CPB Netherlands Bureau for Economic Policy Analysis

CPB Discussion Paper | 273

Saving behavior and risk taking

Evidence from the Dutch Tax Reform in 2001

Erik Floor
Arjan Lejour

Saving behavior and risk taking
Evidence from the Dutch Tax Reform in 2001

Erik Floor (CPB) & Arjan Lejour (CPB)

ABSTRACT

We estimate the impact of the marginal tax rate on the ownership in risk-bearing assets and on the share in total assets. In contrast to the literature, we use instrumental variables to correct for endogeneity of the marginal tax rate on capital income. Moreover, we use the exogenous variation in marginal tax rates from the Dutch tax reform of 2001. We find that a change in the difference in the marginal tax rate between risky assets and riskless assets has a significant positive impact on the ownership of risky assets and growth funds. A ten percentage point increase of the marginal rate results in a 0.5 percentage point increase of the probability of owning risky assets. The tax rate has no impact on the share of risky assets if we correct for endogeneity and selection.

JEL codes: G11, H24, H31

Keywords: Household portfolio choice, Taxes, Tax reform, Instrumental variables, Selection model

We appreciate constructive comments from and fruitful discussions with Rob Alessie, Leon Bettendorf, Casper van Ewijk, Johannes Hers, Bas Jacobs, Egbert Jongen and Floris Zoutman. Moreover, we appreciate the advice of Mauro Mastrogiacomo with the data and the availability of his Stata files. The data are available at CentERdata and the Stata do-files and output files by the authors.

1. Introduction

The theoretical literature agrees that marginal tax rates affect savings behavior of individuals. It does not only affect the size of savings but could also influence the allocation of savings. There are two main channels through which the marginal tax rate can affect portfolio choice (Poterba, 2001). The first adverts that if an asset is taxed more, this asset will become less attractive compared to other assets. The second channel argues that a higher marginal tax implies that governments share to a larger extent in the investment risks and this increases the demand for risk-bearing assets (see Sandmo (1985) for an extensive discussion). These two channels lead to opposing effects of a change in the marginal tax rate on risk-bearing assets. The empirical literature finds in general that higher marginal taxes induce higher participation in risky assets. The risk-sharing channel thus seems to dominate the after-tax return channel. However, the effects on the intensive margin (the share of risky assets) are small and often insignificant.[1]

This study uses the exogenous variation in the marginal tax rate on capital income as a result of the Dutch tax reform of 2001 to estimate the effects of capital taxation on portfolio choice. We examine the effects of changes in the marginal tax rates on capital on the wealth distribution over asset categories. Before the year 2001 dividend income was taxed, but capital gains were untaxed in the Netherlands. Moreover, interest income on savings was also taxed.[2] This is different from the tax systems in most papers where capital gains, dividend and interest are taxed by the same tax rate. From 2001 neither dividends nor capital gains are taxed which implies that the Dutch government does not share in asset risks, at least related to dividend, suggesting less demand for risk-bearing assets. However, this effect is expected to be very modest because most of the investment risk is probably related to the stock value and not to dividend income. After the tax reform in 2001 interest income is also not taxed which suggests that the net return on risk-free savings has increased compared to the net return on risky assets. This will also probably result in a lower ownership of risky assets and a smaller share of these assets in the portfolio.

As in previous papers we focus on both the choice whether or not to invest in risky assets (extensive margin, see Hochguertel et al. (1997) & Bernheim (2002)) and the size of these investments (intensive margin), but in contrast to the previous literature we solve two endogeneity problems simultaneously. Both the marginal tax rate on capital income and the variation in marginal tax rates are often endogenous, because these are determined by income and wealth (Alan et al., 2010). First, we create exogenous variation in the level of the marginal

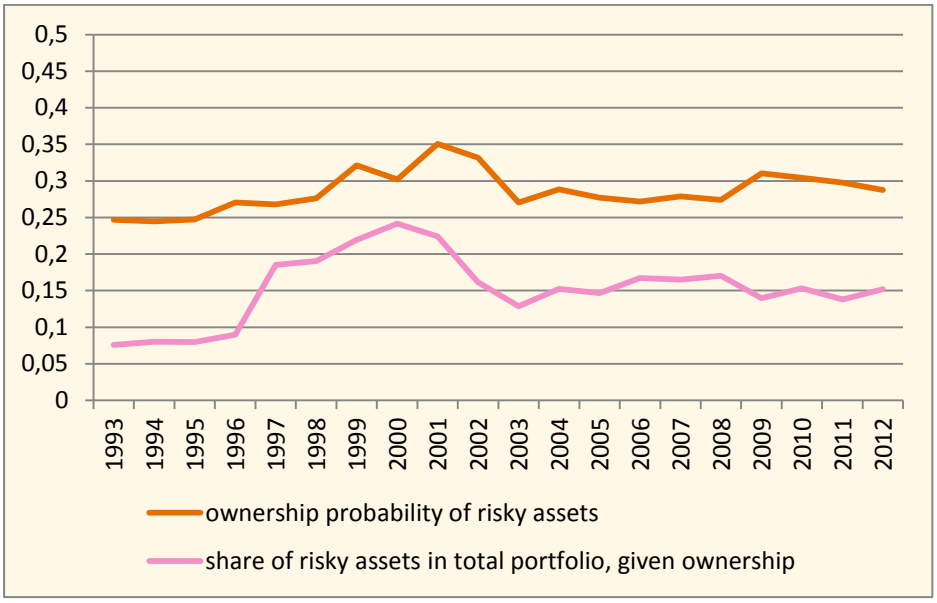
[1] See Feldstein (1976), King and Leape (1998), Poterba (2001), Poterba and Samwick (2002) Hochguertel et al. (1997) and Alan et al. (2010) among others.

