilon}^{(r)}_{jj\vert l}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk\vert l}$)	
Housing Assets	0.558	.	−0.444
	(0.049)***	.	(0.024)***
Financial Assets	0.089	−0.111	.
	(0.005)***	(0.010)***	.
Compensated			
Housing Assets	0.600	.	−0.478
	(0.049)***	.	(0.024)***
Financial Assets	0.096	−0.120	.
	(0.005)***	(0.010)***	.
		Constrained	
Budget El. ($\widehat{\eta}_{j\vert l}$)[a]		1.196	0.961
		(0.005)***	(0.001)***
Uncompensated	Own-Rate ($\widehat{\varepsilon}^{(r)}_{jj\vert l}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk\vert l}$)	
Housing Assets	0.646	.	−0.419
	(0.033)***	.	(0.021)***
Financial Assets	0.084	−0.129	.
	(0.004)***	(0.007)***	.
Compensated			
Housing Assets	0.688	.	−0.453
	(0.033)***	.	(0.021)***
Financial Assets	0.091	−0.137	.
	(0.004)***	(0.007)***	.

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. $\widehat{\eta}_{j|l}$ is the conditional budget elasticity on asset levels, $\widehat{\varepsilon}^{(r)}_{jj|l}$ is the own-rate elasticity of asset j on asset levels, conditional on the budget in cluster l. $\widehat{\varepsilon}^{(r)}_{jk|l}$ is the respective cross-rate elasticity.
[a]: Null hypothesis for the budget elasticities is $\widehat{\eta}_{j|l} = 1$.
Source: Own calculations using the EVS data (1998, 2003).

Table 3.13: Rate-of-Return and Budget Elasticities on Cond. Housing Asset Dem. Levels

on Asset Levels		Owner-Occupied	Non-Owner-Occupied	Mortgages
		Unconstrained		
Budget El. ($\widehat{\eta}_{j\|l}$)[a]		1.234	1.399	0.926
		(0.008)***	(0.014)***	(0.002)***
Uncompensated	Own-Rate ($\widehat{\varepsilon}^{(r)}_{jj\|l}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk\|l}$)		
Owner-Occupied Housing	0.785	.	−0.372	−0.243
	(0.094)***	.	(0.219)*	(0.046)***
Non-Owner-Occupied	1.056	0.299	.	−0.798
	(0.380)***	(0.164)*	.	(0.080)***
Mortgage Repayments	0.105	−0.174	−0.004	.
	(0.010)***	(0.020)***	(0.046)	.
Compensated				
Owner-Occupied Housing	0.827	.	−0.377	−0.292
	(0.094)***	.	(0.219)*	(0.046)***
Non-Owner-Occupied	1.124	0.288	.	−0.853
	(0.380)***	(0.164)*	.	(0.080)***
Mortgage Repayments	0.068	−0.181	0.065	.
	(0.010)***	(0.020)***	(0.046)	.
		Constrained		
Budget El. ($\widehat{\eta}_{j\|l}$)[a]		1.235	1.398	0.926
		(0.008)***	(0.014)***	(0.002)***
Uncompensated	Own-Rate ($\widehat{\varepsilon}^{(r)}_{jj\|l}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk\|l}$)		
Owner-Occupied Housing	0.398	.	−0.040	−0.349
	(0.065)***	.	(0.079)	(0.042)***
Non-Owner-Occupied	1.255	−0.073	.	−0.763
	(0.238)***	(0.149)	.	(0.078)***
Mortgage Repayments	0.123	−0.072	−0.083	.
	(0.009)***	(0.008)***	(0.008)***	.
Compensated				
Owner-Occupied Housing	0.440	.	−0.045	−0.398
	(0.065)***	.	(0.079)	(0.042)***
Non-Owner-Occupied	1.323	−0.084	.	−0.819
	(0.238)***	(0.149)	.	(0.078)***
Mortgage Repayments	0.086	−0.079	−0.013	.
	(0.009)***	(0.008)***	(0.008)	.

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 and are defined as in Table (3.12).
[a]: Null hypothesis for the budget elasticities is $\widehat{\eta}_{j|l} = 1$.
Source: Own calculations using the EVS data (1998, 2003).

Table 3.14: Rate-of-Return and Budget Elasticities on Cond. Financial Asset Dem. Levels

on Asset Levels		Bank Depos.	Build. S. Dep.	Stocks	Bonds	Insurances	Cs. Credits
				Unconstrained			
Budg. El. ($\widehat{\eta}_{j\|l}$) [a]		1.297	0.746	1.492	1.889	0.443	0.822
		(0.002)***	(0.005)***	(0.009)***	(0.026)***	(0.004)***	(0.006)***
Uncompensated	Own-Rate ($\widehat{\varepsilon}^{(r)}_{jj\|l}$)			Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk\|l}$)			
Bank Deposits	−0.009	.	−0.019	0.251	0.572	−0.361	−0.084
	(0.004)**	.	(0.005)***	(0.021)***	(0.055)***	(0.007)***	(0.002)***
Building S. Dep.	0.160	−0.030	.	0.085	0.162	−0.244	−0.054
	(0.010)***	(0.008)***	.	(0.042)**	(0.111)	(0.014)***	(0.005)***
Stocks	−0.357	0.107	−0.036	.	−0.738	−0.281	−0.116
	(0.075)***	(0.015)***	(0.018)**	.	(0.195)***	(0.025)***	(0.009)***
Bonds	−0.607	0.064	0.042	−0.578	.	−0.261	−0.182
	(0.581)	(0.043)	(0.054)	(0.222)***	.	(0.075)***	(0.025)***
Insurances	1.092	0.012	−0.043	−0.398	−0.736	.	−0.056
	(0.011)***	(0.006)**	(0.008)***	(0.032)***	(0.084)***	.	(0.004)***
Credits	0.622	−0.014	−0.050	−0.131	−0.686	−0.044	.
	(0.006)***	(0.010)	(0.012)***	(0.051)**	(0.134)***	(0.017)***	.
Compensated							
Bank Deposits	−0.007	.	−0.030	0.244	0.572	−0.376	−0.088
	(0.004)*	.	(0.005)***	(0.021)***	(0.055)***	(0.007)***	(0.002)***
Building S. Dep.	0.208	−0.031	.	0.081	0.162	−0.252	−0.056
	(0.010)***	(0.008)***	.	(0.042)*	(0.111)**	(0.014)***	(0.005)***
Stocks	−0.286	0.104	−0.049	.	−0.739	−0.297	−0.121
	(0.075)***	(0.015)***	(0.018)***	.	(0.195)***	(0.025)***	(0.009)***
Bonds	−0.570	0.061	0.025	−0.589	.	−0.282	−0.187
	(0.581)	(0.043)	(0.054)	(0.222)***	.	(0.075)***	(0.025)***
Insurances	1.139	0.011	−0.047	−0.400	−0.736	.	−0.057
	(0.011)***	(0.006)*	(0.008)***	(0.032)***	(0.084)***	.	(0.004)***
Credits	0.647	−0.015	−0.057	−0.135	−0.687	−0.053	.
	(0.006)***	(0.010)	(0.012)***	(0.051)***	(0.134)***	(0.017)***	.
				Constrained			
Budg. El. ($\widehat{\eta}_{j\|l}$) [a]		1.297	0.742	1.495	1.892	0.444	0.826
		(0.002)***	(0.005)***	(0.009)***	(0.026)***	(0.004)***	(0.006)***
Uncompensated	Own-Rate ($\widehat{\varepsilon}^{(r)}_{jj\|l}$)			Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk\|l}$)			
Bank Deposits	0.035	.	0.003	0.158	0.018	−0.357	−0.091
	(0.002)***	.	(0.005)	(0.012)***	(0.007)**	(0.006)***	(0.002)***
Building S. Dep.	0.192	−0.000	.	−0.020	0.001	−0.112	−0.036
	(0.010)***	(0.001)	.	(0.011)*	(0.002)	(0.008)***	(0.003)***
Stocks	−0.168	0.059	−0.025	.	−0.043	−0.281	−0.102
	(0.061)***	(0.004)***	(0.017)	.	(0.013)***	(0.022)***	(0.008)***
Bonds	−0.082	0.109	0.043	−0.689	.	−0.327	−0.201
	(0.307)	(0.043)**	(0.054)	(0.217)***	.	(0.075)***	(0.025)***
Insurances	1.056	−0.067	−0.090	−0.145	−0.010	.	−0.051
	(0.010)***	(0.001)***	(0.006)***	(0.011)***	(0.002)***	.	(0.003)***
Credits	0.608	−0.062	−0.104	−0.188	−0.023	−0.181	.
	(0.006)***	(0.001)***	(0.009)***	(0.014)***	(0.003)***	(0.010)***	.
Compensated							
Bank Deposits	0.037	.	−0.008	0.151	0.018	−0.371	−0.094
	(0.002)***	.	(0.005)	(0.012)***	(0.007)***	(0.006)***	(0.002)***
Building S. Dep.	0.240	−0.002	.	−0.024	0.001	−0.120	−0.039
	(0.010)***	(0.001)**	.	(0.011)**	(0.002)	(0.008)***	(0.003)***
Stocks	−0.096	0.056	−0.038	.	−0.043	−0.297	−0.106
	(0.061)	(0.004)***	(0.017)**	.	(0.013)***	(0.022)***	(0.008)***
Bonds	−0.045	0.105	0.027	−0.699	.	−0.347	−0.207
	(0.307)	(0.043)**	(0.053)	(0.217)***	.	(0.075)***	(0.025)***
Insurances	1.103	−0.068	−0.094	−0.148	−0.011	.	−0.052
	(0.010)***	(0.001)***	(0.006)***	(0.011)***	(0.002)***	.	(0.003)***
Credits	0.633	−0.063	−0.111	−0.193	−0.023	−0.190	.
	(0.006)***	(0.001)***	(0.009)***	(0.014)***	(0.003)***	(0.010)***	.

Notes: Standard errors computed by the delta method in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Elasticities at mean of all covariates and defined as in Table (3.12). [a]: Null hypothesis for budget elasticities is $\widehat{\eta}_{j|l} = 1$.

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

Results - Estimation - Structural Model

Table 3.15: SUR Estimates for Conditional Asset Demand at the 1. Stage

dep. var.: share of housing assets from total assets ($\in [0,1]$)	Housing Assets Coeff	(SE)
prices:		
$ln(p_{hou})$	-1.8876	$(0.1564)^{***}$
$ln(p_{fin})$	2.2703	$(0.1159)^{***}$
total budget:		
log total gross budget	-0.0463	$(0.0028)^{***}$
log total gross budget sq.	0.0062	$(0.0002)^{***}$
stock of net assets:		
1. quintile (ref.)		
2. quintile	0.0156	$(0.0035)^{***}$
3. quintile	0.0996	$(0.0037)^{***}$
4. quintile	0.2034	$(0.0037)^{***}$
5. quintile	0.1658	$(0.0038)^{***}$
age:		
30 and younger (ref.)		
30 - 35	0.0320	$(0.0048)^{***}$
35 - 40	0.0378	$(0.0047)^{***}$
40 - 45	0.0314	$(0.0048)^{***}$
45 - 50	0.0170	$(0.0049)^{***}$
50 - 55	0.0009	(0.0050)
55 - 60	-0.0045	(0.0051)
60 - 65	-0.0127	$(0.0058)^{*}$
65 - 70	-0.0309	$(0.0068)^{***}$
70 - 75	-0.0544	$(0.0071)^{***}$
75 and older	-0.0721	$(0.0070)^{***}$
education:		
educ degree high	0.0110	$(0.0023)^{***}$
educ degree med	0.0080	$(0.0026)^{**}$
educ degree low (ref.)		
educ degree non	-0.0032	(0.0055)
social status:		
selfemployed	0.0130	$(0.0042)^{**}$
public servants	0.0092	$(0.0031)^{**}$
employee (ref.)		
workers	-0.0002	(0.0031)
pensioners	0.0008	(0.0046)
nonemployed, student	0.0049	(0.0043)
household type:		
single female	0.0238	$(0.0048)^{***}$
single male	0.0075	(0.0048)
single parent	0.0156	$(0.0056)^{**}$
couple, no kids (ref.)		
couple, 1 kid	0.0231	$(0.0032)^{***}$
couple, ≥ 2 kids	0.0401	$(0.0031)^{***}$
other households	-0.0067	(0.0050)
demographics:		
employed > 2	-0.0046	(0.0024)
female	0.0007	(0.0031)
married	0.0327	$(0.0037)^{***}$
divorced	0.0267	$(0.0038)^{***}$
german	-0.0059	(0.0073)
east germany	-0.0180	$(0.0025)^{***}$
time:		
quart1	-0.0177	$(0.0026)^{***}$
quarter 2 (ref.)		
quart3	0.0092	$(0.0025)^{***}$
quart4	-0.0147	$(0.0025)^{***}$
year 2003	-0.0094	$(0.0026)^{***}$
$E[s_j \mid a_{tot} > 0]$	0.132	
Observations	85,699	
R^2	0.159	

Notes: Standard errors in parentheses. Additional covariates: a constant.
Significance levels: $^{*}\,p < 0.05$, $^{**}\,p < 0.01$, $^{***}\,p < 0.001$.
Source: Own calculations using the EVS data (1998, 2003).

