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Differential Income Taxation and Household Asset Allocation *

Richard Ochmann[†]

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Abstract

This paper empirically investigates the effects of differential income taxation on households' portfolio choice and asset allocation applying a two-stage budgeting model of asset demand to German survey data. The model is structured into the discrete asset choice and the continuous asset choice, and the marginal income tax rate is simulated in a module of income taxation. Households that face relatively higher 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 non-owner-occupied housing, for mortgage repayments, for building society deposits, for stocks, for insurances, and for consumer credits, whereas demand is lower for owner-occupied housing, bank deposits, and bonds.

Keywords: Household asset allocation, portfolio choice, two-stage budgeting, capital income taxation.
JEL Classification: C35, G11, H31

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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 diminishing relevance of the statutory pension system for old-age income induces German governments to subsidize private accumulations of financial assets for retirement income in the framework of the so called 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 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. Such reforms are likely to affect aggregate savings of private households as well as the allocation of savings between various available assets given a fixed level of savings, as the relative prices of consumption and savings as well as the relative net returns of related asset types are altered.[1] This paper investigates the effects of differential taxation of capital income on households' decisions of portfolio choice and asset allocation given the level of savings at the household level.

There is a vast literature of comparable studies that empirically identifies effects of differential 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 only for tax-exempt bonds (between +18% and +56% on the unconditional share)

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

[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.

and for non-privileged interest bearing accounts (between -2% and -6% on the unconditional share), effects on conditional demand are significant and robust over time.

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. 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]

The paper at hand contributes to this literature by constructing a two-stage budgeting model of asset allocation, where asset demand is a function of the household's marginal tax rate (MTR). Given a decision how to allocate disposable income to consumption and to savings, the household decides how to allocate total assets disposable 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, the decision of asset allocation is separated into the decision 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.

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

[5]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), 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), and Heaton and Lucas (2002) highlights 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).

Two cross sections from official survey data on income and consumption in Germany for 1998 and 2003 provide the variation in the MTR explored. 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 capital 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 relatively higher MTR on income allocate a greater fraction of total assets to tax-privileged assets than households with a relatively lower MTR. Such effects are found and they are relatively strong for owner-occupied housing, for non-owner-occupied housing, for mortgage repayments, and for 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. Section 4 deals with the estimation approach and the identification strategy for the tax effects, and Section 5 presents the data set as well as descriptive statistics on portfolio choice and asset allocation. In Section 6, results for conditional and unconditional tax effects are discussed, and Section 7 concludes.

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 (EStG) are introduced. The focus here is on the regulations as of the time for which the analysis is undertaken, which is the years 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 income tax module in Appendix B.

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). Additionally, a withholding tax on capital income (Kapitalertragsteuer, KEST) is raised at the time and the point where the capital income accrued to the taxpayer; it though 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 with PIT. Specifically, interest income from deposits in interest bearing accounts at banks and in building society savings contracts (Bausparverträge, a kind of home-ownership savings plans) are fully taxable with PIT (and a prepayment of 30% KEST). Dividends from stocks are also fully taxable with PIT.[7] Interests from bonds and other fixed-income investments are also fully taxable with 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 12 years and contributions were paid for a minimum of 5 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 w.r.t. 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

[6] Additionally, 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.

[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.

estates is fully taxable (§ 23 EStG) if there were less than two years time 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). But, as net income results from reducing gross rental income by expenses that are related to rental income, e.g. 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 shall be classified as either relatively more tax-privileged, or relatively less tax-privileged, or not 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 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 6 as a benchmark to evaluate the estimated tax effects. Firstly, a model of asset allocation is introduced in the next section.

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.

[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).

Definition of Total Assets Disposable for Allocation

It is assumed that a household intends to hold a certain 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:

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

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 assets available 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 how to allocate assets to a portfolio may well be determined by different factors. As the focus in this analysis shall be only on the latter decision, 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] The consumption-savings decision is analyzed in a similar framework in Beznoska and Ochmann (2010), results from which will be applied here in order to extend the results. Given the level of savings in t, the household allocates disposable assets between various types of assets.

By the separability assumption, it follows for the decision how to allocate disposable assets that the origin of the assets does not matter, only the level of disposable assets is 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, though excluding housing.

[10] Furthermore, by intertemporal separability, it is assumed here that the asset allocation decision today is not affected by expectations about asset prices and asset returns in the future. These assumptions on separability may be very restrictive and only approximately valid. A test for separability suggested by Browning and Meghir (1991) 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.

Thus, for the decision whether to allocate disposable assets to housing assets or to financial assets, it is not relevant whether the disposable assets 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 total assets disposable for allocation:

$$\begin{aligned} A_j &= A_j^+ - min(A_j^+, A_j^-) \qquad \forall\, j = 1, \ldots, J_A \\ L_k &= L_k^+ - min(L_k^+, L_k^-) \qquad \forall\, k = 1, \ldots, J_K \end{aligned} \tag{2}$$

Thus, the focus is effectively on net asset accumulations censored at zero, i.e. expenditures for asset purchases reduced by income from asset liquidations. By this definition, asset accumulations are non-negative, so that shares from total assets, as they will be defined for the demand system in Section 3, fall in the interval $[0, 1]$.[12] The resulting budget, i.e. asset demand at time t (in the following: total assets disposable), follows from:[13]

$$A_t = A \equiv \sum_{j=1}^{J_A} A_j + \sum_{k=1}^{J_K} L_k \tag{3}$$

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

The Structure of Asset Allocation

Given the decision how much assets to accumulate is taken, the household can generally allocate total assets disposable, A, to two clusters of assets at a first stage (in the following also: the upper stage):[14] housing assets and financial assets.[15] At a second stage (in the following also: the lower stage), expenditures devoted to the clusters are simultaneously allocated to asset sub-categories 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

[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.

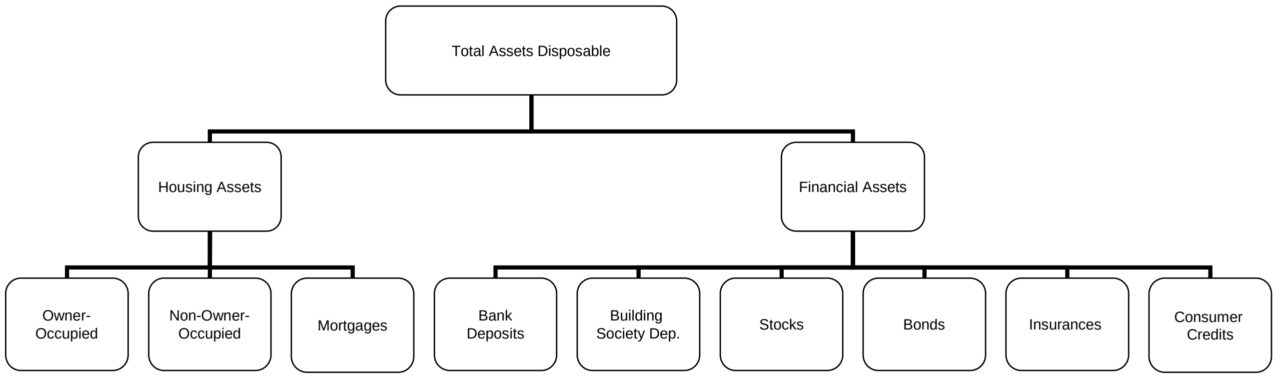
[13] Note that thereby this approach focuses on asset *flows* and models directly asset accumulations, rather than variations in asset stocks as usual in this literature. See Lang (1998) for a similar approach.

[14] 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.

[15] 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.

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,[16] and to consumer credit repayments.[17]

Figure 1: The Structure of Asset Allocation



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 e.g. that the decision how much assets to invest in stocks is only affected by the decision 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 how to allocate housing assets to owner-occupied housing, to non-owner-occupied housing, and to mortgages.[18]

[16]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 (2008).

[17]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).

[18]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 4.

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.[19] 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, Blundell, and Lewbel, 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 assets disposable. Thus, the share invested in, e.g. financial assets is related to total assets disposable 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. Then asset demand in the QUAIDS is generally represented by the following system of $j = 1, \ldots, J$ equations, where J denotes the number of all asset types available to the household:

$$s_{ij} \;=\; \alpha_{0j} \;+\; \beta_{1j}\,\ln(A_{il}/P) \;+\; \beta_{2j}\,\ln(A_{il}/P)^2 \;+\; \sum_{k=1}^{J} \gamma_{jk}\,\ln(p_{ik}) \tag{4}$$

for households $i = 1, \ldots, N$ and assets $j = 1, \ldots, J$ and clusters $l = 1, \ldots, L$. 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. (4) is linear in the budget parameters and linear in the price parameters. It imposes the following 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 together imply adding-up of the budget shares to one, $\sum_j^J \widehat{s}_{ij} = 1 \; \forall\, i = 1, ..., N$.[20] 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 ($\varepsilon^c_{jj} \leq 0 \; \forall\, j = 1, ..., J$), the Slutsky-matrix is symmetric if the

[19] 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).