[2] Section 2 describes the Dutch tax system in more detail. The first 1000 Dutch guilder (453.8 euro) of interest income and dividend income were tax exempted. Besides there was a wealth tax of 0.7 or 0.8% depending on the year.

tax rate by instrumenting it with birth cohorts, gender and education level, following Blundell et al. (1998). Moreover, we use a Heckman selection model for estimating the intensive margin. This is the main contribution of our paper. Second, we identify the effect of marginal tax rates on asset allocation by the exogenous change in tax rates that is created by the Dutch tax reform.

We use the dataset of the Dutch Household Survey covering 1993 to 2012. In this dataset individuals participate for a number of years and provide information about their wealth, income and (economic) preferences, amongst others. From these data we observe that the share of risky assets (stocks, bonds and mutual funds) decreases in 2001, and remains fairly constant until 2012 (Figure 1). That could be evidence of the tax reform in 2001. From the reported ownership probabilities for risky assets we observe a sharp drop in participation after the tax reform, indicating a possible causal link. Although Figure 1 suggests an impact on both the extensive and the intensive margin for risky assets of the Dutch Tax Reform, the share in risky assets could also be affected by the dotcom bubble at the end of the 1990s and its burst in 2001.[3]

Figure 1 - (%) Ownership probabilities of risky assets & share of risky assets in total portfolio, given ownership (*DNB Household Survey*)[4]



Using the instrumental variables technique for the marginal tax rates and the tax reform for the variation (Blundell et al., 1998), we find that changes of the marginal tax rate have significant impact on the ownership of risky assets, but not on the share.

[3] The increase in owning stocks and mutual funds for the Netherlands in the 1990s is also described by Alessie et al. (2001).
[4] Note that the numbers are not necessarily representative for the Dutch population. Alessie et al. (2001) analyze the representativeness of the survey for the year 1993 to 1998. These are fairly good if sample weights are used. We do not apply these, because we are mainly interested in the characteristics of the data set.

This paper builds upon a series of findings in the economic literature since Feldstein (1976) on the theoretical aspects of portfolio choice. His main finding is that the personal income tax 'has a very powerful effect on individuals' demands for portfolio assets' (Feldstein, 1976, p. 648). King and Leape (1998) present related evidence. They find that marginal taxes affect the extensive margin, but they do not find clear evidence for the intensive margin. Poterba and Samwick (2002) use data from the American Survey of Consumer Finances.[5] They impute marginal tax rates from all income-related variables from the dataset and present estimates for 1983, 1989, 1992, 1995, and 1998. Their paper suggests that higher marginal tax rates affect asset allocation decisions towards more risk-bearing assets, but the effects are not significant for all years. We find similar mixed outcomes, when we use similar cross section analysis (see section 6). They try to correct for the present endogeneity of the marginal tax rate by calculating marginal tax rates as the difference in a household's tax liability at a base level of income and that base level of income plus an increment. They set the base to zero to create a 'first dollar' effect. The increment is equal to 5% of the households' total financial assets or $100. However, we are not convinced by this approach, for still reverse causality might hold (Poterba and Samwick (2002), p. 19-20).

Hochguertel et al. (1997) focuses on the choice for risk-bearing and risk-free assets for Dutch households.[6] They show that the size of financial wealth and the marginal tax rate are the main determinants of the allocation. The share of risky stocks and bonds increases by 3%, given a 1% rise in the marginal tax rate, even in the absence of a tax on capital gains. These are large effects compared to other papers. However, their estimation suffers from a small number of observations (156 individuals own shares) and the endogeneity problem. With adding a threshold equation using financial wealth depending on education and family characteristics, they try to overcome the 'participation effect': when someone invests in a particular asset, he tends to invest a substantial amount, suggesting that some transaction costs (the threshold) are present. Alessie et al. (2001) discuss in detail the portfolio composition of households between 1993 and 1998 using DHS data and compare the outcomes with the Dutch national statistics. Moreover, they use discrete choice models and selection models for relating asset ownership and asset shares to background variables such as age, household composition, education, etc. but they do not consider explicitly marginal tax rates. In another study, Alessie et al. (2004) consider the interaction between participating in stocks and mutual funds over time between

[5] Nearly all US evidence is from this survey. The Survey of Consumer Finances (SCF) is normally a triennial cross-sectional survey of U.S. families, but over the 1983–1989 and 2007–2009 periods, the survey collected panel data. No other study for the US collects comparable information (Federal Reserve, 2013).