Table 3.16: SUR Estimates for Conditional Asset Demand for Housing Assets at the 2. Stage

	Owner-Occupied Housing		Non-Owner-Occupied Housing	
dep. var.: share of asset j from housing assets ($\in [0,1]$)	Coeff	(SE)	Coeff	(SE)
prices:				
$ln(p_{ooc})$	-2.3410	(0.2824)***	-0.3297	(0.1826)
$ln(p_{noc})$	0.7783	(0.4563)	-0.8190	(0.2951)**
$ln(p_{mor})$	0.7732	(0.1420)***	0.9282	(0.0918)***
housing budget:				
log housing budget	-0.0444	(0.0026)***	-0.0165	(0.0017)***
log housing budget sq.	0.0069	(0.0002)***	0.0034	(0.0001)***
stock of net assets:				
1. quintile (ref.)				
2. quintile	0.0139	(0.0152)	0.0076	(0.0099)
3. quintile	-0.0341	(0.0123)**	-0.0109	(0.0080)
4. quintile	-0.0314	(0.0120)**	-0.0221	(0.0078)**
5. quintile	-0.0015	(0.0121)	0.0235	(0.0078)**
age:				
30 and younger (ref.)				
30 - 35	-0.0265	(0.0131)*	-0.0047	(0.0085)
35 - 40	-0.0591	(0.0127)***	-0.0035	(0.0082)
40 - 45	-0.0583	(0.0128)***	0.0021	(0.0083)
45 - 50	-0.0523	(0.0129)***	0.0070	(0.0083)
50 - 55	-0.0341	(0.0132)**	0.0139	(0.0085)
55 - 60	-0.0192	(0.0135)	0.0297	(0.0087)***
60 - 65	0.0083	(0.0147)	0.0450	(0.0095)***
65 - 70	0.0671	(0.0171)***	0.0676	(0.0110)***
70 - 75	0.1321	(0.0188)***	0.0628	(0.0122)***
75 and older	0.2282	(0.0197)***	0.1086	(0.0127)***
education:				
educ degree high	-0.0248	(0.0045)***	0.0107	(0.0029)***
educ degree med	-0.0112	(0.0051)*	0.0045	(0.0033)
educ degree low (ref.)				
educ degree non	0.0181	(0.0172)	0.0120	(0.0111)
social status:				
selfemployed	-0.0086	(0.0072)	0.0117	(0.0047)*
public servants	0.0077	(0.0053)	0.0020	(0.0034)
employee (ref.)				
workers	0.0115	(0.0061)	0.0049	(0.0039)
pensioners	0.0543	(0.0096)***	-0.0012	(0.0062)
nonemployed, student	0.0253	(0.0113)*	0.0153	(0.0073)*
household type:				
single female	-0.0346	(0.0115)**	-0.0102	(0.0075)
single male	-0.0452	(0.0115)***	0.0143	(0.0075)
single parent	-0.0282	(0.0130)*	-0.0165	(0.0084)
couple, no kids (ref.)				
couple, 1 kid	-0.0166	(0.0060)**	-0.0118	(0.0039)**
couple, $\geq$ 2 kids	-0.0291	(0.0060)***	-0.0158	(0.0038)***
other households	0.0195	(0.0097)*	0.0068	(0.0063)
demographics:				
employed $>$ 2	-0.0093	(0.0043)*	-0.0051	(0.0028)
female	-0.0019	(0.0059)	0.0073	(0.0038)
married	-0.0217	(0.0084)**	-0.0118	(0.0054)*
divorced	-0.0188	(0.0096)*	-0.0081	(0.0062)
german	0.0382	(0.0159)*	0.0080	(0.0103)
east germany	0.0899	(0.0057)***	0.0425	(0.0037)***
time:				
quart1	-0.0284	(0.0054)***	-0.0069	(0.0035)*
quarter 2 (ref.)				
quart3	-0.0026	(0.0050)	0.0013	(0.0032)
quart4	-0.0129	(0.0050)**	-0.0000	(0.0032)
year 2003	0.0195	(0.0058)***	-0.0073	(0.0037)
$E[s_j \mid a_{hou} > 0]$	0.170		0.060	
Observations	32,961		32,961	
R^2	0.094		0.063	

Notes: Standard errors in parentheses. Additional covariates: a constant. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: Own calculations using the EVS data (1998, 2003).

Table 3.17: SUR Estimates for Conditional Asset Demand for Financial Assets at the 2. Stage

d. v.: share ($\in [0,1]$)	Bank Deposits Coeff (SE)	Building Coeff (SE)	Stocks Coeff (SE)	Bonds Coeff (SE)	Insurances Coeff (SE)
prices:					
$ln(p_{dep})$	0.9987 (0.4114)*	1.0340 (0.2900)***	-1.6231 (0.2223)***	-0.1237 (0.0856)	-0.6113 (0.2908)*
$ln(p_{bui})$	0.4031 (0.0408)***	-0.8616 (0.0288)***	0.1342 (0.0221)***	-0.0159 (0.0085)	0.2885 (0.0289)***
$ln(p_{sto})$	-1.4440 (0.1183)***	-0.1171 (0.0834)	0.2960 (0.0639)***	0.0661 (0.0246)**	1.0131 (0.0836)***
$ln(p_{bon})$	-6.9860 (0.6474)***	-0.2760 (0.4564)	1.2526 (0.3499)***	0.1497 (0.1347)	3.8937 (0.4577)***
$ln(p_{ins})$	3.1659 (0.0608)***	0.6527 (0.0429)***	0.3859 (0.0329)***	0.0438 (0.0127)***	-4.3303 (0.0430)***
$ln(p_{cre})$	1.3887 (0.0390)***	0.2853 (0.0275)***	0.2937 (0.0211)***	0.0583 (0.0081)***	0.4114 (0.0276)***
financial budget:					
log financial budget	0.0804 (0.0042)***	0.0863 (0.0030)***	-0.0540 (0.0023)***	-0.0124 (0.0009)***	-0.0168 (0.0030)***
log financial budget sq.	0.0043 (0.0004)***	-0.0102 (0.0003)***	0.0072 (0.0002)***	0.0017 (0.0001)***	-0.0082 (0.0003)***
stock of net assets:					
1. quintile (ref.)					
2. quintile	-0.0422 (0.0051)***	0.0648 (0.0036)***	0.0213 (0.0027)***	-0.0005 (0.0011)	0.0518 (0.0036)***
3. quintile	-0.1246 (0.0058)***	0.0946 (0.0041)***	0.0224 (0.0031)***	0.0004 (0.0012)	0.0375 (0.0041)***
4. quintile	-0.1460 (0.0061)***	0.1193 (0.0043)***	0.0143 (0.0033)***	-0.0009 (0.0013)	0.0213 (0.0043)***
5. quintile	-0.1896 (0.0065)***	0.1329 (0.0046)***	0.0345 (0.0035)***	0.0012 (0.0013)	0.0399 (0.0046)***
age:					
30 and younger (ref.)					
30 - 35	0.0020 (0.0067)	-0.0395 (0.0047)***	0.0044 (0.0036)	0.0005 (0.0014)	0.0111 (0.0047)*
35 - 40	0.0192 (0.0066)**	-0.0508 (0.0047)***	-0.0051 (0.0036)	0.0009 (0.0014)	0.0154 (0.0047)***
40 - 45	0.0267 (0.0067)***	-0.0581 (0.0047)***	-0.0106 (0.0036)**	0.0009 (0.0014)	0.0181 (0.0048)***
45 - 50	0.0290 (0.0069)***	-0.0576 (0.0048)***	-0.0158 (0.0037)***	0.0007 (0.0014)	0.0212 (0.0049)***
50 - 55	0.0406 (0.0071)***	-0.0557 (0.0050)***	-0.0245 (0.0038)***	0.0003 (0.0015)	0.0195 (0.0050)***
55 - 60	0.0391 (0.0073)***	-0.0564 (0.0051)***	-0.0221 (0.0039)***	0.0018 (0.0015)	0.0208 (0.0051)***
60 - 65	0.0510 (0.0082)***	-0.0596 (0.0058)***	-0.0203 (0.0044)***	0.0011 (0.0017)	0.0150 (0.0058)**
65 - 70	0.0860 (0.0096)***	-0.0670 (0.0068)***	-0.0257 (0.0052)***	0.0037 (0.0020)	-0.0044 (0.0068)
70 - 75	0.1496 (0.0101)***	-0.1063 (0.0071)***	-0.0323 (0.0054)***	0.0037 (0.0021)	-0.0054 (0.0071)
75 and older	0.2079 (0.0099)***	-0.1379 (0.0070)***	-0.0339 (0.0053)***	0.0046 (0.0021)*	-0.0180 (0.0070)*
education:					
educ degree high	-0.0238 (0.0032)***	0.0149 (0.0023)***	0.0123 (0.0018)***	0.0017 (0.0007)*	-0.0024 (0.0023)
educ degree med	-0.0063 (0.0036)	0.0083 (0.0026)**	0.0032 (0.0020)	-0.0009 (0.0008)	-0.0016 (0.0026)
educ degree low (ref.)					
educ degree non	0.0662 (0.0078)***	-0.0125 (0.0055)*	-0.0005 (0.0042)	-0.0015 (0.0016)	-0.0324 (0.0055)***
social status:					
selfemployed	-0.1280 (0.0059)***	-0.0419 (0.0042)***	0.0099 (0.0032)**	-0.0014 (0.0012)	0.1478 (0.0042)***
public servants	-0.0073 (0.0043)	0.0259 (0.0031)***	-0.0121 (0.0023)***	-0.0025 (0.0009)**	-0.0021 (0.0031)
employee (ref.)					
workers	-0.0005 (0.0045)	-0.0025 (0.0031)	-0.0154 (0.0024)***	-0.0015 (0.0009)	0.0057 (0.0031)
pensioners	0.0209 (0.0065)**	-0.0312 (0.0046)***	-0.0130 (0.0035)***	-0.0006 (0.0014)	0.0345 (0.0046)***
nonemployed, student	0.0657 (0.0061)***	-0.0601 (0.0043)***	-0.0108 (0.0033)**	0.0007 (0.0013)	0.0266 (0.0043)***
household type:					
single female	0.0577 (0.0067)***	0.0033 (0.0048)	0.0079 (0.0036)*	0.0036 (0.0014)*	-0.0566 (0.0048)***
single male	0.0323 (0.0068)***	-0.0078 (0.0048)	0.0219 (0.0037)***	0.0041 (0.0014)**	-0.0615 (0.0048)***
single parent	0.0333 (0.0078)***	-0.0096 (0.0055)	-0.0071 (0.0042)	0.0014 (0.0016)	-0.0205 (0.0055)***
couple, no kids (ref.)					
couple, 1 kid	-0.0110 (0.0045)*	0.0081 (0.0032)*	-0.0055 (0.0025)*	-0.0019 (0.0009)*	0.0134 (0.0032)***
couple, $\geq$ 2 kids	-0.0084 (0.0043)	0.0126 (0.0030)***	-0.0134 (0.0023)***	-0.0026 (0.0009)**	0.0151 (0.0030)***
other households	0.0175 (0.0071)*	0.0098 (0.0050)*	-0.0198 (0.0038)***	-0.0053 (0.0015)***	-0.0019 (0.0050)
demographics, time:					
employed > 2	-0.0023 (0.0034)	0.0241 (0.0024)***	-0.0065 (0.0018)***	-0.0014 (0.0007)	-0.0047 (0.0024)*
female	-0.0022 (0.0043)	-0.0028 (0.0030)	-0.0054 (0.0023)*	-0.0008 (0.0009)	0.0040 (0.0031)
married	-0.0137 (0.0052)**	0.0024 (0.0037)	-0.0058 (0.0028)*	-0.0005 (0.0011)	0.0010 (0.0037)
divorced	-0.0146 (0.0054)**	0.0050 (0.0038)	-0.0043 (0.0029)	-0.0002 (0.0011)	-0.0006 (0.0038)
german	-0.0265 (0.0103)*	0.0120 (0.0073)	0.0090 (0.0056)	-0.0034 (0.0021)	0.0013 (0.0073)
east germany	0.0080 (0.0035)*	-0.0195 (0.0025)***	0.0082 (0.0019)***	0.0011 (0.0007)	0.0055 (0.0025)*
quart1	-0.0269 (0.0039)***	0.0063 (0.0028)*	-0.0022 (0.0021)	0.0022 (0.0008)**	0.0163 (0.0028)***
quarter 2 (ref.)					
quart3	-0.0189 (0.0037)***	0.0062 (0.0026)*	0.0065 (0.0020)**	0.0009 (0.0008)	0.0018 (0.0026)
quart4	-0.0020 (0.0036)	0.0125 (0.0025)***	-0.0109 (0.0019)***	-0.0024 (0.0008)**	0.0104 (0.0025)***
year 2003	0.1048 (0.0064)***	-0.0712 (0.0045)***	-0.0169 (0.0034)***	-0.0034 (0.0013)*	0.0077 (0.0045)
$E[s_j \mid a_{fin} > 0]$	0.477	0.142	0.059	0.008	0.201
Observations	84,046	84,046	84,046	84,046	84,046
R^2	0.227	0.101	0.070	0.021	0.302

Notes: Standard errors in parentheses. Additional covariates: a constant. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: Own calculations using the EVS data (1998, 2003).

Results - Estimation - Simplified Model - Discrete Asset Choice

Table 3.18: Multinomial Logit Estimates for Conditional Probability of Positive Demand for First-Stage Assets (Marg. Effects and SE)

	Housing Assets		Financial Assets	
dep.var.: demand prob.	Mfx	(SE)	Mfx	(SE)
tax rate:				
marginal tax rate in %	0.0018	(0.0001)***	0.0001	(0.0002)
age:				
30 and younger (ref.)				
30 - 35	0.0776	(0.0095)***	-0.0071	(0.0114)
35 - 40	0.0959	(0.0094)***	-0.0085	(0.0111)
40 - 45	0.0980	(0.0094)***	-0.0082	(0.0112)
45 - 50	0.0738	(0.0094)***	-0.0090	(0.0113)
50 - 55	0.0601	(0.0090)***	-0.0034	(0.0113)
55 - 60	0.0489	(0.0094)***	-0.0071	(0.0115)
60 - 65	0.0466	(0.0102)***	-0.0121	(0.0121)
65 - 70	0.0269	(0.0116)*	-0.0197	(0.0133)
70 - 75	-0.0259	(0.0122)*	-0.0201	(0.0143)
75 and older	-0.0935	(0.0129)***	-0.0278	(0.0143)
stock of net assets:				
1. quintile (ref.)				
2. quintile	-0.0033	(0.0087)	-0.0055	(0.0109)
3. quintile	0.1768	(0.0082)***	-0.0212	(0.0086)*
4. quintile	0.3732	(0.0101)***	-0.0435	(0.0094)***
5. quintile	0.3469	(0.0109)***	-0.0497	(0.0102)***
total budget:				
log total gross budget	0.2265	(0.0078)***	0.0365	(0.0110)***
log total gross budget sq.	-0.0110	(0.0007)***	-0.0000	(0.0009)
education:				
educ degree high	0.0076	(0.0033)*	-0.0080	(0.0043)
educ degree med	0.0128	(0.0038)***	-0.0023	(0.0050)
educ degree low (ref.)				
educ degree non	-0.0163	(0.0109)	-0.0019	(0.0146)
social status:				
selfemployed	-0.0180	(0.0056)**	-0.0089	(0.0074)
household type:				
single female	-0.0218	(0.0054)***	-0.0057	(0.0072)
single male	-0.0330	(0.0063)***	-0.0043	(0.0083)
single parent	0.0253	(0.0079)**	-0.0130	(0.0101)
couple, no kids (ref.)				
couple, 1 kid	0.0458	(0.0045)***	-0.0002	(0.0060)
couple, $\geq$ 2 kids	0.0791	(0.0044)***	-0.0005	(0.0058)
other households	-0.0073	(0.0068)	-0.0000	(0.0092)
location:				
east germany	-0.0098	(0.0037)**	0.0026	(0.0051)
time:				
year 2003	0.0129	(0.0027)***	0.0020	(0.0036)
$Pr(s_j > 0)$	0.273		0.881	
N	91,904		91,904	
Pseudo-R^2	0.451		0.451	

Notes: Marginal effects are average marginal effects.
Standard errors in parentheses, estimated by the delta method, assuming zero covariance between alternatives.
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Additional covariates: a constant.
Inclusive values omitted from estimation. Descriptive probabilities weighted by population weights.
Source: Own calculations using the EVS data (1998, 2003).