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

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 net real rate of return to the asset: $p_{ij} = \left(1 + r_{ij}^{net} - \pi_i\right)^{-1} = \left(1 + r_{ij}^{gro}(1 - t_{ij}) - \pi_i\right)^{-1}$, where r_{ij}^{gro} is the expected gross 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.[21] 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: $r_{ij}^{gro} = r_j^{gro}, \; \forall \, j$. 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 assumption that the relevant returns for the asset allocation decision are net real returns.[22] The log-price of asset j for household i in the demand equations in Eq. (4) follows as:

$$\ln(p_{ij}) \; = \; \left(1 + r_j^{gro}(1 - t_{ij}) - \pi_i\right)^{-1} \tag{5}$$

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

$$\eta_{ij} \; \equiv \; \frac{\partial A_{ij}}{\partial A_{il}} \frac{A_{il}}{A_{ij}} = 1 \; + \; \left(\beta_{1j} + 2\beta_{2j} \ln(A_{il}/P^*)\right) / s_{ij} \tag{6}$$

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 the demand level of asset j w.r.t. price of good k is:

$$\varepsilon_{ijk}^u \; \equiv \; \frac{\partial A_{ij}}{\partial p_{jk}} \frac{p_{jk}}{A_{ij}} \; = \; -\delta_{jk} + \gamma_{jk}/s_{ij} - \left(\beta_{1j} + 2\beta_{2j} \ln(A_{il}/P^*)\right) \, \bar{s}_k / s_{ij} \tag{7}$$

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

[21] 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.

[22] 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.

$\delta_{jk} = 0$ if $j \neq k$. By the Slutsky equation, the compensated price elasticity follows as:

$$\varepsilon^{c}_{ijk} \;\equiv\; \varepsilon^{u}_{ijk} + s_{ik}\eta_{ij} \;=\; -\delta_{jk} + \gamma_{jk}/s_{ij} + s_{ik} + \left(\beta_{1j} + 2\beta_{2j}\ln(A_{il}/P^{*})\right)\,(s_{ik} - \bar{s}_{k})\,/s_{ij} \tag{8}$$

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

$$\varepsilon^{(r)\,u}_{ijk} \;=\; -\varepsilon^{u}_{ijk} * \frac{\tilde{r}^{net}_{j}}{1+\tilde{r}^{net}_{j}} \tag{9}$$

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

$$\varepsilon^{(r)\,c}_{ijk} \;=\; -\varepsilon^{c}_{ijk} * \frac{\tilde{r}^{net}_{j}}{1+\tilde{r}^{net}_{j}} \tag{10}$$

Results on estimated compensated and uncompensated rate-of-return elasticities for asset demand levels will be presented in Section 6.1.

A Reduced-Form 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 marginal tax rate is not as simple as in the general definition in Eq. (5). 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 5 for the exact definition of each asset price in the context of the tax schedule. However, as the hypothesis to test in this analysis shall be whether households facing a relatively higher MTR allocate a greater fraction of disposable assets to tax-privileged assets than households with a relatively lower MTR, the complexity of the asset price function shall be reduced. For this reduced-form model, which shall be estimated in addition to the structural model in Eq. (4), it is assumed that the effects of gross returns are invariant over the assets. For the demand equations in Eq. (4), there follows an asset-invariant log-price for household i: $\ln(p_i) = \ln\left(\frac{1}{1+r(1-t_i)-\pi_i}\right)$. For $r(1-t_i) - \pi_i$ close to zero, the log-price can be approximated by:

$$\ln(p_i) \approx -\left(r(1-t_i) - \pi_i\right) \tag{11}$$

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. (4) then only contain a single asset-invariant price and simplify to:

$$s_{ij} = \alpha_{0j} + \beta_{1j} \ln(\widetilde{A}_{il}) + \beta_{2j} \ln(\widetilde{A}_{il})^2 + \gamma_{jj} \ln(p_i) \tag{12}$$

where the variables and parameters are defined as in Eq. (4) and $\ln(p_i)$ is defined in Eq. (11). While adding-up still holds for this reduced-form 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 w.r.t. the asset *shares*. The budget elasticity for the asset shares follows as:

$$\frac{\partial s_{ij}}{\partial A_{il}} \frac{A_{il}}{s_{ij}} = \left(\beta_{1j} + 2\beta_{2j} \ln(A_{il}/P^*)\right) / s_{ij} \tag{13}$$

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: $\sum_j^J \left((\beta_{1j} + 2\beta_{2j} \ln(A_{il}/P^*))/s_{ij}\right) = 0$. The uncompensated own-price elasticity for the share of asset j in this reduced-form model follows as:

$$\frac{\partial s_{ij}}{\partial p_{ij}} \frac{p_{ij}}{s_{ij}} = \gamma_{jj}/s_{ij} \tag{14}$$

Results on estimated uncompensated own-price elasticities will be used in Sections 6.2 and 6.3 to derive direct and unconditional tax effects. The next section deals with the empirical strategy for the estimation of the tax effects.

4 Empirical Strategy

Although the risk-minimizing strategy from portfolio theory for risk averse agents clearly advocates for perfect diversification (Auerbach and King, 1983), 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.[23] Thus, the decision of asset allocation shall be separated into the decision whether to buy an asset (the discrete asset choice) and the decision 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. Thereat, it must be accounted for that the demand probability and the conditional demand for an asset are

[23] Various arguments for incomplete portfolios can be found in the literature, e.g. 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), borrowing or liquidity constraints (e.g. Auerbach and King, 1983).

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 the continuous choice à la Heckman (1979), though applied to multinomial selection.[24] 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:

$$s_{ij}^{*} = x_i' \alpha_j + \epsilon_{ij} \tag{15}$$

$$a_{ij}^{*} = x_i' \delta_j + \nu_{ij} \tag{16}$$

$$a_{ij} = \begin{cases} 1 & \text{if } a_{ij}^{*} > 0 \\ 0 & \text{if } a_{ij}^{*} \leq 0 \end{cases} \tag{17}$$

$$s_{ij} = a_{ij}\, s_{ij}^{*} \tag{18}$$

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. (17) together with Eq. (16) mirrors the discrete asset choice, and Eq. (18) together with Eq. (15) 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. (4) and the reduced-form model in Eq. (12) are estimated.

[24] 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.

For the estimation of the reduced-form model, the two-step selection correction approach is applied. Results on this estimation in Section 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. (4), and thus selection correction is omitted in the estimation there.[25]

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.[26] 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.[27]

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, there result 2^J regimes, 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, e.g. (0 1 1) for non-owner-occupied housing assets and mortgage repayments, and 64 combinations of financial assets, e.g. (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 selection equations for each asset in a cluster are treated as a simultaneous decision.

[25] Selection is found to only slightly affect the tax rate coefficient in the reduced-form 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.

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

[27] 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.

Demand for stocks, e.g., is investigated conditionally on the demand, possibly zero or non-zero, for any combination of all other financial assets.[28] 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,[29] each of them conditionally on positive demand in the respective cluster, so that each MNL is reduced by one alternative (i.e. the null portfolio):[30]

$$U_{j|l} \;=\; x_l' \, \delta_{j|l} + \eta_{j|l} \qquad \forall \, l \in \{hou, fin\} \tag{19}$$

Secondly, among the two clusters at the upper stage, one MNL is estimated for the four combinations of housing assets and financial assets.[31]

$$U_j \;=\; x' \, \delta_j \;+\; \eta_j \tag{20}$$

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 marginal tax rate, 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.[32] From the MNLs in Eqs. (19) and (20), 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.[33]

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

[29] 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.

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

[31] 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, total budget is replaced by 1 euro.

[32] 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).

[33] 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. (20) is additionally augmented with inclusive values from the within-cluster MNLs. This is done in Appendix A 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.

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 applied in the literature, see Maddala (1983, pp. 275-278). Bourguignon, Fournier, and Gurgand (2007) compare some approaches in simulations and conclude that the method proposed by Dubin and McFadden (1984) is the one that performs best, which is why it shall be applied here.[34] The implied selection term is similar to an inverse Mills' ratio in the style of Heckman (1978), and for asset combination j in cluster l, it is defined by (see Dubin and McFadden, 1984, pp. 355-356):

$$\lambda_{j|l} = \sum_{k \neq j}^{J_l} \left(\frac{\widehat{P}_{k|l} \ \ln(\widehat{P}_{k|l})}{1 - \widehat{P}_{k|l}} \right) + \ln(\widehat{P}_{j|l}) \tag{21}$$

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), there results one selection term for each asset, see Appendix A for an example. This term will be applied to correct for selection due to conditional estimation of the reduced-form 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 A.