[6] There are many papers which focus on wealth and savings in the Netherlands using the DHS data. Nearly all focus on risk free savings (Hochguertel, 2003) or the displacement effects between mandatory pension savings and free savings. An exception is Alessie et al. (2001) analyzing the participation in stocks and mutual funds.

1993 and 2004. A recent paper of Zoutman (2013) also studies the effect of the tax reform of 2001 on portfolio composition. He focuses on financial and housing wealth, and ignores the choice between risky and non-risky assets. He uses an estimation technique of Saez et al. (2009) and finds modest effects from the tax reform. Saez et al. (2009) use data before a tax reform for predictions after the reform. This makes it possible to compare a treatment group (actual values) with a control group (predicted values). This method compares individuals directly and also controls for changes over time.

Alan et al. (2010) signal that income is highly correlated with the marginal tax rate in most cross-section studies, which makes it difficult to unveil the real effect of the tax rate. They solve this endogeneity problem by studying individuals with the same level of income, but with different marginal tax rates: they exploit natural variation due to different taxation of single and non-single households in Canada. They find that a ten percentage point increase in the marginal tax rate increases the mean portfolio share of tax-favored assets by 1.7 percent and decreases the mean portfolio share of moderately taxed assets by 1.3 percentage points.

Scholz (1994) and Samwick (2000) also use data from the American Survey of Consumer Finances between 1983 and 1989 but implement a difference-in-difference approach with a tax-reform as identification. Scholz (1994) finds small effects and Samwick (2000) concludes that there is a clear relationship between marginal tax rates and portfolio structure, although he is not able to explain changes over time by the marginal tax rate. Potential problems with this method are the identification of a control group (everyone is affected by a large tax reform) and limitations of the time-span of the dataset (Alan et al, 2010).

In sum, the papers on the empirical implications of taxing capital on portfolio choice find in general that higher marginal taxes induce larger participation in risky assets. However, the effects on the intensive margin are small and sometimes insignificant. We have to be aware that not all endogeneity problems are completely solved. Tax reforms as an exogenous change in marginal tax rates are often applied to identify the real effects on portfolio choice. We extend this literature by using instrumental variables to estimate the level of the marginal tax rates and by applying a Heckman selection model for the intensive margin.

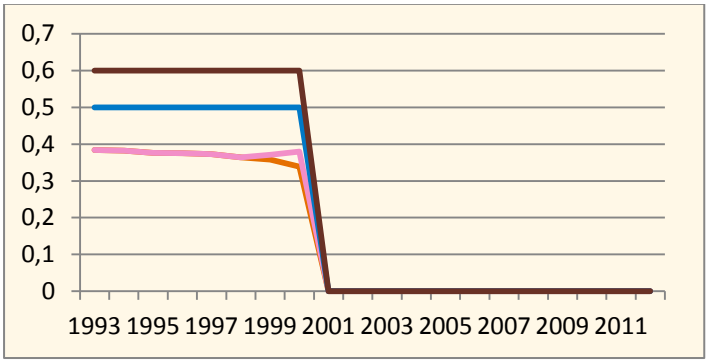
Section 2 describes the Dutch income tax system and the reform in 2001. The underlying theoretical model is discussed in Section 3 and Section 4 presents the data. Section 5 explains the estimation techniques and Section 6 discusses the regression results. Section 7 concludes.

2. Dutch tax system

Before 2001 the Netherlands had a synthetic income tax system. Basically, all income, except capital gains, was taxed under the same progressive tax rates, after a tax deduction that differed among individuals, depending on age and marital status. In addition to the income tax, wealth was taxed at a rate of 0.7% between 1998 and 2000 (0.8% up to 1997). Wealth included almost all types of assets, including 60 percent of the housing value, excluding capital and life insurances, furniture, pensions and art collections.[7]

In 2001 the Dutch tax system was reformed in two fundamental ways.[8] First, the so-called box system was introduced, which created three separated tax systems for labor income (box 1), income from substantial shares in closely-held companies (box 2)[9] and capital income (box 3). The first box is the most important one, as it captures 90% of the total tax base. Second, capital income is differently taxed, motivated by the huge arbitrage possibilities in the old system. By participating in stocks or in the so-called growth funds investors could avoid the progressive rates of the income tax, because capital gains were untaxed (Bovenberg & Ter Rele, 1998).[10] From 2001 the returns on savings and stocks in box 3 are assumed to be 4%. This fixed return on capital is taxed at a rate of 30%. Thereby the aforementioned arbitrage has become impossible. In fact, the wealth tax changed from 0.7% to 1.2% and the taxation of returns on capital (savings and assets) was eliminated, for the taxation of capital was after 2001 unrelated to capital income. This switch created a remarkable variation in marginal tax rates, as is shown in Figure 2. Each line shows a different tax bracket. After 2001 all marginal tax rates on capital income decreased to 0%. We expect that the elimination of taxes on interest income will be the main driving force of changes in the portfolio share of risk-bearing assets. Because the (risky) capital gains were and are not taxed, the risk sharing argument will probably be less relevant.