Table 3.19: Multinomial Logit Estimates of Conditional Probability of Positive Demand for Housing Assets (Marg. Effects and SE)

	Owner-Occupied		Non-Owner-Occ.		Mortgages	
dep.var.: demand prob.	Mfx	(SE)	Mfx	(SE)	Mfx	(SE)
tax rate:						
marginal tax rate in %	-0.0050	(0.0003)***	0.0008	(0.0002)***	0.0043	(0.0003)***
age:						
30 and younger (ref.)						
30 - 35	-0.0410	(0.0228)	-0.0099	(0.0188)	0.0404	(0.0210)
35 - 40	-0.0878	(0.0210)***	-0.0173	(0.0174)	0.0929	(0.0203)***
40 - 45	-0.0973	(0.0212)***	0.0021	(0.0198)	0.0827	(0.0204)***
45 - 50	-0.0887	(0.0216)***	0.0099	(0.0205)	0.0670	(0.0205)**
50 - 55	-0.0714	(0.0227)**	0.0256	(0.0226)	0.0394	(0.0209)
55 - 60	-0.0518	(0.0240)*	0.0506	(0.0253)*	-0.0037	(0.0212)
60 - 65	-0.0283	(0.0256)	0.0623	(0.0268)*	-0.0326	(0.0220)
65 - 70	-0.0032	(0.0294)	0.0960	(0.0327)**	-0.0958	(0.0233)***
70 - 75	0.0568	(0.0330)	0.0856	(0.0342)*	-0.1430	(0.0244)***
75 and older	0.1170	(0.0385)**	0.1389	(0.0409)***	-0.2537	(0.0239)***
stock of net assets:						
1. quintile (ref.)						
2. quintile	0.0064	(0.0260)	0.0157	(0.0197)	-0.0253	(0.0240)
3. quintile	-0.0451	(0.0204)*	-0.0104	(0.0143)	0.0555	(0.0199)**
4. quintile	-0.0369	(0.0196)	-0.0447	(0.0114)***	0.0833	(0.0193)***
5. quintile	0.0092	(0.0213)	0.0274	(0.0163)	-0.0181	(0.0198)
housing budget:						
log housing budget	0.0328	(0.0365)	0.0759	(0.0332)*	0.2357	(0.0377)***
log housing budget sq.	0.0092	(0.0005)***	0.0024	(0.0004)***	-0.0176	(0.0006)***
education:						
educ degree high	-0.0300	(0.0083)***	0.0245	(0.0069)***	0.0105	(0.0072)
educ degree med	-0.0144	(0.0095)	0.0096	(0.0077)	0.0092	(0.0084)
educ degree low (ref.)						
educ degree non	0.0187	(0.0284)	0.0226	(0.0243)	-0.0264	(0.0261)
social status:						
selfemployed	-0.0280	(0.0143)	0.0195	(0.0107)	-0.0017	(0.0119)
household type:						
single female	-0.0199	(0.0141)	0.0059	(0.0105)	0.0033	(0.0128)
single male	-0.0160	(0.0179)	0.0299	(0.0135)*	-0.0144	(0.0154)
single parent	-0.0281	(0.0220)	-0.0059	(0.0155)	0.0344	(0.0194)
couple, no kids (ref.)						
couple, 1 kid	-0.0162	(0.0113)	-0.0217	(0.0073)**	0.0344	(0.0100)***
couple, $\geq$ 2 kids	-0.0252	(0.0107)*	-0.0299	(0.0067)***	0.0524	(0.0096)***
other households	0.0224	(0.0163)	-0.0018	(0.0113)	-0.0095	(0.0148)
location:						
east germany	0.0768	(0.0114)***	0.0663	(0.0101)***	-0.1287	(0.0088)***
time:						
year 2003	-0.0009	(0.0071)	0.0038	(0.0052)	0.0076	(0.0062)
$Pr(s_j > 0 \mid a_{hou} > 0)$	0.228		0.090		0.834	
$Pr(a_{hou} > 0)$	0.269		0.269		0.269	
$Pr(s_j > 0)$	0.063		0.025		0.223	
N	32,961		32,961		32,961	
Pseudo-R^2	0.118		0.118		0.118	

Notes: Marginal effects are average marginal effects. Standard errors in parentheses, estimated by the delta method, assuming zero covariance between alternatives. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Additional covariates: a constant. Descriptive probabilities weighted by population weights.
Source: Own calculations using the EVS data (1998, 2003).

Table 3.20: Multinomial Logit Estimates for Conditional Probability of Positive Demand for Financial Assets (Marg. Effects and SE)

dep.var.: demand prob.	Bank Dep. Mfx (SE)	Build.-Soc.D. Mfx (SE)	Equities Mfx (SE)	Insurances Mfx (SE)	C.Credits Mfx (SE)
tax rate:					
marginal tax rate in %	-0.003 (0.000)***	0.002 (0.000)***	0.002 (0.000)***	0.003 (0.000)***	0.003 (0.000)***
age:					
30 and younger (ref.)					
30 - 35	-0.003 (0.009)	-0.107 (0.009)***	-0.008 (0.006)	0.053 (0.009)***	0.032 (0.008)***
35 - 40	0.014 (0.009)	-0.142 (0.008)***	-0.032 (0.006)***	0.072 (0.008)***	0.038 (0.008)***
40 - 45	0.011 (0.009)	-0.176 (0.008)***	-0.050 (0.006)***	0.088 (0.008)***	0.051 (0.008)***
45 - 50	0.010 (0.009)	-0.163 (0.008)***	-0.071 (0.005)***	0.104 (0.008)***	0.061 (0.009)***
50 - 55	0.012 (0.009)	-0.166 (0.008)***	-0.089 (0.005)***	0.101 (0.008)***	0.055 (0.009)***
55 - 60	0.021 (0.010)*	-0.178 (0.008)***	-0.097 (0.005)***	0.084 (0.009)***	0.032 (0.009)***
60 - 65	0.035 (0.010)***	-0.210 (0.008)***	-0.104 (0.005)***	0.034 (0.009)***	0.003 (0.009)
65 - 70	0.082 (0.011)***	-0.237 (0.009)***	-0.119 (0.005)***	-0.061 (0.011)***	-0.028 (0.010)**
70 - 75	0.166 (0.011)***	-0.341 (0.008)***	-0.153 (0.005)***	-0.116 (0.012)***	-0.097 (0.009)***
75 and older	0.217 (0.010)***	-0.394 (0.006)***	-0.135 (0.005)***	-0.153 (0.012)***	-0.201 (0.008)***
stock of net assets:					
1. quintile (ref.)					
2. quintile	-0.061 (0.007)***	0.170 (0.007)***	0.103 (0.007)***	0.188 (0.006)***	-0.164 (0.004)***
3. quintile	-0.115 (0.007)***	0.239 (0.007)***	0.145 (0.007)***	0.204 (0.006)***	-0.255 (0.004)***
4. quintile	-0.127 (0.007)***	0.282 (0.007)***	0.136 (0.007)***	0.172 (0.006)***	-0.274 (0.004)***
5. quintile	-0.183 (0.007)***	0.310 (0.007)***	0.176 (0.007)***	0.189 (0.006)***	-0.333 (0.004)***
financial budget:					
log financial budget	0.007 (0.013)	0.704 (0.011)***	-0.061 (0.006)***	0.549 (0.006)***	0.280 (0.006)***
log financial budget sq.	0.017 (0.001)***	-0.055 (0.001)***	0.010 (0.000)***	-0.045 (0.001)***	-0.023 (0.001)***
education:					
educ degree high	-0.028 (0.004)***	-0.024 (0.004)***	0.027 (0.003)***	-0.079 (0.004)***	-0.018 (0.004)***
educ degree med	-0.014 (0.005)**	-0.005 (0.005)	0.015 (0.004)***	-0.017 (0.005)***	-0.005 (0.005)
educ degree low (ref.)					
educ degree non	0.077 (0.011)***	-0.065 (0.011)***	-0.042 (0.009)***	-0.105 (0.011)***	-0.048 (0.010)***
social status:					
selfemployed	-0.148 (0.009)***	-0.117 (0.007)***	-0.015 (0.005)**	0.075 (0.008)***	0.053 (0.007)***
household type:					
single female	0.112 (0.006)***	-0.039 (0.006)***	-0.002 (0.005)	-0.111 (0.006)***	-0.074 (0.005)***
single male	0.087 (0.007)***	-0.090 (0.007)***	0.024 (0.006)***	-0.138 (0.007)***	-0.044 (0.006)***
single parent	0.073 (0.009)***	-0.024 (0.009)**	-0.026 (0.006)***	-0.043 (0.009)***	0.003 (0.008)
couple, no kids (ref.)					
couple, 1 kid	-0.037 (0.006)***	0.063 (0.006)***	-0.004 (0.004)	0.059 (0.006)***	0.042 (0.006)***
couple, $\geq$ 2 kids	-0.046 (0.006)***	0.073 (0.006)***	-0.021 (0.004)***	0.073 (0.006)***	0.063 (0.005)***
other households	0.002 (0.010)	0.055 (0.010)***	-0.037 (0.006)***	0.039 (0.009)***	0.030 (0.009)**
location:					
east germany	0.006 (0.005)	0.024 (0.005)***	0.035 (0.004)***	0.036 (0.005)***	-0.013 (0.004)**
time:					
year 2003	0.076 (0.004)***	-0.094 (0.004)***	-0.006 (0.003)*	-0.018 (0.004)***	0.019 (0.003)***
$Pr(s_j > 0 \mid a_{fin} > 0)$	0.621	0.377	0.156	0.550	0.296
$Pr(a_{fin} > 0)$	0.881	0.881	0.881	0.881	0.881
$Pr(s_j > 0)$	0.555	0.328	0.134	0.479	0.255
N	84,046	84,046	84,046	84,046	84,046
Pseudo-R^2	0.185	0.185	0.185	0.185	0.185

Notes: Marginal effects are computed at the mean of all covariates.
Standard errors in parentheses, estimated from univariate probit regressions by the delta method.
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Additional covariates: a constant. Descriptive probabilities weighted by population weights.
Source: Own calculations using the EVS data (1998, 2003).

Results - Estimation - Simplified Model - Continuous Choice

Table 3.21: SUR Estimates of Conditional Asset Demand at the First Stage

	Housing Assets		Financial Assets	
dep.var.: share in %	Coeff	(SE)	Coeff	(SE)
tax rate:				
marginal tax rate in %	0.03	(0.01)***	-0.03	(0.01)**
age:				
30 and younger (ref.)				
30 - 35	3.19	(0.30)***	-3.19	(0.38)***
35 - 40	4.06	(0.30)***	-4.06	(0.37)***
40 - 45	3.61	(0.30)***	-3.61	(0.38)***
45 - 50	2.17	(0.31)***	-2.17	(0.38)***
50 - 55	0.61	(0.32)	-0.61	(0.39)
55 - 60	0.14	(0.32)	-0.14	(0.41)
60 - 65	-0.05	(0.33)	0.05	(0.43)
65 - 70	-1.11	(0.35)**	1.11	(0.47)*
70 - 75	-3.35	(0.36)***	3.35	(0.49)***
75 and older	-4.90	(0.36)***	4.90	(0.47)***
stock of net assets:				
1. quintile (ref.)				
2. quintile	0.22	(0.15)	-0.22	(0.19)
3. quintile	6.29	(0.19)***	-6.29	(0.26)***
4. quintile	17.89	(0.24)***	-17.89	(0.31)***
5. quintile	14.01	(0.25)***	-14.01	(0.34)***
total budget:				
log total gross budget	-6.14	(0.31)***	6.14	(0.36)***
log total gross budget sq.	0.71	(0.03)***	-0.71	(0.03)***
social status:				
selfemployed	0.48	(0.37)	-0.48	(0.47)
household type:				
single female	1.35	(0.20)***	-1.35	(0.28)***
single male	-0.29	(0.24)	0.29	(0.33)
single parent	2.27	(0.32)***	-2.27	(0.43)***
couple, no kids (ref.)				
couple, 1 kid	2.80	(0.26)***	-2.80	(0.32)***
couple, $\geq$ 2 kids	5.55	(0.25)***	-5.55	(0.31)***
other households	-1.70	(0.38)***	1.70	(0.50)***
location:				
east germany	-2.06	(0.16)***	2.06	(0.21)***
time:				
year 2003	-1.32	(0.14)***	1.32	(0.18)***
selection terms:				
λ_{hou}	8.54	(0.21)***		
λ_{fin}			-8.54	(0.37)***
$E[s_j \mid a_{tot} > 0]$	13.2		86.8	
$Pr(a_{tot} > 0)$	0.898		0.898	
$E[s_j]$	11.8		77.9	
Observations	85,699		85,699	
R^2	0.325		0.142	

Notes: Standard errors from ML estimation in parentheses, robust to heteroskedasticity.
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Additional covariates: a constant.
Source: Own calculations using the EVS data (1998, 2003).