The Continuous Asset Choice

In the second step of the estimation, the focus is on the continuous asset choice in Eqs. (15) and (18), i.e. the decision 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 reduced-form with selection correction, FGLS estimation in a SUR differs from ordinary least squares (OLS) estimation equation-by-equation, as the selection term from the discrete asset choice differs over the equations *and* the

[34] 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.

covariance matrix of the errors in the demand system is not diagonal.[35] The demand system for the estimation of the structural model in Eq. (4) omitting selection is specified as follows:

$$s_{ij} = \alpha_{0j} + x_i' \alpha_j + \beta_{1j} \ln(\widetilde{A}_{il}) + \beta_{2j} \ln(\widetilde{A}_{il})^2 + \sum_{k=1}^{J} \gamma_{jk} \ln(p_{ik}) + \epsilon_j \tag{22}$$

for households $i = 1, \ldots, N$ and assets $j = 1, \ldots, J$ in cluster $l = 1, \ldots, L$, where 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. (5), 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.

For the reduced-form estimation of Eq. (12) with selection correction, asset demand is specified as follows:

$$s_{ij} = \alpha_{0j} + x_i' \alpha_j + \beta_{1j} \ln(\widetilde{A}_{il}) + \beta_{2j} \ln(\widetilde{A}_{il})^2 + \gamma_{jj} t_i + \theta_j \lambda_{ij|l} + \epsilon_j \tag{23}$$

where, besides the coefficients and variables from Eq. (22), t_i is household i's marginal tax rate, λ_{ij} is the selection term defined in Eq. (21). 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. (11). This implies that the effect of the asset-invariant gross return, r, is swapped into α_{0j}.[36] 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. (19) and (20), is left out in the reduced-form estimation of the demand equations as an exclusion restriction.[37] Moreover, social status is substituted by a dummy variable for self-employed heads in the reduced-form estimation.

Conditional asset demand in Eqs. (22) and (23) is estimated in three separate demand sys-

[35]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.

[36]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, non of the interactions are significant in all demand equations. Thus, results for the significant interaction effects are left as a robustness check.

[37]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), e.g. , find that education affects the probability of accumulating an asset, while it has no significant effect on conditional asset demand.

tems: one within each of the two clusters and one among the clusters. As demand is 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 reduced-form estimation, where the selection term differs over the equations. In this case, all J equations can though be estimated by iterated FGLS, which converges to the maximum likelihood estimates. For the estimation of the structural model, adding-up of predicted asset shares is guaranteed by definition of the QUAIDS. These systems are estimated either imposing the theoretical constraints of homogeneity and symmetry, or omitting the constraints.[38] In Section 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 tax effects on the conditional as well as the unconditional shares.

Another econometric issue is the potential endogeneity of the budget, A_l, in Eqs. (22) and (23). In a decision to e.g. allocate financial assets between stocks and bonds, the budget for financial assets is likely itself a function of the demand for stocks and bonds. This endogeneity is usually dealt with in the literature by instrumental variables estimation, see e.g. Banks et al. (1997), or Hochguertel et al. (1997), or Lang (1998). The potentially endogenous budget is commonly instrumented by the respective "pre-stage" budget. That is, total assets disposable at the upper stage of the 2SBM is instrumented with disposable income (or here net savings), and at the lower stage, the housing budget and the financial budget are instrumented with total assets disposable 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. (22) and (23) 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 reduced-form estimation, 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 6.2 and do not differ much from the main approach, where the budget in not instrumented.

[38]However, as mentioned in Section 3, for the reduced-form model, homogeneity and symmetry can not be imposed. Rather the adding-up constraints $\sum_j^J \widehat{\beta}_j = 0$, and $\sum_j^J \widehat{\alpha}_{0j} = 1$ are imposed. These constraints guarantee that adding-up holds approximately for the reduced-form estimation.

Identification of the Tax Effects

As already mentioned in Section 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 capital income taxation. In order to identify tax effects in asset demand equations of the form in Eq. (12), the marginal tax rate applied should be exogenous to the asset allocation decision under analysis.[39] Taxable income for each household is thus simulated on the basis of only exogenous capital income and any income from other sources that is assumed exogenous here.[40] 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 itself considered exogenous, see Section 3. 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.[41]

Based on the simulated taxable income, a marginal tax rate is derived for each household member who is considered relevant for the allocation decision, 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). There results one MTR on income in general for each household, which is assumed relevant for the household's asset allocation decision, also see Appendix B for details. Table B.2 in Appendix B 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 w.r.t. capital income and labor income.[42] On the other hand, for a given level of capital income, the MTR varies with the structure of exogenous capital income w.r.t. the asset types, as the rules of differential taxation of capital income from the various

[39] 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.

[40] 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.

[41] 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.

[42] Since asset demand is modeled here as a function of several socio-demographic characteristics that are also highly correlated with the MTR, as e.g. age of 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 highly significant (t-statistic of 19.7).

sources of asset types is modeled in detail in the income taxation module, see Appendix B. Additional variation in the MTR over time from the first implementations of a major income tax reform in the years of 2000/2001 is exploited here to identify the tax effects.

This variation in the MTR becomes apparent from Table B.2 in Appendix B when comparing the mean MTR in the tax brackets and the maximum MTR over all brackets 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 Appendix B for details. In the next section, the data set and descriptive statistics on asset portfolios are presented.

5 Data and Household Asset Portfolios

Data

The data applied in this analysis stem from the Income and Consumption Survey for Germany (Einkommens- und Verbrauchsstichprobe, EVS). The EVS is maintained by the German Federal Statistical Office (Statistisches Bundesamt, StaBu). Households are recruited voluntarily for reports every five years, according to stratified quota samples from Germany's current population survey (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 caserns, students in dormitories, elderly and disabled people in nursery homes or hospitals, nurses or migrant workers in residences, people in jails), homeless people, and households with monthly net household income greater than 35,000 DM for 1998 (18,000 euros for 2003). For the two cross sections applied here, the scientific use files contain 49,720 households for the year 1998 and 42,420 for 2003. For details on how the data set has been manipulated, see Appendix C.1.

For gross returns to assets, generally quarterly averages of aggregate monthly consumer price and interest rate data are applied. Generally, 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 B. The amounts of tax-free allowances granted on e.g. financial assets is 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 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 C.2.

Household Asset Portfolios

Asset accumulations in the pooled sample are compiled in Table 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 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 assets disposable (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 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 e.g. 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 C.1 in Appendix C.3.

Breaking down average shares by tax brackets in the following columns of Table 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.[43] The increase is especially great for

[43] 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 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 assets disposable		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 assets disposable	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).

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, 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, 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 e.g. age effects, budget effects, or wealth effects. The focus of the next section shall be on the estimation results, where other relevant effects are controlled.

6 Results

Asset demand has been estimated in two models, the structural demand system as specified in Eq. (22) and the reduced-form model as specified in Eq. (23). In this section, first of all, results for the structural demand system are presented. Budget and rate-of-return elasticities are derived and interpreted w.r.t. relative price effects and resulting substitutive and complementary relations between the assets. Then, tax effects from the estimation of the reduced-form 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).

6.1 Rate-of-Return Effects in the Structural Model

Results for elasticities from the estimation of the structural demand system in Eq. (22) are compiled in Appendix D.1 in Table D.1 for the upper stage and in Tables D.2 and D.3 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.

For all three demand systems, the theoretical constraints of homogeneity and symmetry can be rejected. As Table A.1 in Appendix A 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 D.2, in Table D.5 for the upper stage, and in Tables D.6 as well as D.7 for the lower stage.

At the upper stage of the 2SBM, the allocation decision is conditioned on positive demand for total assets disposable. 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 Beznoska and Ochmann (2010) for the budget elasticity of savings (w.r.t. current income) to $\eta_{sav} = 1.84$, for the uncompensated interest rate elasticity of savings to $\varepsilon_{sav}^{(r)u} = 0.11$, and for the respective compensated elasticity to $\varepsilon_{sav}^{(r)c} = 0.55$.[44]

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:

$$\eta_j \;=\; \eta_{j|l} \cdot \eta_l \cdot \eta_{sav} \tag{24}$$

The unconditional uncompensated rate-of-return elasticity for asset j in cluster l follows from:

$$\varepsilon_{jk}^{(r)u} \;=\; \delta_{lm}\, \varepsilon_{jk|l}^{(r)\,u} \;+\; \eta_{j|l}\, \bar{s}_{k|m} \left(\delta_{lm} + \varepsilon_{lm}^{(r)\,u}\right) \;+\; \eta_j\, \bar{s}_k \left(1 + \varepsilon_{sav}^{(r)\,u}\right) \tag{25}$$

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 w.r.t. 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

[44] In Beznoska and Ochmann (2010), $\varepsilon_{sav}^{(r)u}$ and $\varepsilon_{sav}^{(r)c}$ are actually the estimated elasticities w.r.t. 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.

the uncompensated elasticity of cluster l assets w.r.t. the rate of return to cluster m, η_j is defined in Eq. (24), $\bar{s}_k$ 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:

$$\varepsilon_{jk}^{(r)c} \;=\; \delta_{lm}\,\varepsilon_{jk|l}^{(r)c} \;+\; \eta_{j|l}\,\bar{s}_{k|m}\,\varepsilon_{lm}^{(r)c} \;+\; \eta_{j|l}\,\eta_l\,\bar{s}_k\,\varepsilon_{sav}^{(r)\,c} \tag{26}$$

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. (6), (9), and (10).