Figure 2 - Marginal tax rates on capital income (*Elsevier Belasting Almanak*)



[7] See Elsevier Belasting Almanak, for the years 1993 to 2000.
[8] For a broader discussion on this Tax Reform, see Cnossen and Bovenberg (2000).
[9] Substantial shares in closely-held companies, in Dutch: aanmerkelijk belang (a.b.), see also Cnossen and Bovenberg (2000).
[10] Growth funds did not return any dividend, but only changed in value.

The wealth tax rate is the same over all different assets (excluding housing), and therefore the behavior of agents in allocating their savings is assumed to be independent of this tax. For this reason, we disregard it.

Table 1 - Change in statutory tax rates for different sorts of income and wealth (*Elsevier Belasting Almanak*)

	until 2000	from 2001
Labor	Progressive tax rates	Progressive tax rates[11]
Housing income	Progressive tax rates	Progressive tax rate[13]
	Wealth tax (0.7%)[12]	
Interest (savings)	Progressive tax rates[14]	
	Wealth tax (0.7%)	'Wealth tax' (1.2%)[15]
Dividends (stocks)	Progressive tax rates	
	Wealth tax (0.7%)	'Wealth tax' (1.2%)
Capital gains (growth funds)	Wealth tax (0.7%)	'Wealth tax' (1.2%)
Substantial shareholders	Corporate tax	Corporate tax
	and different tariffs[16]	and 25% (box 2)
Salary savings scheme	Tax-deferred	Tax-deferred

Table 1 shows the various changes of the tax reform for all sorts of income and income on assets. We are especially interested in interest, dividends and capital gains. As mentioned, the latter were not taxed until 2000 (except as part of wealth), making them more attractive than dividends.

3. Data

Our data are collected from the DNB Household Survey. This survey is conducted by CentERdata (linked to Tilburg University), and is sponsored by the Dutch Central Bank (DNB). The aim of the DHS is, among others, to furnish information on both economic and psychological determinants of savings. It is conducted annually since 1993. We use data from 1993 until 2012. Every year, approximately 1500 households are questioned, resulting in about 2000 individuals.

[11] See Figure 2.
[12] There is a threshold of about 90.000 euros of wealth. The definition of wealth also includes 60% of the housing value (net of the mortgage value).
[13] Mortgage interest payments could be deducted from housing income before and after 2001.
[14] Interest income until 453.8 euro was not taxed. For couples the exemption was 907.6 euro. This exemption did also hold for dividend income.
[15] The 30% income tax over an assumed return of 4% is defined as a wealth tax of 1.2%, see also above. The threshold is about 20.000 euro and increases slightly over time (more or less in line with the inflation rate). The housing value is not included in the definition of wealth.
[16] Tax for substantial share holder, in Dutch: aanmerkelijk belang (a.b.). For most substantial shareholders it was 25%.

The questionnaire contains questions on wealth, income, pensions, house ownership and preferences, among others.[17]

We evaluate the data at the household level and not at the individual level, for two reasons. First, the Dutch taxation system was mainly based on household taxation before 2001. Second, although the taxation system switched to individual taxation for labor income from 2001, wealth and the fixed return on capital could still be taxed at the household level if the members of the household identified themselves as fiscal partners.

As usual with surveys, the series include missing values, especially in reporting of income and wealth. Depending on the list of control variables, we have 500 to 2500 useful observations per year. Especially in 2000, the number of observations drops, mainly for income, wealth and risk seeking (Figure 3).[18] This is a pity, for we try to identify exogenous differences in marginal tax rates for which the years just before and after 2001, the year of the tax reform, are important. Moreover, in the first four years of the survey the samples consisted of two waves of households. The first wave consists of 1500 to 2500 households and the second wave of initially 900 households and was terminated in 1997.

Figure 3 - Number of observations (*DNB Household Survey*)