Table 3.22: SUR Estimates of Conditional Demand for Housing Assets

	Owner-Occupied		Non-Owner-Occ.		Mortgages	
dep.var.: share in %	Coeff	(SE)	Coeff	(SE)	Coeff	(SE)
tax rate:						
marginal tax rate in %	-0.41	(0.02)***	0.04	(0.01)***	0.37	(0.02)***
age:						
30 and younger (ref.)						
30 - 35	-2.55	(0.97)**	-0.59	(0.52)	3.14	(1.42)*
35 - 40	-5.70	(0.93)***	-0.56	(0.50)	6.26	(1.36)***
40 - 45	-5.84	(0.93)***	-0.14	(0.50)	5.99	(1.36)***
45 - 50	-6.08	(0.93)***	0.17	(0.51)	5.91	(1.38)***
50 - 55	-5.14	(0.95)***	0.68	(0.53)	4.46	(1.40)**
55 - 60	-4.11	(0.98)***	2.35	(0.55)***	1.76	(1.46)
60 - 65	-2.69	(1.05)*	4.10	(0.60)***	-1.41	(1.56)
65 - 70	2.68	(1.25)*	6.65	(0.73)***	-9.32	(1.81)***
70 - 75	9.38	(1.57)***	6.16	(0.83)***	-15.54	(2.18)***
75 and older	19.31	(1.97)***	10.50	(1.12)***	-29.81	(2.44)***
stock of net assets:						
1. quintile (ref.)						
2. quintile	2.03	(1.25)	1.04	(0.79)	-3.07	(1.72)
3. quintile	-2.80	(1.01)**	-0.78	(0.62)	3.58	(1.32)**
4. quintile	-3.03	(0.98)**	-2.37	(0.60)***	5.40	(1.29)***
5. quintile	-0.44	(1.00)	1.19	(0.62)	-0.74	(1.30)
housing budget:						
log housing budget	-8.90	(0.72)***	-2.09	(0.29)***	10.99	(1.30)***
log housing budget sq.	1.08	(0.06)***	0.35	(0.03)***	-1.42	(0.11)***
social status:						
selfemployed	-1.92	(0.45)***	1.09	(0.34)**	0.83	(0.77)
household type:						
single female	-0.39	(0.67)	0.61	(0.40)	-0.22	(0.99)
single male	-0.93	(0.71)	2.12	(0.51)***	-1.19	(1.05)
single parent	-2.23	(0.70)**	0.19	(0.44)	2.04	(1.12)
couple, no kids (ref.)						
couple, 1 kid	-2.04	(0.41)***	-0.95	(0.25)***	2.99	(0.65)***
couple, $\geq$ 2 kids	-2.56	(0.36)***	-1.07	(0.23)***	3.64	(0.58)***
other households	0.83	(0.82)	0.87	(0.46)	-1.70	(1.20)
location:						
east germany	5.85	(0.41)***	3.68	(0.23)***	-9.53	(0.63)***
time:						
year 2003	-0.31	(0.26)	0.24	(0.16)	0.07	(0.40)
selection terms:						
λ_{ooc}	7.24	(0.36)***				
λ_{noc}			5.57	(0.30)***		
λ_{lho}					-12.81	(0.49)***
$E[s_j \mid a_{hou} > 0]$	17.0		6.0		77.1	
$Pr(a_{hou} > 0)$	0.269		0.269		0.269	
$E[s_j]$	4.6		1.6		20.7	
Observations	32,961		32,961		32,961	
R^2	0.292		0.327		0.052	

Notes: Standard errors from ML estimation in parentheses, robust to heteroskedasticity.
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Additional covariates: a constant.
Source: Own calculations using the EVS data (1998, 2003).

Table 3.23: SUR Estimates for Conditional Demand for Financial Assets

	Bank Dep.	Build.-Soc.D.	Stocks	Bonds	Insurances	C.Credits
dep.var.: share in %	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)
tax rate:						
MTR in %	-0.34 (0.01)***	0.05 (0.01)***	0.01 (0.01)	-0.01 (0.00)*	0.20 (0.01)***	0.08 (0.01)***
age:						
<= 30 (ref.)						
30 - 35	-2.03 (0.67)**	-4.69 (0.48)***	0.32 (0.36)	0.04 (0.10)	3.36 (0.43)***	3.02 (0.47)***
35 - 40	-1.09 (0.65)	-6.51 (0.46)***	-0.73 (0.34)*	0.05 (0.10)	5.01 (0.43)***	3.27 (0.45)***
40 - 45	-1.08 (0.66)	-7.57 (0.47)***	-1.37 (0.34)***	0.02 (0.10)	6.29 (0.44)***	3.71 (0.46)***
45 - 50	-1.67 (0.66)*	-7.31 (0.47)***	-2.00 (0.34)***	-0.02 (0.11)	7.13 (0.45)***	3.87 (0.46)***
50 - 55	-0.88 (0.68)	-6.93 (0.48)***	-2.89 (0.35)***	-0.06 (0.12)	7.36 (0.47)***	3.39 (0.46)***
55 - 60	-0.71 (0.70)	-6.72 (0.50)***	-2.55 (0.37)***	0.13 (0.13)	7.33 (0.49)***	2.53 (0.46)***
60 - 65	0.73 (0.75)	-6.38 (0.54)***	-2.10 (0.39)***	0.07 (0.13)	5.95 (0.52)***	1.74 (0.48)***
65 - 70	5.83 (0.84)***	-6.37 (0.59)***	-2.27 (0.42)***	0.35 (0.17)*	1.34 (0.56)*	1.13 (0.52)*
70 - 75	13.20 (0.91)***	-10.09 (0.62)***	-2.84 (0.44)***	0.35 (0.18)	0.36 (0.61)	-0.99 (0.52)
>= 75	20.05 (0.88)***	-12.83 (0.57)***	-2.94 (0.44)***	0.46 (0.19)*	-1.71 (0.57)**	-3.02 (0.48)***
net assets:						
1. quint. (ref.)						
2. quintile	-3.51 (0.51)***	6.93 (0.30)***	2.62 (0.19)***	0.09 (0.05)	11.47 (0.36)***	-17.60 (0.43)***
3. quintile	-6.94 (0.49)***	10.87 (0.30)***	4.03 (0.20)***	0.44 (0.07)***	14.14 (0.35)***	-22.54 (0.42)***
4. quintile	-7.30 (0.50)***	13.67 (0.32)***	3.56 (0.20)***	0.37 (0.07)***	12.72 (0.35)***	-23.02 (0.43)***
5. quintile	-11.93 (0.53)***	14.67 (0.34)***	5.80 (0.23)***	0.64 (0.08)***	16.74 (0.38)***	-25.92 (0.44)***
fin. budget:						
log fin. budget	6.59 (0.51)***	9.22 (0.23)***	-5.56 (0.24)***	-1.28 (0.10)***	-1.31 (0.51)*	-7.65 (0.47)***
log fin. budget sq.	0.54 (0.05)***	-1.12 (0.02)***	0.73 (0.03)***	0.17 (0.01)***	-0.82 (0.04)***	0.50 (0.04)***
social status:						
selfemployed	-14.86 (0.58)***	-4.03 (0.39)***	1.67 (0.36)***	-0.10 (0.12)	16.42 (0.55)***	0.91 (0.36)*
househ. type:						
single female	10.39 (0.47)***	-1.65 (0.31)***	1.52 (0.23)***	0.43 (0.10)***	-6.70 (0.34)***	-3.99 (0.28)***
single male	7.82 (0.58)***	-2.94 (0.35)***	3.43 (0.33)***	0.57 (0.13)***	-7.43 (0.40)***	-1.43 (0.37)***
single parent	5.04 (0.67)***	-1.35 (0.45)**	-0.25 (0.30)	0.20 (0.11)	-3.65 (0.52)***	0.01 (0.50)
cpl., no k. (ref.)						
couple, 1 kid	-2.86 (0.43)***	2.47 (0.31)***	-0.98 (0.24)***	-0.23 (0.09)**	1.24 (0.32)***	0.35 (0.27)
couple, $\geq$ 2 kids	-3.05 (0.40)***	2.94 (0.29)***	-1.75 (0.22)***	-0.29 (0.08)***	1.69 (0.30)***	0.47 (0.26)
other househ.	0.72 (0.68)	1.82 (0.49)***	-2.15 (0.37)***	-0.57 (0.13)***	-0.18 (0.48)	0.35 (0.39)
location:						
east germany	0.19 (0.34)	-0.70 (0.23)**	1.04 (0.17)***	0.13 (0.06)*	-0.74 (0.24)**	0.07 (0.22)
time:						
year 2003	8.16 (0.26)***	-6.16 (0.18)***	-1.10 (0.14)***	-0.20 (0.05)***	0.62 (0.19)**	-1.33 (0.16)***
select. terms:						
λ_{dep}	-0.01 (0.01)					
λ_{bui}		-0.03 (0.01)*				
λ_{sto}			-0.21 (0.06)***			
λ_{bon}				0.32 (0.35)		
λ_{ins}					0.02 (0.01)*	
λ_{ccr}						-0.08 (0.02)***
$E[s_j \mid a_{fin} > 0]$	47.7	14.2	5.9	0.8	20.1	11.4
$Pr(a_{fin} > 0)$	0.881	0.881	0.881	0.881	0.881	0.881
$E[s_j]$	42.0	12.5	5.2	0.7	17.7	10.0
Observations	84,046	84,046	84,046	84,046	84,046	84,046
R^2	0.190	0.084	0.065	0.018	0.214	0.142

Notes: Standard errors from ML estimation in parentheses, robust to heteroskedasticity.
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Additional covariates: a constant.
Source: Own calculations using the EVS data (1998, 2003).

Chapter 4

Reform Evaluation[‡‡]

4.1 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 most from the reform. However, these aggregate numbers do 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

[‡‡]This chapter is based on the discussion paper Ochmann (2010b).

demand. The reform is however 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 chapter intends to investigate distributional and welfare effects of Germany's year 2000 tax reform that are related to households' consumption-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 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 is 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. This chapter extends the literature by quantifying distributional and welfare effects of the reform that are related to savings and asset demand. The focus is on the 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.

[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 et al. (1997); Agell and Edin (1990). For Germany, only Lang (1998) conducts a comparable analysis. For more studies, see Section 3.1 of Chapter 3. 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).

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. Furthermore, 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 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 4.3 presents the data applied and the methodology for evaluating the tax reform. In Section 4.4, results for distributional and welfare effects are discussed, and Section 4.5 concludes.

4.2 Germany's Year 2000 Income Tax Reform

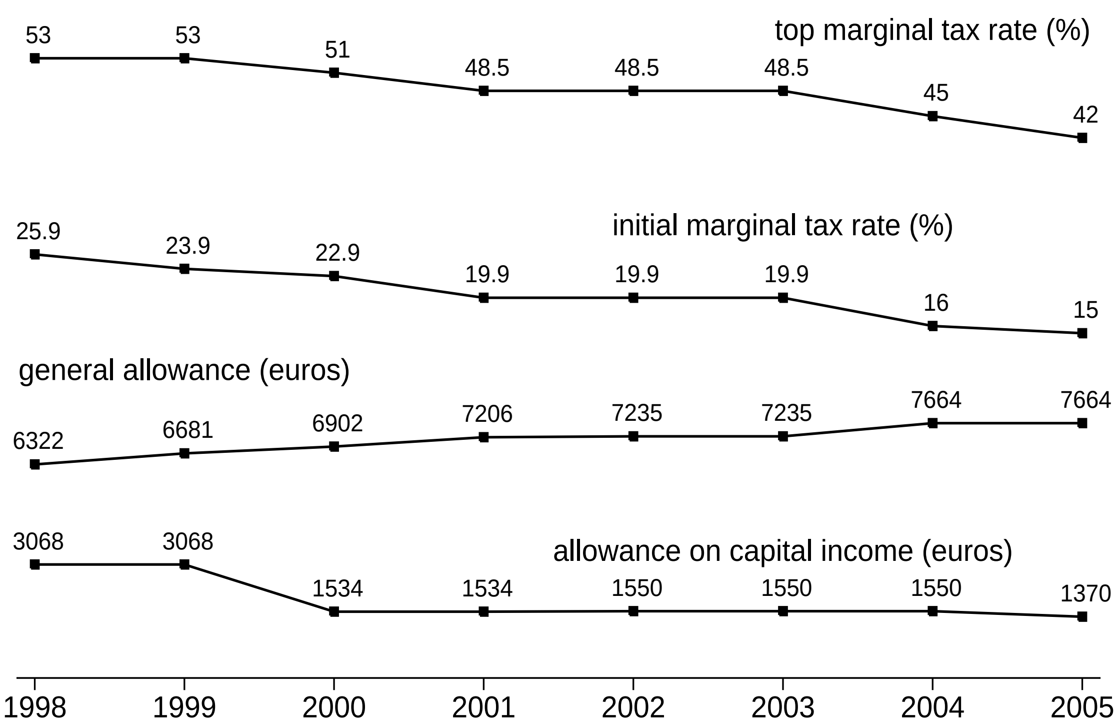
Germany's year 2000 income tax reform was implemented in three steps: the first step was initiated at the beginning of 2001. The second step was postponed to the beginning of 2004 due to excessive costs resulting from a flood in 2002. Finally, the third step of the reform was implemented at the beginning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

However, as this analysis shall only focus on the part of the reform that affected private households, changes at the taxation of corporate profits 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 shifts in the tariff of the PIT, as well as on a couple of reform components related to capital income taxation, that are targeted to broaden the tax base and that may affect households' consumption-savings decision and asset demand, through variation in the net return. The components of the reform that are considered in this analysis are 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 4.1 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 4.1: 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.[2] The tax-free allowance on income from financial capital was gradually reduced, as plotted in Figure 4.1: 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 (*"Halbeinkünftever-*

[2]These changes are mostly based on the "Steuerentlastungsgesetz 1999/2000/2002".

fahren"). 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")[3] were subject to PIT, with only 50% of the net dividend taxable, and the KEST was 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 Appendix 3.9 in Chapter 3 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.[4]

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, resulting in a non-negative income gain, for almost every household through the reform.[5] 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.

4.3 Methodology for Reform Evaluation

The data applied in this analysis stems from the Income and Consumption Survey for Germany (EVS). This data set has already been used for the estimation of the asset demand model in Chapter 3. For details on the EVS data, see Section 3.5 and Appendix 3.10 of Chapter 3.

[3]Net dividends are net of corparate taxes and net of KEST at the shareholder level.

[4]Furthermore, 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.

[5]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 4.4. In fact, the major financing elements of the reform were meant to be adjustments of depreciation rules for companies' assets, which are however not considered here (Bundesministerium der Finanzen, 2004).

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.[6] 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 1998 and 2005, but data is currently only available for 1998 and 2003.[7] 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.

4.3.1 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 Appendix 3.9 of Chapter 3. In the module, the changes at the tax function that are related to the reform, as described in Section 4.2, 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.[8] 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

[6]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 with respect to alternative income concepts.

[7]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 is available.