Table D.4 in Appendix D.1 compiles the results for the unconditional budget and rate-of-return elasticities from the unconstrained demand system estimations of Eq. (22). The first panel of Table D.4 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 budget elasticity is estimated significantly different from one at the 1%-level for all assets. It is significantly greater than one for all assets, except for insurances, indicating that all assets are luxuries, except for insurances, which are necessities. These 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. (24).

Moreover, it can 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 compensated rate-of-return elasticities. Demand increases for almost all assets if the own rate of return 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 w.r.t. the own rate of return for owner-occupied housing ($\hat{\varepsilon}_{jj}^{(r)u}$=1.13), for non-owner occupied housing (1.20), for mortgages (1.40), for bank deposits (1.18), and for insurances (1.27). This results from an uncompensated own-rate elasticity for housing assets in general of 0.56 and a relatively smaller respective own-rate elasticity for financial assets of 0.09 (Table D.1). Demand is inelastic w.r.t. own rates for building society savings (0.38), for stocks (-0.16), for bonds (-0.57), and for consumer credit repayments (0.80).

W.r.t. cross-rates, 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 D.4 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 are not significantly different from zero in the housing asset equations. Only the rates for owner-occupied housing and for mortgage repayments 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 relatively 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 mortgage repayments by only 1% from 104 euros to 105 euros. These effects are though not symmetric. 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 mortgage repayments increases elastically by 30% from 104 euros to 135 euros in turn of a 1%-increase in the own rate. These findings indicate a complementary relation between housing assets and mortgage repayments. If the returns to housing assets increase, households take up more mortgages and start repaying them or 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 e.g. for stocks 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.

Moreover, substitutive effects between financial assets are found e.g. 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 credit repayments 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 D.3 in Appendix D.1). 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 to between 0.50 and 1.09 (where the former is for savings bank deposits and the latter for fixed deposits), for building society deposits to between 2.80 and 2.98 (depending on the specification), and for bonds to between 0.28 and 0.39. Uncompensated own-rate elasticities are estimated for bank deposits to between -0.17 and 1.09, for building society deposits to between 0.47 and 0.66, and for bonds to between 0.40 and 0.69.

6.2 Conditional Tax Effects

In the following, the focus shall be on the estimated tax effects from the estimation of the reduced-form model in Eq. (23). 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 2 shows estimated conditional tax effects for various specifications, marginal effects of a 10%-points increase in the MTR from the respective conditional mean[45] on conditional asset demand shares ($s_{j|l}$) are presented. Detailed results from the reduced-form estimations of the continuous asset choice are given in Appendix D.4, in Table D.11 for the upper stage, and in Tables D.12 as well as D.13 for the lower stage. The estimation results for the demand probabilities from the discrete asset choice can be found in Tables D.8, D.9, and D.10 in Appendix D.3.

The focus here shall firstly be on the main approach, "SUR + Selection" in the "pooled" version in Table 2. 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 an error probability of 0.1% 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 only.[46]

Most of the estimated conditional tax effects though 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 2. Among financial assets, there is a

[45]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.

[46]Eicker-Huber-White heteroskedasticity-robust standard errors are generated from maximum likelihood estimation, see Tables D.11 - D.13 in Appendix D.4. 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.

Table 2: 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	$+0.2^{\ddagger}$	$+0.0$	$+0.2^{\ddagger}$	-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: $\ddagger p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$, based on heteroskedasticity-robust standard errors from the SUR system estimations, see Tables D.11 - D.13 in Appendix D.4. $\bar{s}_{j|l}$ 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 assets disposable 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 0.001%-level.

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

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 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 these effects are relatively small.

The strongest conditional tax effects are estimated for the conditional allocation of housing assets to owner-occupied housing, to non-owner occupied housing, and to 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.[47] 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, e.g. 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 demand systems have been re-estimated by instrumenting the potentially endogenous budget with its respective pre-cluster budget (specification "SUR + IV" in Table 2), while neglecting selection correction, based on observations with positive budget only. As instruments for the upper stage, total assets, net savings, and the employment status of the household head are applied.[48] The results vary a little from the main approach. Effects are stronger for bank deposits, for owner-occupied housing, and for mortgages. Moreover, at the upper stage, the effects are much stronger. But it shall be noted here that net savings can be doubted as a good instrument for total assets and thus, the "SUR + IV" results should be interpreted with caution here, which is why in the main approach, the budget shall not be instrumented.

As robustness checks for the main approach, other specifications have been estimated, which largely confirm the main results. The demand systems have been re-estimated without any selection correction (specification "SUR" in Table 2). 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.[49] 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.

The only significant differences in the tax effects between East- and West-Germany ("SUR

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

[48] 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.

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

+ 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 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.

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 assets disposable. Figure D.1 in Appendix D.5 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. Moreover, 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.

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. (25) can be applied to derive the unconditional uncompensated own-price elasticity for asset j in cluster l as:

$$\varepsilon_j \;=\; \varepsilon_{j|l} \;+\; \eta_{j|l}\, \bar{s}_{j|l}\, (1+\varepsilon_l) \tag{27}$$

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 cluster l assets. Conditional budget and own-price elasticities are defined for the asset shares in the QUAIDS in Eqs. (13) and (14).[50]

The unconditional uncompensated own-price elasticity (in the following also: tax elasticity) of cluster l assets (ε_l) is determined at the upper stage of the 2SBM, which is estimated conditionally on positive total asset demand so that tax effects occur at the intensive as well as at the extensive margin. It follows that ε_l is a function of both, the conditional elasticity and the elasticity of the probability of positive total asset demand, see Appendix D.5 for details. The resulting unconditional tax effects for cluster asset demand are presented in Table D.14 in Appendix D.5. 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 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 (ε_l) and budget (η_l) elasticities on the unconditional cluster shares are in the following applied to derive unconditional tax effects on assets at the lower stage.

Table 3 displays the point estimates and standard errors for the elements of Eq. (27). 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. (27).[51] There results 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.[52] The resulting unconditional tax elasticities on the shares (ε_j) do not differ much

[50] It should though be noted, that the own-price effects do not have a structural interpretation in the reduced-form model, as the price effect on the budget, $\widetilde{A}_{il} = A_{il}/P$, 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).

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

[52] All elasticities presented here refer to the asset *shares*. The corresponding budget elasticities on the *levels* follow from: $\eta^{lev}_{j|l} = 1 + \eta_{j|l}$. They allow the interpretation that owner-occupied housing, non-owner occupied

Table 3: 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 ($\varepsilon_j = -0.72$), for non-owner-occupied housing (0.21), for building society deposits (0.03), for stocks (0.08), for bonds (-0.21), and for 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

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 6.1. Moreover, 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 reduced-form 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.

relatively 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 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.[53]

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 resulting effects in the range of 0.1-0.8%-points in absolute terms appear rather small. Nevertheless, as already the results for ε_j show, there remain some relatively strong results. 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 of the less privileged or not privileged assets. Demand for relatively more tax-privileged assets is increased: the unconditional share of non-owner occupied housing assets 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%. Mortgage repayments are increased 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, 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%.

[53]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.

Demand for assets that are not privileged in the tax system is ambiguous: while it 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%.

All unconditional tax effects have been evaluated for an average household, with an average conditional MTR. The effects may though 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 D.2 in Appendix D.5 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, in this study, 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, for insurances, and for 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.

7 Conclusion

Effects of differential taxation of capital income on households' portfolio choice and asset allocation decision have been investigated. A two-stage budgeting model of asset demand has been 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. 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 relatively 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 the 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 assets disposable 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 for assets that are not privileged in the tax system is ambiguous: while it 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 from state subsidization, at least as far as differential taxation of asset returns and other income is concerned. There remains the open issue to which extent these effects are related to the presence of other subsidies and state grants that are not subject to taxation, but that affect the net return on assets. For Germany at that time, there was e.g. a home-building allowance (Eigenheimzulage) granted on owner-occupied housing, and there still are today building society premiums (Wohnungsbauprämie), which are paid for building society deposits. There are savings bonuses for employees (Arbeitnehmersparzulage), which are paid for contributions to capital formation that are directly invested by the employer out of basic salaries (vermögenswirksame Leistungen). Today, asset accumulations for old-age pension income in Germany are subsidized in the framework of the so called Riester-scheme. The effects of all such subsidies on the asset allocation decisions are not disentangled here yet from the tax effects. This shall be subject of further research in evaluation of specific policy reforms.