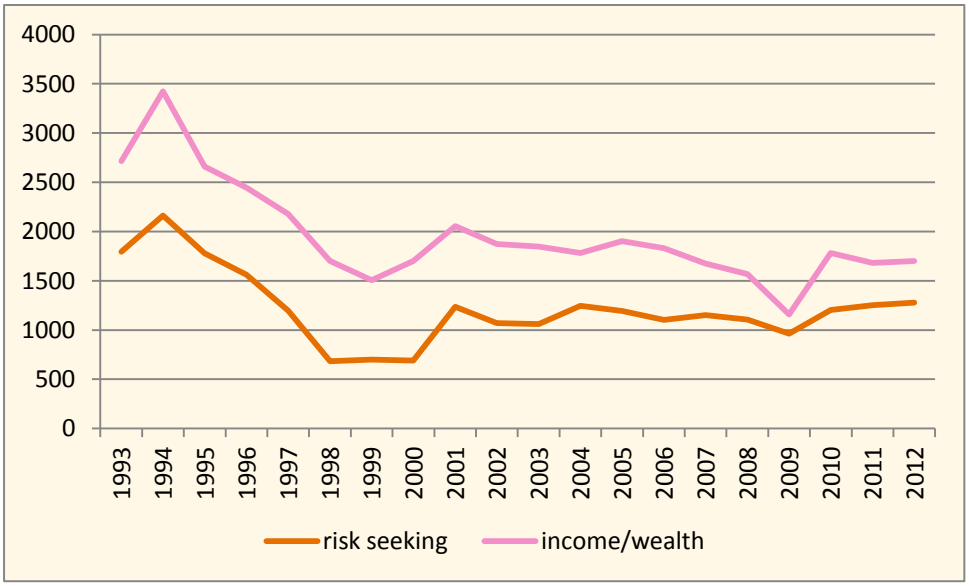


Table 2 aims to present the characteristics of the sample.[19] Female is a binary variable, taking the value of 1 if the breadwinner of a household is a woman. Approximately three-quarters of participating breadwinners are male. Age has a downward limit of 18. Partner indicates

[17] See http://centerdata.nl/en/survey-research/dnb-household-survey-dhs and Teppa and Vis (2012).
[18] CentERdata could not provide a clear reason why the number of non missing observations is low in 2000. There is no obvious reason that this is related to the tax reform.
[19] Due to non response the results in Table 2 are not necessarily representative for the Netherlands (Alessie et al., 2001).

whether the household consist of partners. Higher education is a dummy for higher professional and academic education. The variable for risk-seeking behavior is constructed using the response to the following statement: 'I think it is more important to have safe investments and guaranteed returns, than to take a risk to have a chance to get the highest possible returns.' Respondents have to answer on a scale from 1 (fully disagree) to 7 (fully agree). If respondents choose 5, 6 or 7, we define them as risk-seeking.

Table 2 - Descriptive statistics (*DNB Household Survey*)

Non-missing observations				**24411**
	mean	st. dev.	min	max
MTR	18.0	24.4	0.0	60.0
Income (*1000)	35.7	32.3	0.0	874.3
Wealth (*1000)	137.5	189.2	0.0	5248.6
Female	0.2	0.4	0.0	1.0
Age	51.7	14.5	18.0	94.0
Partner	0.7	0.5	0.0	1.0
Higher education	0.4	0.5	0.0	1.0
# Children	0.7	1.1	0.0	7.0
Risk-seeking	0.2	0.4	0.0	1.0

Note: the wealth includes all financial and housing wealth.
No sample weights are used.

We define four main groups of assets: *savings*, assumed to be risk-free or nearly risk-free, *funds, shares and bonds*,[20] assumed to be risk-bearing, *housing* and *tax-deferred assets* (see an overview in Table 3). This split into four groups is in line with the standard literature for the sake of comparison with e.g. Hochguertel et al. (1997). Substantial shares in closely-held companies, pension savings and investments in durables are excluded because of unreliable or unavailable data. In this study we focus on the economic decisions on risky assets (I). We create the share of risky assets in the total portfolio (I+II+III+IV), given that someone owns risky assets.

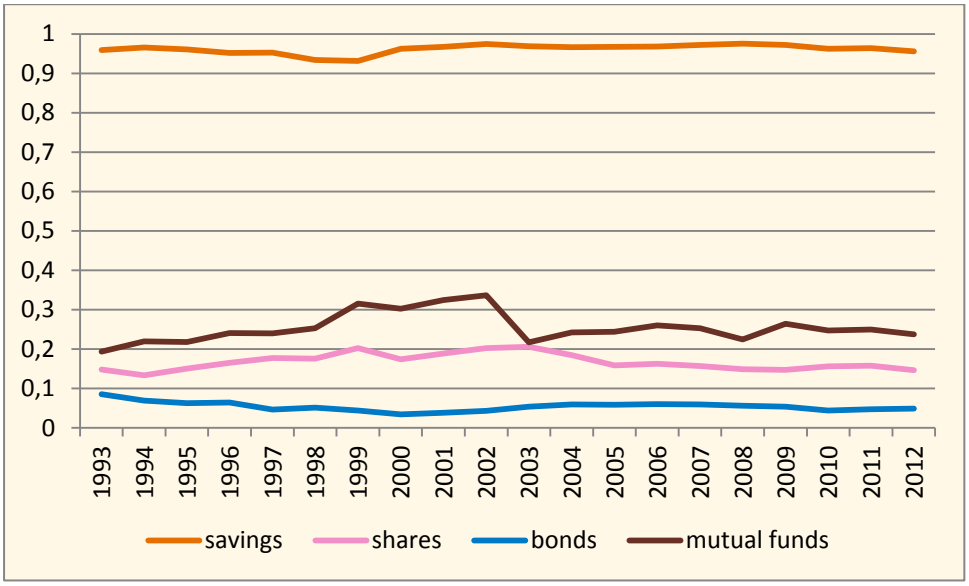
Table 3 - Classification of asset categories

	I	II	III	IV
	Risky assets	**Risk-less assets**	**Primary residences**	**Tax-deferred assets**
Includes	Shares	Savings	Houses (corrected for	Salary savings schemes
	Mutual funds		mortgages)	Life insurances
	Bonds			Growth funds

[20] Growth funds are excluded, because they are assumed to be completely tax-avoiding. Moreover, we neglect wealth in own firms, because of the limited number of observations.