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

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.[9] Technically, taxable incomes in 1998 prices are inflated by the CPI[10] 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.[11]

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 the asset market are not considered here.[12] Thus, labor supply effects are also not considered here. In Section 4.4, it is discussed how this might affect the results. In the following, a model for household asset demand will be briefly introduced.

4.3.2 A Model for Household Asset Demand

Another aim of this analysis is to evaluate the 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 in addition, by changes in taxation schemes and allowances related to capital income. In order to determine whether households, in addition

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

[10] 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.

[11] 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, for example, 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 4.4.

[12] For a study of effects of tax reforms on asset prices in a general equilibrium framework, see e.g. Hall (1996).

to the income effect through the reform, gain or lose utility by substituting relatively more expensive assets for relatively less expensive ones, household preferences for assets need to be known. As preferences are not observed, they 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 the two-stage budgeting model (2SBM) and modeled in a linearized quadratic almost ideal demand system (QUAIDS), as it is described in detail in Section 3.3 of Chapter 3. In that model, households maximize utility that is generated from a stream of service flows provided by the assets.[13] The structural demand system is defined in Eq. (3.6), budget elasticities in Eq. (3.8), and price elasticities in Eqs. (3.9) and (3.10), which are all to be found in Section 3.3.3 of Chapter 3. Again, for the sake of interpretation, (net) rate-of-return elasticities rather than price elasticities will be presented. They follow from price elasticities according to Eqs. (3.11) and (3.12). 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. (3.6), see also Section 3.3.1 of Chapter 3. Thus, total asset demand can be interpreted as *gross* savings.[14] For more details on the model, see Section 3.3 of Chapter 3.

4.3.3 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, changes in household utility may occur 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 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.[15] The structural demand system in Eq. (3.6) allows for between-asset substitution, so that compensated price (or rate-of-return) elasticities can be estimated.

[13]Service flows of an asset may involve the return to investment, risk-related attributes, transaction-related characteristics, and other asset-specific services. See Section 3.3.1 of Chapter 3, for more details.

[14]When estimated effects are summed up to aggregate asset demand in Section 4.4, effects on asset liquidations are inferred from simplifying assumptions, so that conclusions can also be drawn on *net* savings. Liquidations are however not integrated into the model.

[15]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, 1980b, pp. 184-186).

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.[16] This is the original Hicksian definition of the CV. It shall be applied here in a version that is related to the welfare concept, which actually equals the Hicksian definition with reversed signs (see Appendix 4.6 for the proof).

Following the welfare-concept definition of the compensating variation, the CV can be written as (see Deaton and Muellbauer, 1980b, pp. 184-190):

$$CV_i = c(u_i^1, p_i^1) - c(u_i^0, p_i^1) \tag{4.1}$$

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. (3.10).[17] 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 (1980b), p. 174 or an application in Banks, Blundell, and Lewbel (1996)):

$$c(u^0, p^1) \approx c(u^0, p^0) + \sum_j \frac{\partial c(u^0, p^0)}{\partial p_j^0}(p_j^1 - p_j^0) + \frac{1}{2}\sum_j\sum_k \frac{\partial^2 c(u^0, p^0)}{\partial p_j^0 \partial p_k^0}(p_j^1 - p_j^0)(p_k^1 - p_k^0) \tag{4.2}$$

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

Rewriting the definition of the CV in Eq. (4.1) and using Eq. (4.2), the CV of a combined price and income change can be approximated[18] by estimates for the compensated price

[16] 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).

[17] Note that *price* rather than rate-of-return elasticities should be applied here in order to approximate the expenditures in Eq. (4.1).

[18] 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).

elasticities (see Appendix 4.6 for a detailed derivation):

$$\widehat{CV} \approx y^1 - y^0 - \sum_j p_j^0 q_j^0 \left(\frac{p_j^1 - p_j^0}{p_j^0} \right) \left(1 + \frac{1}{2} \sum_k \widehat{\varepsilon}_{jk}^c \frac{p_k^1 - p_k^0}{p_k^0} \right) \tag{4.3}$$

where $\widehat{\varepsilon}_{jk}^c$ is an estimate for the compensated price elasticity of asset j with respect to price of asset k.[19] Eq. (4.3) 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).[20]

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.[21] Results on estimated elasticities and welfare effects, together with distributional income effects, are presented in the next section.

4.4 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

[19]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).

[20]Generally, there is a trade off regarding accuracy between such a first-order approximation and a second-order approximation of the form in Eq. (4.3). 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 4.5, implications for further research are directed to the investigation into which approximation is the most appropriate for the application at hand.

[21]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 4.4 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.

behavioral response. Secondly, effects of households' demand reactions on savings and asset demand are featured.[22] 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.

4.4.1 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, i. e. for example, 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- 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 4.6.

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 4.1 presents results for first-round distributional effects of the tax reform, where the effects of "bracket creep" are accounted for. Pre- 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 4.1. First-round income gains, defined by differentials in pre- 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.

An average household gains 461 euros per year in equivalent terms by first-round effects of

[22]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.

Table 4.1: 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
Gini_{west}		0.2717	0.2739	0.0022		0.82
Gini_{east}		0.2206	0.2239	0.0033		1.48
GE(-1)		0.1285	0.1319	0.0034		2.59
GE(-1)_{west}		0.1320	0.1352	0.0032		2.44
GE(-1)_{east}		0.0844	0.0874	0.0030		3.47
Theil		0.1236	0.1261	0.0025		2.03
Theil_{west}		0.1238	0.1262	0.0024		1.93
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. 6 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 4.6. 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).

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%).[23] This finding indicates that the reform has a

[23]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

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.[24]

As a consequence, income inequality increases by the reform. In the lower panel of Table 4.1, results for various inequality measures for pre- 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, 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.[25]

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

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.

[24]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.

[25]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. This increase in the income gain through the omission of "bracket creep" is found to be greater in relative terms for low income deciles. Moreover, 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.

pre-reform incomes using SOEP data. This is on the one hand due to a different income concept (net vs. disposable equivalent), and on the other hand to a different base year (2000 vs. 1998).[26] The average income gain through the reform as 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.[27]

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".

4.4.2 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 however 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 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- and post-reform net asset prices vary over the assets. While for some assets, the net

[26] Generally, income inequality slightly increased during 1998 and 2000 in Germany (Bach, Corneo, and Steiner, 2009). Moreover, Becker, Frick, Grabka, Hauser, Krause, and Wagner (2003) point out, that on average net incomes are slightly greater and income inequality slightly lower in the EVS data than in the SOEP data. Though, for 1998 data, this result is based on SOEP data that does 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).

[27] 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.

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 4.2 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%), bonds (<0.00%), bank deposits (<0.00%), and 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.[28] 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.[29] 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

[28] Note that mortgage repayments are treated as an asset here. In 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 Appendix 3.10 of Chapter 3.

[29] 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 4.2: 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.)	Δ_{gross}	%	Net (Pre-Ref.)	Δ_{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 Section 3.3 of Chapter 3. $\widehat{\varepsilon}_{jj}^{(r)u}$ 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).

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 4.2). Net prices are invariant for consumer credit repayments as the latter 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 slightly decreases on average (0.12%), while the price for financial assets increases on average (0.58%). Finally, this lets the net price for savings in general decrease slightly by 0.20%.[30] This price decrease induces households

[30]This decrease in the savings price corresponds to an increase in the rate of the return of about 0.20 percentage points, for example 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

to substitute consumption for savings, as will be derived from the demand model in the following. Furthermore, households have asset-price related incentives to substitute relatively more expensive assets for relatively cheaper assets, due to the changes 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 3.3 of Chapter 3. For methodological issues concerning its estimation, see Section 3.4 of Chapter 3. 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, resulting in 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 4.2, both for demand levels.[31]

As the first column of Table 4.2 reveals, savings are found to be elastic with respect to 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 relative price shifts.[32] 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 asset accumulations, there results an increase of annual *net* savings by 107 euros for an average household.[33]

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 4.2). In addition to the 107 euros from the income effect, an average household increases annual net savings by 23 euros due to a decrease 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 4.1). This implies a marginal savings rate of 18.6% at the household

decrease in the price for housing assets. For details, see Section 3.10 in Chapter 3.

[31] 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 Section 3.6.1 of Chapter 3.

[32] This budget elasticity is estimated in Chapter 2. Its size is almost identical with respect to current and permanent income. Therefore, the results presented here could be interpreted as valid for the short term, as well as for the long term.

[33] 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.

level. Effects on the aggregate savings rate will be analyzed in the next subsection.

These additional savings are then at the first stage of the model 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 4.2) and for the latter inelastic (0.94) with respect to 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 is increased if the own-rate of 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.[34] The estimates for the rate-of-return elasticities are discussed in more detail in Section 3.6.1 of Chapter 3.

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 4.3. 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 4.2 reveals in the last two columns. Relating this increase to the increase in disposable income through the reform, which results here as 25.51 bn. euros aggregated to the

[34]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.

population of private households, the aggregate net savings rate increases by 0.17 percentage points, from 10.92% to 11.09%, through the reform.[35]

Aggregate demand shifts can be further analyzed, differentiated by the single assets. Given the pre- and post-reform price differentials, together with the estimated demand elasticities in the first three columns of Table 4.2, households' cumulated asset demand reactions can be quantified. These aggregate sums are in turn compiled in columns four to eight of Table 4.2. 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 of the reform. 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, bank deposits, and bonds. Accumulations also increase relatively strongly for owner-occupied housing and for stocks, in spite of rising prices.[36] 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 4.2. 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, bank deposits, and 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 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.[37] 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 for

[35] 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, 2007a). However, comparability of the micro with the macro aggregates is limited due to conceptual reasons, also see Section 2.4 in Chapter 2.

[36] 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.

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

"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 from 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.

4.4.3 Second-Round Distributional Effects

If the effects from the demand reactions discussed in the preceding subsection are considered in addition to 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 4.3. 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 gain, 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 the substitution effect, the latter 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 in the first-round effects. The second-round income effects are not yet the entire effects of the tax reform. Households'

Table 4.3: 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
Gini_{west}		0.2717	0.2739	0.0022		0.79
Gini_{east}		0.2206	0.2238	0.0035		1.54
GE(-1)		0.1285	0.1318	0.0033		2.54
GE(-1)_{west}		0.1320	0.1352	0.0032		2.39
GE(-1)_{east}		0.0844	0.0873	0.0029		3.42
Theil		0.1236	0.1260	0.0024		1.98
Theil_{west}		0.1238	0.1261	0.0023		1.88
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. 6 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 4.6. 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).

savings and asset demand reactions may cause, in addition to the capital income losses, utility losses that reduce the income gains in money-metric terms. These shall be focused in the following.

4.4.4 Welfare Effects

In addition to the income gains from the second-round effects, changes may occur 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 increase on average 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 are lower than the income gains.[38] 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 4.4: 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. 6 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 4.4. They are needs adjusted by the applied equivalence scale and are thus comparable in absolute terms to the second-round income gains that were presented in Table 4.3. Welfare effects are quantified by the compensating variation, which is approximated by compensated price elasticities (see Section 4.3.3). Estimates for the elasticities are relegated to Table 4.5 in Appendix 4.7, where compensated *rate-of-return* elasticities from demand-system estimations on the pooled 1998

[38] 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.

and 2003 data are compiled.[39] Table 4.4 shows that, for an average household, the welfare effects of the 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 however 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.[40] 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 4.4) 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 4.1). The welfare effects may, however, vary furthermore 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

[39]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. (3.12).

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

asset demand 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 4.6 in Appendix 4.7.

It becomes apparent from the coefficient estimates in Table 4.6, 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 however 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.[41]

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 for only three out of nine assets do 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.[42] Moreover, further utility losses could occur if substitutive effects

[41]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.

[42]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 average 34% (153 euros in annual equivalent income) lower than income gains (449 euros) if labor supply effects are

within the 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 therefore be interpreted as rather a part of the total effects.

4.5 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- 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 in relative terms. As a result, inequality in the income distribution increases due to the reform. The increase in inequality is found to be largely related to the lower, 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 only some 321 euros (1.98%) 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, bank deposits, and 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 bn. euros per year. The aggregate increase in disposable household income amounts to

accounted for.

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, such as 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 should be noted that the income and welfare effects of the tax reform that are found here should be interpreted only as a part of the total 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 furthermore investigate the question of 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 of 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 the substitution of assets, 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 savings and asset demand. This opens up another avenue for potential further research.

4.6 Appendix - Data and Methodology

Indices of Inequality

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

$$I_{GE} = \frac{1}{2n} \sum_{i=1}^{n} \left(\frac{\bar{x}}{x_i} - 1 \right) \tag{4.4}$$

The Gini coefficient is defined as:

$$I_{Gini} = \sum_{i=1}^{n} \frac{x_i}{n\bar{x}} \frac{(2i - n - 1)}{n} \tag{4.5}$$

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

$$I_{Theil} = \frac{1}{n} \sum_{i=1}^{n} log \left(\frac{x_i}{\bar{x}} \right) \frac{x_i}{\bar{x}} \tag{4.6}$$

Definition of the Compensating Variation

Following the welfare-concept definition of the compensating variation, the CV can be written as (see Deaton and Muellbauer, 1980b, p. 186): $CV_i = c(u_i^1, p_i^1) - c(u_i^0, p_i^1)$. Rewriting and applying the fact that $c(u^1, p^1) = y^1 = y^0 = c(u^0, p^0)$, it can be easily shown that the definition of the CV according to the welfare concept, which is applied here, equals the Hicksian definition with reversed signs:

$$\begin{aligned} CV_i &= \quad c(u_i^1, p_i^1) - c(u_i^0, p_i^1) \\ &= \quad c(u_i^0, p_i^0) - c(u_i^0, p_i^1) \\ &= - \big(c(u_i^0, p_i^1) - c(u_i^0, p_i^0) \big) \\ &= - CV_i^{Hicks} \end{aligned} \tag{4.7}$$

where CV_i^{Hicks} denotes the Hicksian definition of the CV.