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A Appendix - Estimation

Tests for the Demand System

Table A.1: 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. (20) can be augmented with inclusive values from the within-cluster MNLs:

$$U_j \; = \; x'\delta_j + \sum_l \tau_{l,j} \widehat{I}_l \; + \; \eta_j \tag{28}$$

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, $\widehat{\tau}_{hou,j} = \widehat{\tau}_{fin,j} = 1$ $\forall j = 1, \ldots, J_1 - 1$. For all these three tests, this hypothesis is rejected at the 1%-level, providing further arguments for maintaining the nested structure of the 2SBM.

Table A.2: 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 (cf. 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 A.3 provides evidence that the null hypothesis of no systematic differences between the coefficients can 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.

Table A.3: Tests for IIA Assumption in a Single-Stage MNL and in the NLM

	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
NLM within clusters:						
Housing cluster:						
01	63.698	30	0.000	21.111	30	0.884
10	51.562	30	0.008	15.281	30	0.988
11	19.152	30	0.937	21.755	30	0.863
Loan cluster:						
01	307.035	30	0.000	38.028	30	0.149
10	179.428	30	0.000	79.491	30	0.000
11	395.357	30	0.000	30.088	30	0.461

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).

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 are conducted on the MNLs within each cluster. Table A.3 provides evidence that the IIA assumption can be maintained for most of the alternatives within the clusters. For the financial cluster, these tests could though not have be computed within reasonable time.

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 is appropriate for the estimation of the discrete asset choice in Eq. (17) here. 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. (21) by aggregating over all $2^{J_l}/2$ combinations of an asset. This term corrects for conditional estimation of the continuous asset choice. E.g., 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.[54] Likewise, from the MNL among the clusters in Eq. (20), 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: $\widehat{P}_{jl} = \widehat{P}_{j|l} * \widehat{P}_l$.

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

B Appendix - A Module of Capital Income Taxation

An individual marginal tax rate is derived in a module of capital income taxation that implements the German income tax law as of the time of 1998 and 2003. This is necessary here, since the actually assessed income tax burden is not observed in the data. 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 assuming the quarterly observation is representative for the entire year and thus multiplying it by four. 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 member of the household is regarded relevant in the context of taxable income if she reports some positive income for any income component at the individual level.

Taxable income at the individual level is derived according to the scheme in Table B.1. In the following, the single income components are described 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.

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 them 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 them, a seasonality is observed, 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 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

Table B.1: 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).

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.[55] 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. It is assumed that this

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

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").[56] 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 are contributions paid for at least 5 years and the entire contract duration is at least 12 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 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.[57] Income from any pensions is applied with a taxable fraction of 27%.[58] Income from speculative trading occurs if households sell certain assets in a specific time frame from the point of acquisition.[59] 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.[60] If housing assets are

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

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

[58] 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.

[59] 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.

[60] There may occur losses from speculative trading, which may be deducted from any profits from speculative

sold within two years from acquisition in 1998, net 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 in case net profits generated exceeded 1,000 DM in 1998 and 512 euros in 2003, but in this case the entire net profits were taxable.[61] Income from alimony is assumed taxable here upon approval of the recipient.[62]

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. There results 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 far as it does not exceed 5% of the adjusted sum of all forms of income.[63] **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.[64] The greater

trading. Such losses are assumed to be zero here.

[61] 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 C 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.

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

[63] 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.

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

of actual expenses and a lump-sum allowance for provisional expenses is applied, 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. There result 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 burden 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 and 2,000 DM for each following 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.[65] §10e and §10h EStG are relevant in case construction of the building was started 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. But, 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,[66] 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. Further assuming that 80% of the total expenses for housing assets are financed by debt, the initial costs of purchasing result.[67]

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.[68] 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 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 added

[65] It is assumed that there are no old cases remaining from the tax shields in §7b and §7c EStG, which were abolished in 1987.

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

[67] 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.

[68] 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 C for further details.

60,000 DM for each child eligible for child benefit.[69]

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, the 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.[70] It is deducted for both, the household head and its partner. In case spouses are jointly assessed for income taxation,[71] the child allowance is doubled and solely deducted 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 currently 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). As such are treated here for 1998 and 2003: 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.

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

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

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

Married couples are assumed to choose joint assessment.[72] For them, individual taxable incomes are added up, so are the non-taxable income components affecting progressive taxation, the tax tariff is applied to half of this sum, and the resulting tax burden is doubled.

Table B.2: 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, 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,

[72] 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.

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. There results one **general marginal tax rate on income at the household level** for each household.

C Appendix - Data and Household Asset Portfolios

C.1 Data

The data applied stem from the Income and Consumption Survey for Germany (Einkommens- und Verbrauchsstichprobe, EVS). The EVS is maintained by the German Federal Statistical Office (Statistisches Bundesamt, StaBu). Households are recruited for reports according to stratified quota samples from Germany's current population survey (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 tried 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 w.r.t. 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 moreover restricted, not covered are: institutionalized people (i.e. military people in caserns, students in dormitories, elderly and disabled people in nursery homes or hospitals, nurses or migrant workers in residences, people in jails), homeless people, and households with monthly net household income greater than 35,000 DM 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. (1).

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. Modified-OECD-equivalence-scale weighted monthly disposable household income is below 300 euros (in prices of 2003) (drops 23 observations)

2. Statistical difference in absolute terms is more than twice as large as disposable household income (drops 174 observations)

3. Consumption (adjusted for redistributions of durable goods expenditures) is more than twice as large as disposable household income (drops 321 observations)

4. Other expenditures (not attributed to any category of consumption) is more than twice as large as 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, by household type, social status, household net income. For 2003, the population is stratified by: location in federal states, household type, social status, and household net income, and additionally by age of household head.[73] According to its stratification, the sample is aggregated to the population, see Statistisches Bundesamt (2005) for methodological details. The household weights in the SUF are incorrect for 2003. They have been regenerated such that the weighted sample units match the population sizes in each strata (cf. Buslei, Schulz, and Steiner (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 though needed separately for stocks and bonds. This allocation is estimated by asset holdings for stocks and bonds.

When quarterly data are aggregated to annual data, for certain income components, seasonal effects are estimated and eliminated; such are Christmas bonuses, vacation bonuses, extra

[73]Household head is defined to be the person with the highest income in the household.

month's pay and other extra payments. Also 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 year is applied. For 1998, this is though 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. (2) and (3), it follows that total assets disposable can be decomposed into accumulations in the J asset classes that are considered here:

$$
\begin{array}{ll}
 & \text{Expenditures for housing assets (gross, including loans raised to buy a house)} \\
+ & \text{Expenditures for financial assets} \\
+ & \text{Expenditures for loan repayments} \\
- & \text{Revolving assets} \\
= & \text{Total assets disposable for allocation} \\
\hline
= & \text{Expenditures for owner-occupied housing} \\
+ & \text{Expenditures for non-owner-occupied housing} \\
+ & \text{Repayments of housing-related loans (mortgages)} \\
+ & \text{Assets accumulated in savings accounts and fixed deposits} \\
+ & \text{Assets accumulated in building society deposits} \\
+ & \text{Assets accumulated in stocks} \\
+ & \text{Assets accumulated in bonds} \\
+ & \text{Assets accumulated in (life and private pension) insurances} \\
+ & \text{Repayments of consumption loans} \\
- & \text{Revolving assets}
\end{array}
\qquad (29)
$$

Concerning the definition of total assets disposable, 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, $A^{+}_{OOH} = 10,000$. Additionally 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.

C.2 Rates of Return

Generally, gross 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 in the following described 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. Additionally, 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 thereby that part of the total returns that is related to speculative trading is 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 was 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 w.r.t. 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 mortgages loans is applied. As with consumer credits, the asset under consideration is mortgage *repayments*, so that the resulting rates are applied in positive terms in the price function, as 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 w.r.t. 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 German DAX-listed companies are applied. Furthermore, taxation of dividends is implemented, which was changed in 2000/2001 from taxation of gross dividends and consideration of corporate tax payments as tax credits (the so called "Anrechnungsverfahren") to taxation of net dividends with only 50% of the dividends taxable (the so called "Halbeinkünfteverfahren"). 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. For **bonds**, the current yield on domestic private and public securities is applied. Additionally, net profits generated from speculative trading is considered as a potential increase in the rate of return to bonds, especially in case 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 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.