Figure 4 shows that nearly everybody in the sample owns a savings account. This is confirmed by Hochguertel et al. (1997) and Poterba (2001). The probability of having shares or funds is roughly also the same as shown in the U.S. data and the Dutch data in Hochguertel et al. (1997). The percentage of individuals owning bonds is very low compared to Poterba (2001), who estimates a share of approximately 30% of having tax-exempt bonds. This might be related to the pension system in the United States, where tax-exempt bonds are rather popular. The decrease of ownership of (growth) funds right after the tax reform is remarkable. This might be due to the elimination of the arbitrage opportunities as we discussed in Section 2. Moreover, the probabilities of owning a certain asset, conditional on the ownership of another asset show that ownership of shares, bonds and funds are heavily correlated (see annex). This is an extra reason to combine these three assets in one category as is normally done in the literature.

Figure 4 - Probability of owning an asset (*DNB Household Survey*)



We have to construct the marginal tax rate for capital income. After the tax reform of 2001 it is zero by definition (see Figure 2), but for the years 1993 to 2000 we lack data on capital income. We have data on gross labor income and add estimated capital income based on fixed average returns per year on the actual value of wealth. For the returns on savings, bonds and the dividends on risky investments, such as stocks and mutual funds, we have used the 10-years interest rate on Dutch government bonds.[21] This is a good approximation, as interest rates and dividends follow almost the same pattern between 1993 and 2000 (Tweede Kamer, 2005). For less than 500 observations between 1993 and 2000, adding estimated capital increases the marginal tax rate. For approximately 12000 observations the marginal tax rates remain the same as the ones that are only based on gross labor income.

[21] The rate is 7% for 1993 to 1996, 6% for 1997 and 5% for 1998 to 2000.

4. Theoretical model

According to Poterba (2001, p1), 'tax rules are a potentially important determinant of household portfolio structure'. Tax rules and tax rates influence the portfolio choice, for example decisions whether to hold stocks, bonds or just a savings account. In his overview paper, Poterba concludes that taxation influences the decision which asset to own, how much to invest in these assets, how much to borrow, where to locate the assets (tax-deferred accounts) and when to trade assets. We limit ourselves to the first two questions, which is the standard approach; see the literature discussion in Section 1.

According to Poterba (2001), the investor has to deal with several tax rates in the capital asset pricing model (CAPM) in order to maximize return on investment and final wealth. This variation in tax rates might occur through the different taxation of capital gains and dividend income. It can be summarized in the following simple model. All risk-free savings are taxed at rate τ_b and all risky assets at another rate τ_i. The investor maximizes a utility function based on the mean and variance of final wealth $W{:}U(W, \sigma^2_W)$. The expected wealth of the investor is equal to the sum of the final value of both the risky and the risk-less assets:

1) $$E(W) = W_0([1 - \sum S_i] * (1 - \tau_b)r_b + \sum S_i * (1 - \tau_i)\mu_i)$$

where r_b is the interest rate and μ_i is the expected return on equity *i*. S_i is the share of investments in risky asset *i*. W_0 reflects initial wealth. The variance of expected wealth $E(W)$ equals:

2) $$\sigma^2_W = \sum\sum S_i * S_j * (1 - \tau_i) * (1 - \tau_j) * \sigma_{ij}$$

The variance is only affected by risky assets, because of the assumption that the return on risk-free savings is certain. Using these formulas we can derive the first-order conditions and maximize final utility. The optimal share of risky assets yields:

3) $$S_i^* = \delta * \Omega^{-1} * [(1 - \tau_i)\mu_i - (1 - \tau_b)r_b * 1] \text{ and } \delta = U_W/[2U_{\sigma 2} * (1 - \tau_i)^2]$$

where 1 denotes a column vector of ones. The Ω denotes the covariance matrix of risky returns. When taxes are equal to zero, the normal outcome of the CAPM model would occur.

Net wealth can also be affected by a wealth tax. This tax lowers the returns on risk-free and risk-bearing assets as total wealth exceeds the tax-free threshold. It is a disincentive on savings and wealth, but it does not discriminate between risk-free and risk-bearing assets. Because we are not interested in the effect of the tax reform on total assets, but only on the share of risk-free and risk-bearing assets, we ignore the wealth tax in the theoretical and empirical analysis.