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 (1980b), p.174, or an application in Banks et al. (1996)):

$$c(u^0,p^1) \approx c(u^0,p^0) + \sum_j \frac{\partial c(u^0,p^0)}{\partial p_j^0}(p_j^1 - p_j^0) + \frac{1}{2}\sum_j\sum_k \frac{\partial^2 c(u^0,p^0)}{\partial p_j^0 \partial p_k^0}(p_j^1 - p_j^0)(p_k^1 - p_k^0) \tag{4.8}$$

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

$$\frac{\partial c(u^0,p^0)}{\partial p_j^0} = h_j(u^0,p^0) = q_j^0 \tag{4.9}$$

it follows from Eq. (4.8) that

$$c(u^0,p^1) \approx c(u^0,p^0) + \sum_j q_j^0(p_j^1 - p_j^0) + \frac{1}{2}\sum_j\sum_k \frac{\partial h_j(u^0,p^0)}{\partial p_k^0}(p_j^1 - p_j^0)(p_k^1 - p_k^0) \tag{4.10}$$

where $h_j(u^0, p^0)$ denotes pre-reform Hicksian demand for asset j. Rewriting the welfare-concept definition of the CV in Eq. (4.1) and applying the fact that $c(u^1, p^1) = y^1$, yields:

$$CV = y^1 - y^0 - c(u^0,p^1) + c(u^0,p^0) \tag{4.11}$$

Plugging Eq. (4.10) into Eq. (4.11) and rearranging, it follows that:

$$CV \approx y^1 - y^0 - \sum_j p_j^0 q_j^0 \left(\frac{p_j^1 - p_j^0}{p_j^0}\right)\left(1 + \frac{1}{2}\sum_k \widehat{\varepsilon}_{jk}^c \frac{p_k^1 - p_k^0}{p_k^0}\right) \tag{4.12}$$

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

4.7 Appendix - Results

Table 4.5: 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 4.6: OLS Regression of Welfare Effects on Savings Ratio

dependent variable: welfare effect in equivalent 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: † $p < 0.10$ * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Savings ratio is for *gross* savings, defined as total disposable assets related to disposable income.
Source: Own calculations using the EVS data (1998).

General Conclusions

For general conclusions from this dissertation, the last chapter shall be structured into three sections. Firstly, the main findings of all four chapters are summarized. The focus here shall be mainly on results that are of further relevance for economic and social policy. A couple of, certainly not guidelines, but at least implications for policies shall be elaborated from the results in the second section. In addition to some implications that were given in the single chapters, implications shall be drawn from the composition of all chapters together. Finally, some avenues for further research shall be highlighted in the last section. Here, major points that have already been mentioned in the chapters are summarized in the context of the entire analysis.

Main Findings

The focus of Chapter 1 was on the basic background for the subsequent analyses. This chapter contributed to the growing literature on German wage inequality during the 2000s. In particular, covariance structure models were applied to decompose cross-sectional variance of wages in Germany over a period between 1994-2006 into permanent and transitory components, in order to examine the potential driving forces behind the recent growth of permanent wage inequality in Germany. Results point to a source of growing uncertainty related to income of private households in Germany. The relevance of transitory income variation was found to increase compared to permanent variation. The results identify a break in the trend of growing permanent wage inequality around 2001. While cross-sectional wage inequality steeply rises after 2001, its permanent fraction drops significantly and then stabilizes at around its 2001 level. This evidence implies that the strong expansion of cross-sectional wage inequality in Germany during the 2000s can be increasingly attributed to transitory inequality. It should though be noted that the conclusions can only be drawn for the restricted population of full-time employed males here, as the model is, for methodological reasons, limited to this sample.

The finding of increasing relevance of transitory income inequality then provided the background for Chapter 2 in terms of developments in the environment in which private households decide which fraction of their disposable income to consume and which to save. The consumption-savings decision was modeled in a structural demand system as a function of current household income, net returns to savings, and the consumption price level. It was found that savings are a superior good and, therefore, that consumption is an inferior good, estimating the income elasticity of savings at 1.8 and of consumption at 0.7. Households were moreover found to exhibit no reactions in their level of savings to changes in the rate of return. The basic model was extended to allow for effects of uncertainty in transitory household income. The finding of significant effects of transitory income uncertainty on the consumption-savings decision was interpreted in the context of precautionary savings.

It was found that an average household increases savings by 4.4% in response to a doubling of average transitory income risk. The effects of income uncertainty on the consumption-savings decision were found to vary by household composition and especially by social status. Apparently, kids in a couple's household restrict that part of the budget which is flexibly disposable for purposes of precautionary savings. It was also found that transfer recipients are rather inelastic towards transitory income uncertainty, as they have only a small budget disposable for adjusting savings to a shock. So are public servants, who face a relatively low group-specific income risk and usually devote additional savings to mandatory contractual savings that were beyond the analysis here. The greatest uncertainty effects were found for households that live mainly on capital income, for which savings determine the main source of income. It shall be noted, however, that the results discussed here can only be a proxy for the actual effects of transitory income uncertainty that households face. As the timing, as well as the magnitude, of a transitory income shock is naturally unknown ex ante, the estimated effects can only approximate the actual mechanism behind temporary income uncertainty and households' intertemporal consumption allocation. Ideas on improvement of this proxy shall be proposed below on an avenue of future research.

The results for the savings reaction of private households to changes in the interest rate were then further applied in Chapter 3 to analyze rate-of-return related effects on the subsequent decision to allocate the amount of savings to various types of assets. A structural system of asset demand was estimated in the framework of a two-stage budgeting model, where asset demand was modeled as a function of the own rate of return as well as cross rates of return. Demand was found to be elastic with respect to the own rate of return for mortgage repayments, owner-occupied housing, non-owner-occupied housing, insurances, and bank deposits. Moreover, substitutive relations were found for many assets, like stocks and bonds, bonds and insurances, or bonds and consumer credits. However, complementary effects were found for mortgages and housing assets, for bank deposits with stocks, and for bank deposits with building-society deposits.

Furthermore, in a simplified form of the model, effects of differential taxation of capital income on decisions of portfolio choice and asset allocation at the household level were investigated. Results suggest that households in Germany structure their asset portfolios according to incentives from rate-of-return-related subsidization, at least as far as differential taxation of asset returns and other income is concerned. Specifically, households facing relatively higher marginal income tax rates were found to have relatively greater demand for tax-privileged assets than households in the lower tax brackets. A 10%-points increase in the household's marginal tax rate was found to increase unconditional demand for non-owner-occupied housing assets (from a share of 1.1% from total disposable assets to 1.2%), mortgage repayments (from 12.5% to 12.9%), and capital and private old-age pension insurance assets (from 15.8% to 16.6%). Demand for some less privileged assets is reduced, as for bonds (from 0.8% to 0.7%) and especially for owner-occupied housing (from 3.1% to 2.3%), while it is increased for other less privileged assets, as for stocks (from 5.7% to 5.9%). Demand effects for assets that are not privileged in the tax system are ambiguous: while demand is reduced for bank deposits (from 40.1% to 39.3%), it is increased for consumer credit repayments (from 9.1% to 9.8%) and building society deposits (from 11.9% to 12.1%).

One major limitation of the model for portfolio choice and asset allocation, that was constructed in this chapter, is the restricted focus on asset *accumulations* that was undertaken for technical reasons. There are, moreover, potential effects of capital income taxation on the decision to liquidate assets that were not modeled explicitly here. While it was controlled for selection into positive accumulations of each asset at the estimation approach, and the results on the tax effects were found not to differ significantly when selection is omitted, mechanisms may still exist within the liquidation decision that could spill over to the accumulation decision and that are not captured by this approach. The integration of the liquidation decision shall be framed on another avenue of future research below.

In Chapter 4, constructed tools and major findings from all the preceding chapters were assembled and applied to evaluate a policy reform. In this chapter, distributional effects and welfare effects of Germany's year 2000 tax reform, that are related to households' consumption-savings, as well as asset allocation behavior, were investigated. Effects were quantified by simulating the reform with the help of an income taxation module in the framework of a static behavioral microsimulation model of household savings and asset demand. Generally, income gains were found for about 70% of all households, and 83% of all households were found to be better off through the reform in welfare terms. However, welfare effects were found lower than income gains for almost all households.

Specifically, when accounting for adjustments of households' consumption-savings behavior, as well as asset demand, through the reform, second-round distributional income effects were 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 were found to increase along the distribution of taxable income. As a result, inequality in the income distribution was found to increase due to the reform. The increase in inequality was found to be largely related to the lower, as well as the higher, end of the distribution, while leaving mid-level incomes less affected. The results were found to differ by region, as income gains amount to 490 euros (2.27%) for an average household in West-Germany and to only some 321 euros (1.98%) in East-Germany. The increase in inequality was found to be slightly stronger in East-Germany.

The income gains, together with changes in relative asset prices resulting from shifts in the tax tariff and adjustments of allowances for capital income, induce households to alter their consumption-savings behavior as well as asset demand. When the effects are aggregated up to the population, the increase in disposable household income amounts to 25.5 bn. euros per year, by which amount in turn the income tax revenue declines. A strong income effect, together with a positive price effect on compound savings, induces households to increase aggregate net savings by 4.24 bn. euros per year, which corresponds to an increase in the net savings rate by 0.17 percentage points, from 10.92% to 11.09%. Broken down by asset types, relatively stronger demand effects were found in assets for which the income gains have a strong effect on demand, and which become relatively cheaper in after-tax terms through the reform, namely non-owner-occupied housing, bank deposits, and bonds.

These substitutive effects at the consumption-savings behavior and asset demand lead to utility losses for most of the households. The resulting welfare effects were found to be, on average, lower than income gains. They amount to 439 euros per year in equivalent terms (2.13% of disposable equivalent income). Welfare effects were found to be lower than income gains for almost 90% of all households. This result holds qualitatively over the entire income distribution, as well as by region. The utility loss from asset substitution was found to be greater, in absolute terms, for households with relatively high savings ratios resulting from greater asset demand.

It should be noted that the income and welfare effects of the tax reform that are found here should be interpreted only as a part of the total effects, as several additional potential effects were neglected, namely labor supply effects, substitution effects between accumulating and liquidating assets, or between various commodity groups among the consumption decision. The effects found should rather be interpreted as short-term effects. In the long run, on the one hand, a balanced fiscal budget would probably draw back some, if not all, of the income gains from the households, and on the other hand, shifts in market asset prices could cause additional income, as well as welfare, effects.

Policy Implications

The effects of taxation on the level and structure of savings of private households have traditionally been characterized as one of the central issues in public finance. From an economic or social policy point of view, several aspects evolve advocating the relevance of this topic. On the one hand, there are potential efficiency-related issues concerning the economy: short-term effects on employment and inflation could occur, medium-term effects on the growth rate could be non-negligible, and the capital intensity could be significantly affected in the long term. On the other hand, distributional policies may be concerned about implied factor-related transfers from labor to capital, household-related transfers from low-income households to high-income households, or generation-related transfers from current to future generations or within the former, from younger in-workforce cohorts to older retired cohorts (Sandmo, 1985).

In the literature on the optimal taxation of capital income, there has been an ongoing debate about the optimal level of the tax rate on capital, ever since. When compared to a tax on labor income, or to a (time-constant) consumption tax, the specific welfare costs of a tax on capital income can be framed by the distorting effects on the intertemporal allocation of resources. The traditional approach of evaluating the incidence of a tax on capital income can be traced all the way back to the Harberger approach, where the deadweight loss of taxation was approximated by a function of the compensated interest rate elasticity of savings and the square of the tax rate (Harberger, 1962). This approach was extended in subsequent work by life-cycle models with endogenous steady-state growth and overlapping generations, or infinitely-lived agents in static general equilibrium settings, mainly advocating the conventional optimal-taxation view of the public finance literature, which favors either a lump-sum tax on capital in the first period only (first-best), or a tax on capital income that is close to zero, at least in the long run (second-best), see inter alia Diamond and Mirrlees (1971); Summers (1981); Chamley (1986).

Conclusions became more distinct when the labor market was integrated into the models and further distortionary instruments of taxation became available. Results were theoretically ambiguous, as to which is more harmful, a tax on labor income, on capital income, or on consumption, and the need for empirical investigation of savings and labor supply elasticities was underlined (for example Feldstein, 1978; Auerbach, Kotlikoff, and Skinner, 1983), and aspects of intergenerational redistribution in the context of distortionary taxation on the two integrated markets for labor and for capital were emphasized (Atkinson and Sandmo, 1980).

Still, evidence on the second-best tax system remained ambiguous and heavily dependent on empirical findings for labor, consumption, and savings elasticities (see Sandmo, 1985, for a survey).

Subsequent analyses abstracted from the standard life-cycle framework and introduced aspects like bequest motives, liquidity constraints, and uncertainty, into the positive and normative incidence of capital income taxation (see the survey by Bernheim (2002)). These features may alter the welfare implications of capital income taxation significantly, primarily by its effects on the interest elasticity of savings. If the latter is lowered due to the presence of other savings motives besides the rate-of-return maximization, welfare costs could also be mitigated in turn. Theoretically, uncertainty related to various model components could affect agents' sensitivity to changes in the rate of return, where uncertainty, with respect to the rate of return itself, might come to mind first of all. However, the greatest focus in the literature is put on uncertainty in the process of income and resulting household reactions to save for precautionary motives in order to secure a certain future income stream, which was also investigated in the first two chapters of this dissertation.

Increasing relevance of transitory income uncertainty (Chapter 1) is found to induce households to save for precautionary motives and secure against uncertainty (Chapter 2). However, this result does not relate to savings that are rather dedicated to the longer term, as for old-age private pensions or for investment into corporate finance. It is of fundamental relevance for economic and social policy to understand the pattern behind the intertemporal consumption allocation rationale of private households, in order to guarantee a minimum level of old-age income for the retired, as well as sufficient funds for financing corporate investments to secure long-term employment and economic growth. What are the most efficient tools of economic and social policy when the incentive structure of public subsidies on private savings meets the intertemporal consumption rationale of economic agents?

If the focus is on the level of compound savings, it appears that increasing transitory income uncertainty is a better incentive for private households to save more, than any shift in the rate of return, as uncertainty is found to increase compound savings, whereas the uncompensated interest rate elasticity of savings is estimated close to zero. An attempt to increase the incentives to save more for old age by subsidizing savings in certain assets, for example, would not have any effects on the exterior margin, as the amount of compound savings remains unchanged. A price-induced increase of savings in a certain type of asset (for example, those subsidized in the Riester-scheme) can thus only be obtained on the *interior* margin by shifting savings from other assets, whereas the general consumption-savings behavior is unaffected, at least by price-related incentives.