C.3 Household Asset Portfolios

Table C.1: 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 assets disposable	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).

D Appendix - Results

D.1 Results - Rate-of-Return Elasticities

Table D.1: Rate-of-Return and Budget Elasticities on Conditional First-Stage Asset Demand Levels

on Asset Levels		Housing Assets	Financial Assets
		Unconstrained	
Budget El. ($\widehat{\eta}_{j\|l}$) [a]		1.195	0.961
		(0.005)***	(0.001)***
Uncompensated	Own-Rate ($\widehat{\varepsilon}^{(r)}_{jj\|l}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk\|l}$)	
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. ($\widehat{\eta}_{j\|l}$) [a]		1.196	0.961
		(0.005)***	(0.001)***
Uncompensated	Own-Rate ($\widehat{\varepsilon}^{(r)}_{jj\|l}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk\|l}$)	
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 $\widehat{\eta}_j = 1$.
Source: Own calculations using the EVS data (1998, 2003).

Table D.2: Rate-of-Return and Budget Elasticities on Conditional Housing Asset 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 (D.1).
a: Null hypothesis for the budget elasticities is $\widehat{\eta}_j = 1$.

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

Table D.3: Rate-of-Return and Budget Elasticities on Conditional Financial Asset Demand Levels

on Asset Levels		Bank Deposits	Building 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 are computed at the mean of all covariates and are defined as in Table (D.1). **a**: Null hypothesis for the budget elasticities is $\widehat{\eta}_j = 1$.

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

Table D.4: 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 ($\widehat{\varepsilon}^{(r)}_{jj}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk}$)								
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)***
Building 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 ($\widehat{\varepsilon}^{(r)}_{jj}$)	Cross-Rate Elasticity ($\widehat{\varepsilon}^{(r)}_{jk}$)								
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)
Building 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, $\widehat{\varepsilon}^{(r)}_{jj}$ is the unconditional own-rate elasticity of asset j on asset levels. $\widehat{\varepsilon}^{(r)}_{jk}$ 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).

D.2 Results - Estimation - Structural Model

Table D.5: SUR Estimates for Conditional Asset Demand for Housing Assets at the 1. Stage

dep. var.: share of housing assets from total assets ($\in [0,1]$)	Coeff	(SE)
prices:		
$ln(p_{hou})$	-1.7726	(0.1551)***
$ln(p_{fin})$	2.1738	(0.1148)***
total budget:		
log total gross budget	-0.0470	(0.0028)***
log total gross budget sq.	0.0063	(0.0002)***
stock of net assets:		
1. quintile (ref.)		
2. quintile	0.0148	(0.0035)***
3. quintile	0.0983	(0.0037)***
4. quintile	0.2024	(0.0037)***
5. quintile	0.1649	(0.0038)***
age:		
30 and younger (ref.)		
30 - 35	0.0329	(0.0048)***
35 - 40	0.0389	(0.0047)***
40 - 45	0.0330	(0.0048)***
45 - 50	0.0189	(0.0049)***
50 - 55	0.0025	(0.0050)
55 - 60	-0.0032	(0.0052)
60 - 65	-0.0111	(0.0058)
65 - 70	-0.0294	(0.0068)***
70 - 75	-0.0525	(0.0071)***
75 and older	-0.0704	(0.0070)***
education:		
educ degree high	0.0117	(0.0023)***
educ degree med	0.0078	(0.0026)**
educ degree low (ref.)		
educ degree non	-0.0022	(0.0055)
social status:		
selfemployed	0.0146	(0.0042)***
public servants	0.0080	(0.0031)**
employee (ref.)		
workers	-0.0005	(0.0031)
pensioners	0.0043	(0.0045)
nonemployed, student	0.0090	(0.0043)*
household type:		
single female	0.0237	(0.0048)***
single male	0.0078	(0.0048)
single parent	0.0155	(0.0056)**
couple, no kids (ref.)		
couple, 1 kid	0.0218	(0.0032)***
couple, $\geq$ 2 kids	0.0387	(0.0031)***
other households	-0.0077	(0.0050)
demographics:		
employed $>$ 2	-0.0047	(0.0024)*
female	0.0009	(0.0031)
married	0.0320	(0.0037)***
divorced	0.0264	(0.0038)***
german	-0.0063	(0.0073)
east germany	-0.0180	(0.0025)***
time:		
quart1	-0.0178	(0.0026)***
quarter 2 (ref.)		
quart3	0.0092	(0.0025)***
quart4	-0.0145	(0.0025)***
year 2003	-0.0027	(0.0025)
$E[s_j \mid a_{tot} > 0]$	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 with the EVS data (1998, 2003).

Table D.6: SUR Estimates for Conditional Asset Demand for Housing Assets at the 2. Stage

dep. var.: share of asset j from housing assets ($\in [0,1]$)	Owner-Occupied Housing Coeff	(SE)	Non-Owner-Occupied Housing 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)
$E[s_j \mid a_{tot} > 0]$	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 with the EVS data (1998, 2003).

Table D.7: SUR Estimates for Conditional Asset Demand for Financial Assets at the 2. Stage