Equation (3) shows that a different fiscal treatment of risky and risk-free assets affects the optimal share of particular assets because it affects the expected returns and the risks. Therefore the Dutch tax reform has two consequences. First and most important, risk-free savings become more attractive compared to the non-taxed capital gains, because the after tax return on savings increases. Before 2001 risky assets were less taxed than risk-free assets. Eliminating the capital income tax yields therefore a relative rise in attractiveness of risk bearing assets.

Second, the marginal tax on interest income and dividend income is scrapped. This does not affect the differences in the average return on dividend income and interest income, but decreases the attractiveness of dividends because the government does not longer participate in the risk. Moreover, the arbitration advantage of tax-free capital gains (Bovenberg & Ter Rele, 1998) has disappeared which also limits the attractiveness of growth funds.

There are two reasons that could qualify this outcome. The first is that the model assumes perfect loss offset. This can be justified if losses can be deducted from gains of other assets and this could be still positive on net assuming that the government does not subsidize losses. This is the case with dividends because negative dividends hardly exist in practice. Risk sharing in capital losses is not relevant, because capital gains are not taxed. If imperfect loss setting would occur, Salanié (2003) shows that a higher marginal tax rate could make risk-bearing assets less attractive. However, imperfect loss offset does not seem to be a topic in this analysis because capital gains are not taxed. Second, there could be fixed, non-refundable costs in acquiring assets. In that case it is not clear that the channel of risk taking dominates the one on the expected net return. In particular, if these fixed costs are high relative to the net return, the dominance could be reversed. This could imply that the elimination of the tax on dividend and interest income could increase the attractiveness of risky assets, but it raises the net return compared to the fixed costs. It is hard to judge the empirical relevance of this qualification, but even then risk-free savings have become more attractive because of the higher after-tax return compared to capital gains.

The discussion above focuses on the intensive margin, but the same reasoning also applies to the extensive margin. However, the decision to participate in a category of assets depends on the average tax rate, because of the binary decision to participate a ‘certain amount of money´ into some asset category. Since this certain amount of money is not known in our dataset, we are not able to compute the average tax rate. We assume that the marginal tax rate to be the best predictor of it. This mainly affects the interpretation of the magnitude of the effect of the

tax rate on the ownership of assets. We should be careful in interpreting the size of the coefficients on the extensive margin, but we can be sure about the sign.

5. Methodology

Our main purpose is to estimate the effect of the difference in marginal tax rates on the risk-taking savings behavior of Dutch citizens. To achieve this, we exploit the tax reform of 2001 as a quasi natural experiment. This reform creates exogenous variation in the marginal tax rates on capital income as is shown above in figure 2. The difference in marginal tax rates is defined as MTR(riskless assets) - MTR (risky assets) and is assumed to be equal to the marginal tax rate of riskless assets, as risky were almost tax exempt. When the marginal tax rate is mentioned we mean the difference between the marginal tax rates of riskless and riskless assets, thus the marginal tax rate on income that is not tax exempt. We solve the endogeneity problem between marginal tax rates and income by using instruments for the marginal tax rate. Furthermore we account for self-selection in estimating the intensive margin.

Regular estimations of the marginal tax rate on asset ownership with OLS and probit regressions face at least two endogeneity problems.[22] The first problem is that marginal tax rates might be endogenous, because of progressive tax systems. Higher income yields higher marginal tax rates. Furthermore, it is possible that the marginal tax rate induces changes in income, as individuals are expected to respond to their after-tax rate of return on labor. The problem is limited for capital income because the marginal tax rate for capital income does not vary from 2001 and it affects only 500 of 12,500 individuals in the sample the marginal tax rate (see section 3). This is different for labor income, as this income is the main factor in determining the marginal tax rate in the Netherlands. Table 4 shows the correlation of the main control variables and the marginal tax rates. It is clear that especially income is highly correlated with the marginal tax rate (MTR).

Table 4 - **Correlation of the marginal tax rate (MTR) and main control variables 1993-2012 (*DNB Household Survey*)**

	MTR	Income	Wealth	Age	Education	Cohort
MTR	1					
Income	0.4562	1				
Wealth	-0.0457	0,.1829	1			
Age	-0.1326	-0.016	0.2779	1		
Education	0.0717	0.2171	0.1168	-0.0296	1	
Cohort	-0.2546	-0.2018	0.0649	0.3438	0.0055	1

[22] See Scholz (1994), Samwick (2000) and Alan et al. (2010), among others.

We solve the endogeneity problem by creating exogenous variation in the level of the marginal tax rates using instruments (Angrist & Pischke, 2009). Three available and useful instruments are birth year, sex and education.[23] The data show that older cohorts are wealthier and that birth year correlates with income. Exogenous variation in year of birth generates therefore exogenous variation in marginal tax rates. We determine four cohorts in ten-year intervals: 1935-1944, 1945-1954, 1955-1964, 1965-1974, and an extra cohort for those aged 65 and older. The people in the last cohort face lower tax rates, since they are exempted of paying pension premiums.[24] The exogeneity of this instrument is obvious: influencing your birth date is impossible. Figure 5 shows the decrease of the marginal tax rate over the cohorts. The second instrument is sex. This instrument is related to the average number of hours worked and therefore income. MTRs for men are on average higher than for women as figure 6 shows.