However, increases in disposable income seem to cause more effective incentives to increase savings, as compound savings are found to be elastic with respect to current, as well as permanent and transitory income. This result does however just hold for *compound* savings, whereas the effects are diverse among the assets of a portfolio. This finding is of particular policy relevance, as the portfolio of assets, which are subsidized in the framework of the Riester-scheme, is gradually extended in Germany, covering today certified insurance contracts, as well as owner-occupied housing assets ("Eigenheimrente"). Against the background of the above findings, further extending the range of subsidized assets might reduce the potential for substitutive re-allocation of savings at the interior margin that is intended by state subsidies. However, a closer policy reform analysis appears to be necessary to draw precise conclusions here and shall thus be piloted in future work.

Qualitatively, these policy implications also hold for policy reforms affecting the consumption price. The low consumption price elasticities of savings found in Chapter 2 suggest that households do not substitute between contemporaneous and future consumption if after-tax commodity prices change. An increase, for example, in the value-added tax would induce households to reduce their current consumption just by the negative price effect on income, but would in turn leave their level of savings unchanged. Again, only by reforms affecting disposable income, could the level of savings be altered. Moreover, empirical findings from the consumption-savings model suggest that households react slightly differently in response to a shift in the consumption price and in response to a change in the interest rate. The finding that compound savings are more elastic towards consumption price shocks than towards shocks in the interest rate, suggests the policy implication that a tax on capital income would be favorable, in welfare terms, compared to a consumption tax.

Generally, while for a positive analysis of price effects on the level of savings – for example regarding growth of the capital stock or intergenerational distribution – the uncompensated elasticity is meaningful, for a normative evaluation in the context of welfare effects, it is the *compensated* elasticity that is relevant. From a welfare perspective, the efficiency of a subsidization of private savings for old-age income is generally not unambiguous. The Riester-scheme can not be regarded as a Pareto improvement in classic theoretic terms, as not all households that contribute to the financing of the subsidies by paying taxes are eligible to benefit from them, for example the self-employed. Further welfare costs would occur if savings decisions are distorted by shifts in relative prices and transaction costs are non-negligible (Corneo et al., 2009). The effects of changing relative prices are of even more consequence when it comes to asset allocation decisions.

In the traditional public finance literature on the welfare effects of capital income taxation, the savings decision was usually formulated in terms of the purchase of a single homogeneous asset, largely abstracting from the allocation of savings to a portfolio of assets (Sandmo, 1985).

However, recent literature finds heterogeneity in the effects of taxation and concludes that the effects of capital income taxation on the total volume of savings are less important than its effect on the *composition* of savings (for example Attanasio and Wakefield, 2010).

The classic argument for a systematic taxation effect on portfolio choice is formulated in terms of risk-taking behavior. The potentially distorting mechanism centers around sharing the risk in the expected returns by the investor and the government. If returns are taxed in the case of gains, and if they are tax-deductible in the case of losses, the risk is shared by the two parties. Moreover, if investors put a sufficiently large weight on the loss-sharing property of the tax, it is not clear from an ex-ante point of view whether taxation discriminates against risk taking or encourages it (Sandmo, 1985). The finding of Chapter 3, that demand for stocks is increased if the marginal tax rate increases, suggests that taxation supports risk-taking. However, reduced demand for bonds – which can be regarded as a risky asset, though probably less risky than stocks – rather advocates discrimination of risk taking. The implications are however confined, if it is in addition accounted for that the income process the investor faces is also subject to uncertainty (Chapter 2). In any case, if households are assumed to have a preference structure for the service flows of several assets, including risk-related attributes (Chapter 3), and if households' are induced to substitute assets by incentives from relative price shifts, for example in the course of a tax reform (Chapter 4), utility losses occur that can be quantified in terms of welfare costs.

Against this background, it is astonishing that empirical evidence on welfare effects of differential taxation of capital income in the portfolio context is still very scarce in the literature until now. This is probably due to the lack of suitable structural models for asset demand, which are necessary for a quantification of substitutive reactions and their welfare implications. There are a couple of studies on the effects of capital gains taxation mainly for the U.S., surveyed in Poterba and Samwick (2002). However, even in the state-of-the-art literature in this field, the construction of a structural portfolio model for the estimation of welfare costs is still on top of the agenda for future research (Alan et al., 2010).

The results from the estimation of the structural asset demand model in Chapter 3 shed some light on this issue. A positive evaluation of the main findings from the interior margin, where savings can be shifted from other assets, draws a different picture with respect to substitutive price-related reactions than discussed for the exterior margin above. If the focus is turned to the structure of savings with respect to types of assets, rate-of-return elasticities are found to be relatively great for, among others, owner-occupied housing as well as capital and private pension insurances. These results suggest that households react to incentives related to the rate of return of such assets, as opposed to compound savings, which corresponds to the results from the recent literature (for example Attanasio and Wakefield, 2010). In light of these findings, an implication for economic or social policy concerned with stimulating households to reduce risk-taking activities, and rather increase savings for old-age income, because the latter are too low from a social point of view, due to some market imperfections, or due to agents discounting the future at a higher rate than the public discount rate, shall be accentuated. The results suggest that state subsidizations of owner-occupied housing, or contributions to private old-age pension insurances, could induce households to increase savings in such assets *at the interior margin*, i. e. by shifting savings from other assets, however, households are not expected to accumulate additional savings. Again, targeted policy reform evaluation appears inevitable for further conclusions.

The implications need to be refined when effects of changes in households' disposable income on the interior savings margin of asset allocation are evaluated. While housing assets are shifted elastically with respect to the budget, insurance contributions are shifted inelastically. Thus, if the aim is to increase both for old-age income, owner-occupied housing assets as well as contributions to private pension insurance funds, the former could be achieved by both, increases in disposable income as well as rate-of-return related incentives, while the latter appears accomplishable more effectively by return-related incentives, as for example bonuses on contributions to state-certified old-age pension savings contracts in the Riester-scheme.

Moreover, if the aim is to increase the stock of owner-occupied housing in the population, for example because it could serve as an additional source of old-age pension income, this appears to be better accessible by income- or return-related incentives to housing assets directly, than indirectly by incentives related to instruments that are meant to encourage savings for home-related purposes, as building-society savings contracts. Rate-of-return elasticities are found to be relatively lower, and demand inelastic with respect to budget changes for building-society savings deposits. In this light, the integration of owner-occupied housing in the subsidizing Riester-scheme ("Eigenheimrente") appears to be a reasonable instrument as a compensation for the abolishment of the home-building allowance ("Eigenheimzulage"). However, it remains unclear if such incentives are generally equally effective when they are related to the taxation of capital income, or when they are related to direct cash subsidies on these assets. For a better understanding, again, further targeted policy reform evaluation appears necessary.

Regarding normative evaluation of the effects at the interior savings margin, the welfare effects found in Chapter 4 provide some conclusions. The results from the evaluation of Germany's year 2000 tax reform imply that welfare costs of capital income taxation are not very large, even when substitutive effects at the allocation of compound savings to a portfolio of assets are accounted for, in addition to the distortion of the intertemporal allocation of consumption. However, also here, it remains to investigate in future research whether welfare costs of capital income taxation are significantly greater if additional aspects are considered, see below. Finally, there will always remain aspects that are certainly relevant determinants in agents' intertemporal allocation of resources, that can however not be captured in the framework of a model, primarily due to lack of appropriate data. If economies are hit by world-wide shocks like the recent crisis on the financial markets, a single household's asset allocation rationale is probably affected in so many dimensions that identification of effects related to specific policy instruments appears hardly feasible. In the light of such limitations it only remains to proceed with what *can* be done in further research to improve the analysis.

Further Research

One of the major challenges, in the study of taxation in the context of savings and asset allocation, appears to be the ever-changing nature of the tax law environment. While the results found in this dissertation for the effects of differential taxation in this context suggest that households could be induced to increase savings in, for example, housing assets or state-certified savings contracts to secure old-age income, the question remains open, if this is actually the case for the various specific subsidization instruments implemented in German tax law. The home-building allowance ("Eigenheimzulage"), for example, was abolished in Germany in 2006. It was granted on owner-occupied housing and has been substituted since 2008 by the integration of owner-occupied housing in the subsidizing Riester-scheme ("Eigenheimrente"). The model developed in Chapter 3 shall be applied in further research in order to analyze the distributional and welfare effects of this substitution of subsidizing policy instruments. Similar analyses could be conducted regarding other policy instruments of subsidizing asset accumulation in Germany, for example building society premiums ("Wohnungsbauprämie"), which are paid for building society deposits, savings bonuses for employees ("Arbeitnehmersparzulage", see OECD (2007) for a description), which are paid for contributions to capital formation that are directly invested by the employer out of basic salaries ("vermögenswirksame Leistungen").

Another topic of further research shall be a policy evaluation of the introduction of a withholding tax on income from financial capital. In the course of the latest corporate tax reform in Germany in 2008, a homogeneous tax rate for income from financial capital in the form of a flat tax of 25% ("Abgeltungsteuer") was implemented, separating the taxation of financial capital income from the taxation of labor income. Alternative reform proposals could be analyzed in a comparing study. Furthermore, the shift in the taxation scheme of capital income from dividends from the imputation scheme to the half-dividend scheme, as it was subject to analysis in Chapter 4 in the context of Germany's year 2000 tax reform, could be analyzed separately in a policy reform evaluation. The asset demand model developed in this dissertation shall be further applied to evaluate distributional as well as welfare effects, regarding distorting effects for the consumption-savings decision and the portfolio choice of the various afore mentioned recent reforms in German tax policy.

Some points of future study appear on the agenda that have a rather practical purpose of immediate improvement on the conducted work. The error components model of income dynamics (Chapter 1 and 2) could be extended by a specification of a random walk for the permanent variance component. Furthermore, a plan to improve on the consumption-savings model includes the construction of a pseudo-panel on the LWR data in order to control for household/cohort-specific effects and in order to circumvent the imputation of the estimates of the process for income dynamics from the panel data and have a better capture of household heterogeneity, in the proxy for income risk at the household-level. Also, price expectations shall be modeled in a dynamic approach. The model for income uncertainty could moreover be extended to the self-employed and to business owners along the line of the state-of-the-art literature of precautionary savings (Fossen and Rostam-Afschar, 2009; Hurst et al., 2010). However, this would demand an additional data set on these groups. For this purpose, the "SAVE" data from the Mannheim Research Institute for the Economics of Aging appears to be an interesting source, which opens up several avenues for itself, for further analyses.

Once micro data from the 2008 cross-section of the Income and Consumption Survey for Germany (EVS) is available, the microeconometric asset demand model shall be tested for parameter stability by an out-of-sample prediction for the 2008 data. If this test certifies the model stability, data from the 2008 cross section shall be applied to expand the data base and increase efficiency of the model. Then, the evaluation of Germany's year 2000 tax reform shall be conducted in an ex-post analysis. Alternatively, the first step of the reform, which was implemented in 2001, could be analyzed in an ex-post evaluation with micro data on the 2003 cross section.

As far as the structural asset demand model is concerned, several challenging extensions appear attractive. The model would certainly benefit from an integration of further economic decisions. The most relevant one appears to be the decision of whether to liquidate the stock of assets. The major focus in the literature dealing with the topic of asset liquidations is on the optimal timing of when to sell an asset and realize accrued gains, where for example "lock-in effects" of capital income taxation – especially that part that is related to gains from price arbitrage asset sales – play a relevant role (Poterba and Samwick, 2002; OECD, 2006). It shall thus be left for further research to integrate the asset liquidation decision into the savings and asset demand model in order to account for additional potential taxation effects.

Further research could also integrate the labor supply decision into the consumption-savings and the asset allocation decision. An integration would be particularly interesting if it is considered that policy reforms, that aim at shifts in the marginal tax rate on income in general, thereby affect the after-tax rate of return to all assets that are subject to taxation, to savings in general, as well as to the after-tax wage rate. The optimal portfolio choice would then be related to labor supply, and the household would allocate disposable income to current and future consumption in accordance with the decision how many hours to work. This context could moreover be extended by elements of risk related to portfolio choice, if it can be assumed that households have heterogeneous risk preferences and that some assets bear more risks than others. Then, an integration of the labor market would moreover allow for interrelations between portfolio risk and occupational choice in the context of occupational risks (Sandmo, 1985). However, the integration of the labor supply decision appears to be very challenging as several data sources would have to be integrated.

Another, certainly valuable, extension of the model would be an integration of asset supply. When the model was applied in this dissertation to static behavioral microsimulation techniques, a partial equilibrium on the asset markets was assumed. There is evidence that the assumption of equilibrium asset prices is violated in the context of the tax reform under analysis in Chapter 4 for some assets. Resulting third-round effects could be non-negligible and would enrich future reform analyses conducted with this asset demand model. Moreover, alternative welfare measures shall be applied and compared with respect to their value added.

Another topic, that appears to be highly state of the art and should thus be subject to analysis for further work, concerns the factors of influence for the relation between taxation and savings as well as portfolio choice behavior that go beyond rationality. The impact of taxation on household savings and portfolio choice is a research field that already attracted attention from the disciplines of public economics as well as financial economics. But, there are more research areas affected here. There is a significant amount of literature in behavioral finance suggesting that models of purely rational agents can not capture household rule-of-thumb behavior in the context of changes in the tax law environment. One issue of interest is, for example, the question from financial literacy to what extent the lack of ability to do basic calculus affects households' reaction to changes in the tax law environment (Lusardi and Mitchell, 2009), or with which delay in time responses are undertaken to substantial changes in the tax system (Poterba and Samwick, 2002). The recent literature in this area also looks at cognitive abilities in general in the context of pre- and post-retirement wealth trajectories (Banks, O'Dea, and Oldfield, 2010), in the context of the allocation of household wealth to financial assets (Smith, McArdle, and Willis, 2010), or in the context of the propensity to invest in stocks (Christelis, Jappelli, and Padula, 2009). Several further avenues for future work appear attractive in this context.