	Bank Deposits		Building		Stocks		Bonds		Insurances	
dep. var.: share ($\in [0,1]$)	Coeff	(SE)	Coeff	(SE)	Coeff	(SE)	Coeff	(SE)	Coeff	(SE)
prices:										
$ln(p_{dep})$	1.0027	(0.4115)*	1.0274	(0.2911)***	-1.6215	(0.2224)***	-0.1239	(0.0856)	-0.6089	(0.2910)*
$ln(p_{bui})$	0.1779	(0.0416)***	-0.4661	(0.0294)***	0.0502	(0.0225)*	-0.0055	(0.0086)	0.1475	(0.0294)***
$ln(p_{sto})$	-1.4111	(0.1184)***	-0.1713	(0.0837)*	0.3086	(0.0640)***	0.0645	(0.0246)**	1.0328	(0.0837)***
$ln(p_{bon})$	-6.7800	(0.6474)***	-0.6700	(0.4579)	1.3260	(0.3498)***	0.1407	(0.1346)	4.0302	(0.4577)***
$ln(p_{ins})$	3.1283	(0.0608)***	0.7214	(0.0430)***	0.3722	(0.0329)***	0.0455	(0.0126)***	-4.3545	(0.0430)***
$ln(p_{cre})$	1.3802	(0.0390)***	0.3006	(0.0276)***	0.2906	(0.0211)***	0.0587	(0.0081)***	0.4060	(0.0276)***
financial budget:										
log financial budget	0.0783	(0.0042)***	0.0903	(0.0030)***	-0.0546	(0.0023)***	-0.0123	(0.0009)***	-0.0182	(0.0030)***
log financial budget sq.	0.0045	(0.0004)***	-0.0107	(0.0003)***	0.0073	(0.0002)***	0.0017	(0.0001)***	-0.0080	(0.0003)***
stock of net assets:										
1. quintile (ref.)										
2. quintile	-0.0423	(0.0051)***	0.0652	(0.0036)***	0.0213	(0.0027)***	-0.0004	(0.0011)	0.0516	(0.0036)***
3. quintile	-0.1245	(0.0058)***	0.0945	(0.0041)***	0.0224	(0.0031)***	0.0004	(0.0012)	0.0375	(0.0041)***
4. quintile	-0.1457	(0.0061)***	0.1190	(0.0043)***	0.0144	(0.0033)***	-0.0009	(0.0013)	0.0215	(0.0043)***
5. quintile	-0.1890	(0.0065)***	0.1319	(0.0046)***	0.0347	(0.0035)***	0.0012	(0.0013)	0.0402	(0.0046)***
age:										
30 and younger (ref.)										
30 - 35	0.0045	(0.0067)	-0.0444	(0.0047)***	0.0053	(0.0036)	0.0004	(0.0014)	0.0128	(0.0047)**
35 - 40	0.0228	(0.0066)***	-0.0579	(0.0047)***	-0.0038	(0.0036)	0.0007	(0.0014)	0.0179	(0.0047)***
40 - 45	0.0313	(0.0067)***	-0.0674	(0.0048)***	-0.0090	(0.0036)*	0.0007	(0.0014)	0.0213	(0.0048)***
45 - 50	0.0335	(0.0069)***	-0.0668	(0.0048)***	-0.0142	(0.0037)***	0.0005	(0.0014)	0.0244	(0.0048)***
50 - 55	0.0444	(0.0071)***	-0.0635	(0.0050)***	-0.0232	(0.0038)***	0.0002	(0.0015)	0.0222	(0.0050)***
55 - 60	0.0414	(0.0073)***	-0.0614	(0.0051)***	-0.0213	(0.0039)***	0.0017	(0.0015)	0.0225	(0.0051)***
60 - 65	0.0530	(0.0082)***	-0.0643	(0.0058)***	-0.0197	(0.0044)***	0.0010	(0.0017)	0.0165	(0.0058)**
65 - 70	0.0879	(0.0096)***	-0.0713	(0.0068)***	-0.0251	(0.0052)***	0.0037	(0.0020)	-0.0030	(0.0068)
70 - 75	0.1519	(0.0101)***	-0.1115	(0.0071)***	-0.0316	(0.0054)***	0.0036	(0.0021)	-0.0036	(0.0071)
75 and older	0.2097	(0.0099)***	-0.1420	(0.0070)***	-0.0333	(0.0053)***	0.0046	(0.0021)*	-0.0166	(0.0070)*
education:										
educ degree high	-0.0198	(0.0032)***	0.0076	(0.0023)***	0.0137	(0.0017)***	0.0015	(0.0007)*	0.0002	(0.0023)
educ degree med	-0.0057	(0.0036)	0.0073	(0.0026)**	0.0034	(0.0020)	-0.0009	(0.0008)	-0.0012	(0.0026)
educ degree low (ref.)										
educ degree non	0.0669	(0.0078)***	-0.0144	(0.0055)**	-0.0004	(0.0042)	-0.0015	(0.0016)	-0.0318	(0.0055)***
social status:										
selfemployed	-0.1287	(0.0060)***	-0.0419	(0.0042)***	0.0096	(0.0032)**	-0.0014	(0.0012)	0.1476	(0.0042)***
public servants	-0.0107	(0.0043)*	0.0326	(0.0031)***	-0.0133	(0.0023)***	-0.0024	(0.0009)**	-0.0043	(0.0031)
employee (ref.)										
workers	-0.0043	(0.0045)	0.0042	(0.0031)	-0.0168	(0.0024)***	-0.0014	(0.0009)	0.0033	(0.0031)
pensioners	0.0180	(0.0066)**	-0.0280	(0.0047)***	-0.0143	(0.0036)***	-0.0004	(0.0014)	0.0331	(0.0047)***
nonemployed, student	0.0635	(0.0062)***	-0.0587	(0.0044)***	-0.0119	(0.0034)***	0.0009	(0.0013)	0.0258	(0.0044)***
household type:										
single female	0.0617	(0.0067)***	-0.0036	(0.0048)	0.0094	(0.0036)**	0.0034	(0.0014)*	-0.0541	(0.0048)***
single male	0.0359	(0.0068)***	-0.0143	(0.0048)**	0.0232	(0.0037)***	0.0039	(0.0014)**	-0.0592	(0.0048)***
single parent	0.0327	(0.0078)***	-0.0082	(0.0056)	-0.0072	(0.0042)	0.0014	(0.0016)	-0.0210	(0.0055)***
couple, no kids (ref.)										
couple, 1 kid	-0.0154	(0.0045)***	0.0168	(0.0032)***	-0.0070	(0.0024)**	-0.0017	(0.0009)	0.0105	(0.0032)**
couple, $\geq$ 2 kids	-0.0133	(0.0043)**	0.0224	(0.0030)***	-0.0151	(0.0023)***	-0.0024	(0.0009)**	0.0118	(0.0030)***
other households	0.0144	(0.0071)*	0.0159	(0.0050)**	-0.0208	(0.0038)***	-0.0051	(0.0015)***	-0.0039	(0.0050)
demographics, time:										
employed > 2	-0.0003	(0.0034)	0.0206	(0.0024)***	-0.0057	(0.0018)**	-0.0015	(0.0007)*	-0.0035	(0.0024)
female	-0.0036	(0.0043)	-0.0004	(0.0031)	-0.0059	(0.0023)*	-0.0007	(0.0009)	0.0031	(0.0031)
married	-0.0147	(0.0052)**	0.0047	(0.0037)	-0.0061	(0.0028)*	-0.0005	(0.0011)	0.0002	(0.0037)
divorced	-0.0147	(0.0054)**	0.0053	(0.0038)	-0.0043	(0.0029)	-0.0002	(0.0011)	-0.0006	(0.0038)
german	-0.0270	(0.0103)**	0.0131	(0.0073)	0.0088	(0.0056)	-0.0034	(0.0021)	0.0009	(0.0073)
east germany	0.0058	(0.0035)	-0.0157	(0.0025)***	0.0073	(0.0019)***	0.0012	(0.0007)	0.0042	(0.0025)
quart1	-0.0267	(0.0039)***	0.0062	(0.0028)*	-0.0021	(0.0021)	0.0022	(0.0008)**	0.0163	(0.0028)***
quarter 2 (ref.)										
quart3	-0.0187	(0.0037)***	0.0059	(0.0026)*	0.0066	(0.0020)***	0.0009	(0.0008)	0.0020	(0.0026)
quart4	-0.0014	(0.0036)	0.0112	(0.0026)***	-0.0107	(0.0019)***	-0.0025	(0.0007)**	0.0108	(0.0026)***
year 2003	0.1098	(0.0064)***	-0.0841	(0.0046)***	-0.0155	(0.0035)***	-0.0036	(0.0013)**	0.0118	(0.0046)**
$E[s_j \mid a_{tot} > 0]$	0.477		0.142		0.059		0.008		0.201	
Observations	84,046		84,046		84,046		84,046		84,046	
R^2	0.226		0.094		0.070		0.021		0.301	

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

D.3 Results - Estimation - Reduced-Form Model - Discrete Asset Choice

Table D.8: Multinomial Logit Estimates for Conditional Probability of Positive Demand for 1.Stage Assets (Marg. Effects and SE)

	Housing Assets		Financial Assets	
dep.var.: demand probability	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 with the EVS data (1998, 2003).

Table D.9: 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 probability	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 with the EVS data (1998, 2003).

Table D.10: Multinomial Logit Estimates for Conditional Probability of Positive Demand for Financial Assets (Marg. Effects and SE)

	Bank Dep.		Build.-Soc.D.		Equities		Insurances		C.Credits	
dep.var.: demand probability	Mfx	(SE)	Mfx	(SE)	Mfx	(SE)	Mfx	(SE)	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 with the EVS data (1998, 2003).

D.4 Results - Estimation - Reduced-Form Model - Continuous Choice

Table D.11: SUR Estimates of Conditional Asset Demand at the 1.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 with the EVS data (1998, 2003).

Table D.12: 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 with the EVS data (1998, 2003).

Table D.13: SUR Estimates for Conditional Demand for Financial Assets

dep.var.: share in %	Bank Dep. Coeff	(SE)	Build.-Soc.D. Coeff	(SE)	Stocks Coeff	(SE)	Bonds Coeff	(SE)	Insurances Coeff	(SE)	C.Credits Coeff	(SE)
tax rate:												
marginal tax rate 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 and younger (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 and older	20.05	(0.88)***	-12.83	(0.57)***	-2.94	(0.44)***	0.46	(0.19)*	-1.71	(0.57)**	-3.02	(0.48)***
stock of net assets:												
1. quintile (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)***
financial budget:												
log financial 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 financial 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)*
household 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)
couple, no kids (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 households	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)***
selection 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 with the EVS data (1998, 2003).

D.5 Results - Tax Effects

The tax elasticity of cluster l is determined at the upper stage of the 2SBM, which is estimated conditional on positive total asset demand so that there are effects at the intensive as well as at the extensive margin. The unconditional expected value of asset demand for cluster l 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 asset share in cluster l, $E[s_l|a_{tot} > 0]$ is the respective share conditional on positive total asset demand, and $Pr[a_{tot} > 0]$ is the probability of positive total asset demand. It follows for the marginal effect of taxation on the unconditional asset demand for cluster l:[74]

$$\frac{\partial E[s_l]}{\partial t} = \frac{\partial Pr[a_{tot} > 0]}{\partial t} E[s_l|a_{tot} > 0] + \frac{\partial E[s_l|a_{tot} > 0]}{\partial t} Pr[a_{tot} > 0] \tag{30}$$

from which it follows for the total tax elasticity of asset demand for cluster l:

$$\varepsilon_{E[s_l],\,t} = \frac{\partial E[s_l]}{\partial t}\frac{t}{E[s_l]} = \frac{\partial Pr[a_{tot} > 0]}{\partial t}\frac{t}{E[s_l]} E[s_l|a_{tot} > 0] \;+\; \frac{\partial E[s_l|a_{tot} > 0]}{\partial t}\frac{t}{E[s_l]} Pr[a_{tot} > 0] \tag{31}$$

and finally

$$\varepsilon_{E[s_l],\,t} = \left(\varepsilon_{E[s_l|a_{tot}>0],\,t} + \varepsilon_{Pr[a_{tot}>0],\,t}\right) \frac{E[s_l|a_{tot} > 0] * Pr[a_{tot} > 0]}{E[s_l]} \tag{32}$$

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.