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List of Abbreviations

2SBM	Two-stage budgeting model
AIDS	Almost ideal demand system
BLUP	Best linear unbiased prediction
CPI	Consumer price index
CV	Compensating variation
DAX	Deutscher Aktienindex
EHZ	Eigenheimzulage
EStG	Einkommensteuergesetz
EVS	Einkommens- und Verbrauchsstichprobe
FDZ	Forschungsdatenzentrum der Statistischen Landesämter
FGLS	Feasible generalized least squares
GDR	German Democratic Republic
GE(-1)	General entropy index
GE(1)	Theil index
GMM	Generalized method of moments
IABS	Employment samples from the Institute for Employment Research of Germany's Federal Employment Agency
IIA	Independence of irrelevant alternatives
KEST	Kapitalertragsteuer
LCPIH	Life-cycle/permanent income hypothesis
LIML	Limited information maximum likelihood
LWR	Laufende Wirtschaftsrechnungen

MNL	Multinomial logit model
MTR	Marginal tax rate
NLM	Nested logit model
NLS	Non-linear least squares
NOO	Non-owner-occupied
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary least squares
OO	Owner-occupied
PIGLOG	Price-independent generalized logarithmic
PIT	Personal income tax
QUAIDS	Quadratic almost ideal demand system
SOEP	German Socio-Economic Panel
StaBu	Statistisches Bundesamt
SUF	Scientific use file
SUR	Seemingly unrelated regression

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Summary

This dissertation contributes to the ongoing discussions about the relevance of income taxation in the context of asset accumulation. On the one hand, income uncertainty is emphasized as a relevant factor of influence in the intertemporal consumption decision. On the other hand, the differential treatment of capital and labor income in German income tax law is identified as an additional influential parameter in the consumption-savings decision of private households, as well as in the subsequent decision of how to allocate a given level of savings to a portfolio of various assets.

There is substantial empirical literature that, while certainly not providing unambiguous support, generally finds that taxation plays a considerable role in the consumption-savings decision of private households, as well as their decision of which assets to buy and of how to structure the composition of their savings. However, there is not much empirical evidence yet regarding the welfare effects of capital income taxation. Differential taxation of labor income and capital income can on the one hand have non-negligible effects on the intertemporal consumption allocation of private households if relative asset prices are distorted. On the other hand, significant welfare costs can arise if assets are taxed at heterogeneous rates, so that households may suffer utility losses from altering their allocation of savings to a portfolio of assets.

The central research question that is subject to analysis in this dissertation is whether and how tax-induced distortions in after-tax returns to assets, as well as to compound savings, affect households' consumption-savings decision as well as asset demand. Empirical analyses of the effects of differential income taxation on these sequential demand decisions are conducted, using various micro data sets on income and savings of private households in Germany. In addition, distributional and welfare effects related to asset demand that result from a major tax reform are evaluated. The methodology of this dissertation mainly applies microsimulation as well as microeconometric techniques.

In the opening chapter, the ground is laid for increasing uncertainty in the income processes. Evidence found from the decomposition of cross-sectional wage variation into permanent and transitory components, in the framework of covariance structure models, implies that a strong

expansion of cross-sectional wage inequality during the 2000s can be increasingly attributed to *transitory* inequality.

The findings on recent evolution of income dynamics are in the second chapter applied to analyze the effects of increasing income uncertainty on the household's consumption-savings decision. This decision is modeled in a structural demand system as a function of current household income, after-tax returns to savings, and the consumption price level. Marginal tax rates at the household level are simulated in an income taxation module. One central finding is that the estimate for the uncompensated interest rate elasticity of savings is close to zero, while the respective compensated elasticity is significantly different from zero. Thus, policy-induced variation of net returns to savings, while not being welfare neutral, is expected to have no significant effects on the level of household savings. Furthermore, significant effects of income uncertainty on the consumption-savings decision, in the context of precautionary savings, are found. These turn out to differ by household composition as well as by main source of income.

In the third chapter, a structural two-stage budgeting model of asset allocation is constructed, in which asset demand is modeled in a sequential portfolio choice, as a function of the household's marginal tax rate through the after-tax rate of return. Observing that a great number of households allocate assets to only a subset of all available asset types, potential selection is accounted for. Effects of differential income taxation on conditional as well as unconditional asset demand are investigated, and households facing higher tax rates are found to allocate a greater fraction of total asset demand to tax-privileged assets than households with lower tax rates. These effects are relatively strong for owner-occupied housing, non-owner-occupied housing, mortgages, and insurances.

The structural demand models for savings and for asset demand, as well as the income taxation module, are applied in the fourth chapter to evaluate Germany's year 2000 income tax reform with respect to distributional and welfare effects. An ex-ante analysis of the reform in the framework of a static behavioral microsimulation model of household savings and asset demand is conducted. Behavioral responses are derived from demand elasticities estimated in the structural asset demand model.

Substantial reductions of marginal tax rates cause income gains for most of the households, while leaving the fiscal budget unbalanced in the short run. As a result, income inequality is found to increase over the entire distribution. Furthermore, shifts in relative asset prices induce households to increase savings and alter the structure of asset demand. This substitution results in deadweight loss, causing welfare effects to be lower than income gains for most of the households. Households with relatively high savings ratios and great asset demand are found to experience significantly greater utility losses.

Generally, however, welfare costs of capital income taxation, as estimated for Germany's year 2000 tax reform, appear to be not very large, even when substitutive effects at the allocation of compound savings to a portfolio of assets are accounted for, in addition to the distortion of the intertemporal allocation of consumption. The relevance of the analyses is pointed out by interpreting the findings in a couple of, certainly not guidelines, but at least implications for economic and social policy which are elaborated from the main results in the final chapter. Furthermore, some major limitations of the analyses are emphasized, and several unsolved issues and avenues for subsequent research are discussed.

German Summary

Diese Dissertation untersucht den Zusammenhang zwischen der Besteuerung von Kapitalerträgen und der Vermögensbildung von privaten Haushalten in Deutschland. Zum einen wird die Relevanz von Unsicherheit im Einkommensprozess für die intertemporale Konsumentscheidung herausgestellt. Zum anderen wird die unterschiedliche Besteuerung von Kapitaleinkommen und Arbeitseinkommen im deutschen Einkommensteuerrecht als ein weiterer wesentlicher Parameter, sowohl in der Spar-Entscheidung, als auch in der nachgelagerten Entscheidung, ein gegebenes Volumen an Ersparnis auf ein Portfolio von verschiedenen Anlageformen zu verteilen, identifiziert.

In umfangreicher Literatur wird generell betont, dass Besteuerung eine wesentliche Rolle in der Konsum-Spar-Entscheidung privater Haushalte sowie in der Portfolio-Entscheidung spielt, wobei jedoch auch Uneinigkeit bezüglich dieses Ergebnisses herrscht. Hingegen gibt es bisher wenig empirische Evidenz für die Relevanz von Wohlfahrtseffekten der Besteuerung von Kapitaleinkünften. Unterschiedliche Steuersätze für Kapitaleinkommen und Arbeitseinkommen können jedoch zum einen Effekte von nicht vernachlässigbarem Umfang auf die intertemporale Konsumentscheidung privater Haushalte haben, wenn relative Preise für verschiedene Anlageformen verzerrt werden. Zum anderen können signifikante Wohlfahrtseffekte auftreten, wenn Vermögenstitel mit unterschiedlichen Sätzen besteuert werden und Haushalte Nutzeneinbuße erleiden, wenn sie ihre Portfolio-Entscheidung anpassen.

Die zentrale Frage, der in dieser Dissertation nachgegangen werden soll, ist, inwiefern steuerbedingte Verzerrungen in der Nachsteuerrendite von einzelnen Vermögenstiteln sowie der gesamten Ersparnis die Konsum-Spar-Entscheidung von Privathaushalten sowie ihre Nachfrage nach Vermögensformen beeinflussen. Dazu werden empirische Untersuchungen der Effekte von differenzierter Kapital- und Einkommensbesteuerung auf diese sequentiellen Entscheidungen anhand von Mikrodaten zu Einkommen und zum Sparverhalten von Privathaushalten in Deutschland durchgeführt. Des Weiteren werden Verteilungs- und Wohlfahrtseffekte einer bedeutenden Steuerreform in Bezug auf Vermögensbildung untersucht. Dabei werden im Wesentlichen empirische Methoden der Mikroökonometrie und der Mikrosimulation verwendet.

Die Anlageentscheidung des Haushalts wird in einem Modell der zweistufigen Budgetierung modelliert. In diesem Modell wird davon ausgegangen, dass der Haushalt die Entscheidung der Vermögensbildung sequentiell auf zwei Stufen trifft. Zunächst wird die Entscheidung getroffen, wie das verfügbare Einkommen auf gegenwärtigen Konsum und zukünftigen Konsum (Sparen) aufgeteilt wird. Auf der zweiten Stufe wird dann die Ersparnis – gegeben die Entscheidung von der ersten Stufe – auf diverse Anlageformen verteilt. Die Besteuerung von Kapitalerträgen kann dabei theoretisch auf beiden Stufen eine Rolle spielen. Sie kann den Haushalt auf der ersten Stufe dazu bewegen, seine Konsum-Spar-Entscheidung zu ändern, indem die relativen Preise zwischen zukünftigem und gegenwärtigem Konsum, zum Beispiel durch unterschiedliche Besteuerung von Kapitaleinkommen und Arbeitseinkommen verändert werden. Sie kann des Weiteren auf der zweiten Stufe bewirken, dass die Portfolio-Allokation der Ersparnis verändert wird, wenn unterschiedliche Steuersätze auf die Erträge der Anlageformen gelten. Ob solche Effekte tatsächlich relevant sind, hängt davon ab, wie elastisch Haushalte auf diese differenzierte Besteuerung reagieren. Es ist also letztlich eine empirische Frage, die in dieser Dissertation eingehend untersucht wird.

Im ersten Kapitel werden die Grundlagen in Bezug auf steigende Unsicherheit im Einkommensprozess gelegt. Die Ergebnisse einer Zerlegung von Querschnittsvarianz in Löhnen in permanente und transitorische Komponenten im Rahmen eines Kovarianzstruktur-Modells deuten darauf hin, dass eine signifikante Zunahme der Lohnungleichheit seit der Jahrtausendwende in zunehmendem Maße von *transitorischer* Ungleichheit geprägt ist.

Diese jüngste Entwicklung in der Einkommensdynamik wird im zweiten Kapitel aufgegriffen, um die Effekte zunehmender Einkommensunsicherheit auf die Konsum-Spar-Entscheidung privater Haushalte zu untersuchen. Diese Entscheidung wird dazu in einem strukturellen Nachfragesystem als eine Funktion des laufenden Haushaltseinkommens, eines für den Haushalt relevanten Nachsteuer-Zinssatzes für Ersparnisse, sowie des Konsumpreisniveaus modelliert. Der relevante Grenzsteuersatz wird auf Haushaltsebene in einem Einkommensteuermodul simuliert. Ein zentrales Ergebnis ist, dass die geschätzte unkompensierte Zinselastizität der Ersparnis nahe Null liegt, während die entsprechende kompensierte Elastizität signifikant von Null verschieden geschätzt wird. Eine Steuerreform, die eine Variation der Nachsteuer-Rendite der Ersparnis nach sich zieht, würde demnach erwartungsgemäß keine signifikanten Effekte auf das Niveau der Ersparnis von Privathaushalten haben, während sie jedoch nicht wohlfahrtsneutral wäre. Des Weiteren werden signifikante Effekte von zunehmender Einkommensunsicherheit auf die Konsum-Spar-Entscheidung, im Kontext des Vorsichtssparens, gefunden. Diese fallen unterschiedlich aus, je nach Haushaltszusammensetzung und nach Haupteinkommensquelle.

Im dritten Kapitel wird ein Modell der zweistufigen Budgetierung entwickelt, in welchem die Vermögensbildung des Haushalts in einer sequentiellen Portfolio-Entscheidung als eine Funktion des Grenzsteuersatzes des Haushalts über die Nachsteuer-Rendite modelliert wird. Dabei wird berücksichtigt, dass nicht alle Haushalte jede Vermögensform nachfragen, es also zu Selektion kommt, die diese Effekte möglicherweise verzerrt. Effekte von differenzierter Besteuerung von Kapitalerträgen auf die bedingte sowie auf die unbedingte Nachfrage nach Vermögensformen werden untersucht. Im Ergebnis investieren Haushalte mit höheren Grenzsteuersätzen einen größeren Teil ihres Portfolios in steuerbegünstigte Anlageformen als Haushalte mit einem niedrigeren Grenzsteuersatz. Diese Effekte fallen besonders deutlich aus im Fall von selbstgenutztem Immobilienvermögen, vermietetem Immobilienvermögen sowie Hypotheken.

Das strukturelle Nachfragemodell für die Anlageentscheidung des Haushalts sowie das Einkommensteuermodul werden im vierten Kapitel verwendet, um die Steuerreform 2000 der rot-grünen Bundesregierung im Hinblick auf Verteilungs- und Wohlfahrtseffekte zu untersuchen. Es wird eine ex-ante Analyse der Reform im Rahmen eines statischen Mikrosimulationsmodells mit Verhaltsanpassung bezüglich des Sparverhaltens sowie bei der Portfolio-Entscheidung der Haushalte durchgeführt. Verhaltensanpassungen werden von Nachfrageelastizitäten abgeleitet, die in dem strukturellen Nachfragemodell für die Vermögensbildung geschätzt werden.

Eine signifikante Senkung des Steuertarifs führt zu Einkommenszugewinnen für die meisten Haushalte, während der Staatshaushalt, zumindest in der kurzen Frist, unausgeglichen bleibt. Das hat zur Folge, dass die Einkommensungleichheit entlang der gesamten Verteilung zunimmt. Darüber hinaus werden Haushalte durch Veränderungen bei den relativen Preisen für Vermögensformen dazu bewegt, mehr zu Sparen sowie die Struktur ihrer Nachfrage nach Vermögenstiteln anzupassen. Diese Substitutionen haben Wohlfahrtsverluste zur Folge, die schließlich die Einkommenszugewinne für die meisten Haushalte mindern. Die Wohlfahrtsverluste fallen signifikant höher aus für Haushalte mit höheren Sparquoten und damit höherer Nachfrage nach Vermögenstiteln.

Insgesamt jedoch zeigt sich, dass die Wohlfahrtseffekte der Kapitaleinkommensbesteuerung, wie sie hier im Rahmen der Steuerreform 2000 untersucht werden, nicht besonders groß ausfallen, gegeben, dass sowohl Effekte auf die intertemporale Konsumallokation als auch auf die Portfolio-Entscheidung berücksichtigt werden. Die Bedeutung der Untersuchungen wird schließlich im letzten Kapitel dieser Dissertation hervorgehoben, indem die wichtigsten Ergebnisse im Rahmen von Implikationen für Wirtschafts- und Sozialpolitik zusammengefasst sowie interpretiert werden. Dabei werden des Weiteren auch einige wesentliche Einschränkungen der Untersuchungen genannt sowie noch ungelöste Probleme und potenzielle Richtungen für weitere Forschungsvorhaben aufgezeigt.