Table D.14: Conditional and Unconditional Tax Effects on Cluster Asset Demand Shares

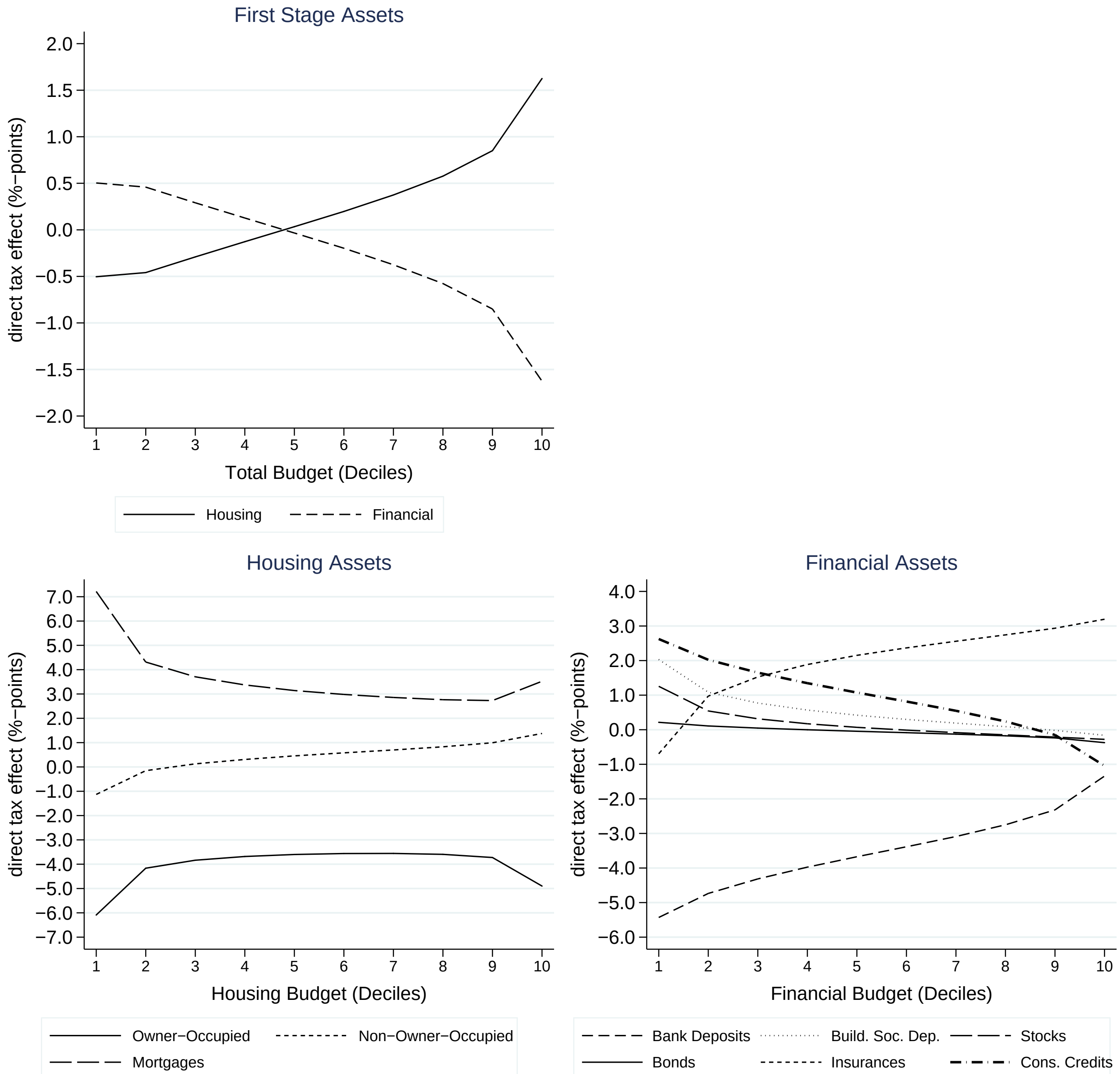
	$\bar{s}_l$	$\bar{s}_{l\|a}$	$\text{Mfx}_{s_{l\|a}}$	$P_{a_{tot}}$	$\text{Mfx}_{P_{a_{tot}}}$	Mfx_{s_l}	ε_l	η_l
Housing Assets	15.5	16.7	0.030***	0.932	−0.00001	0.028***	0.040***	0.130***
	(27.9)	(12.2)	(0.007)	(0.246)	(0.00002)	(0.007)	(0.009)	(0.029)
Financial Assets	77.7	83.3	−0.030***	0.932	−0.00001	−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 $\text{Mfx}_{s_{l|a}} = \partial E[s_l \mid a_{tot} > 0]/\partial t$ 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).

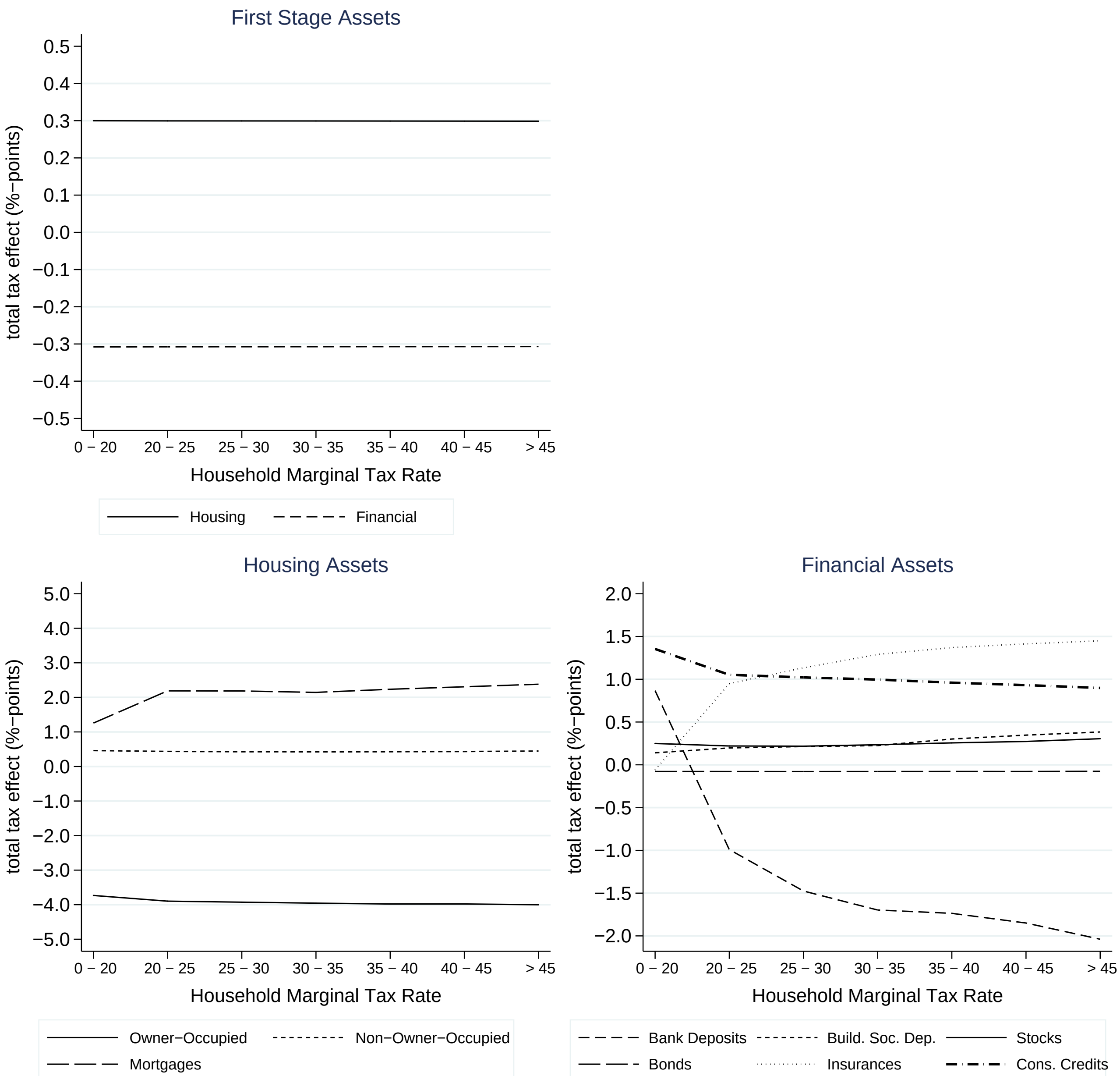
[74] For calculations of total marginal tax effects in similar settings, see Agell and Edin (1990), or King and Leape (1998), or Dubin and McFadden (1984).

Figure D.1: 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.

Figure D.2: 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.