Figure 5 - Marginal tax rate (%) over cohorts 1993-2000 (*DNB Household Survey*)

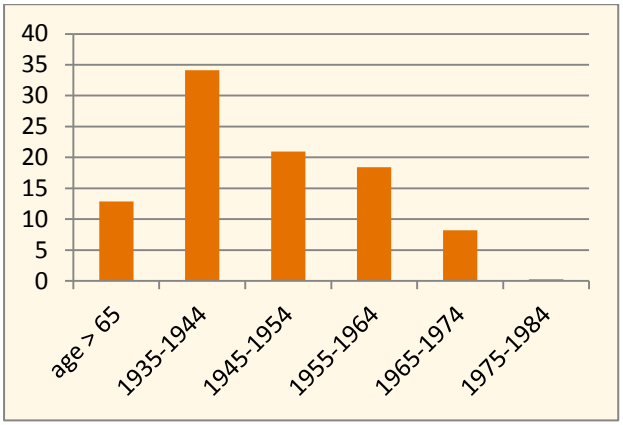
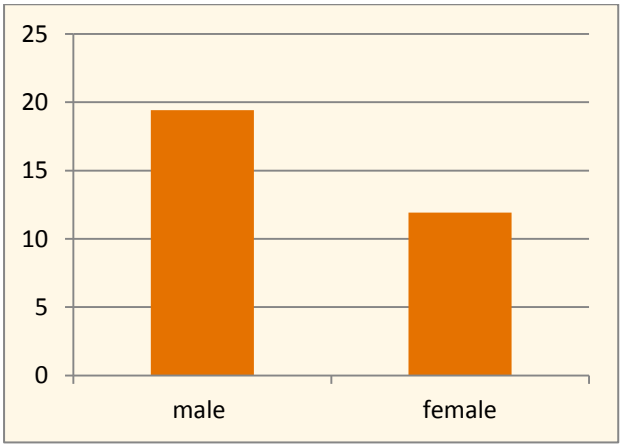
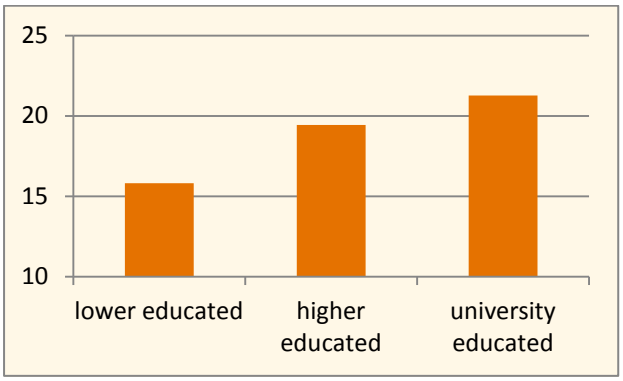


Figure 6 - Marginal tax rate (%) over sex 1993-2000 (*DNB Household Survey*)



[23] See Blundell et al. (1998). Jongen and Stoel (2013) present an application for the Netherlands.
[24] Generally the tax rates of elderly people (>65) are 15-20% lower in the first two tax brackets.

Figure 7 - Marginal tax rate (%) over education 1993-2000 (*DNB Household Survey*)



The third instrument is education.[25] This variable is correlated with income, so we expect that the impact might be substantial. Higher educated people tend to have a higher income and thus have higher marginal rates (Moonen, Otten, & Pleijers, 2011). We distinguish three education categories: lower education, higher education and academic education, covering 93% of all observations.[26] The remaining 7% is dropped due to missing values.

The second problem concerns the endogeneity of changes in the marginal tax rates over time. If the change is not exogenous, it is hardly possible to measure the effect of differences in taxes. In this study we overcome this problem by the use of the tax reform in 2001 as other papers use tax reforms in the US (see Auerbach et al. (1983) and Poterba (2002)). This reform creates exogenous variation in the marginal tax rates that therefore are not affected by choices about income and wealth.

Taking account of the endogeneity problems, we estimate for the extensive margin the following system of regressions following Blundell et al. (1998):

4. $$\tau_{it} = \alpha_g + \alpha_t + \alpha_{gt} + \alpha_2 X_{it} + \varepsilon_{it}$$
5. $$\Pr(O_{a,i,t} = 1) = \Phi(\beta_0 + \beta_1 \hat{\tau}_{it} + \beta_2 X_{it})$$

where τ_{it} denotes the predicted marginal tax rate, α_g is a cohort-sex-education dummy, α_t is a time dummy and α_{gt} is a cohort-sex-education-time dummy (except for first year in the sample, 1993). X_{it} is the set of control variables. $O_{a,i,t}$ denotes the ownership of a particular asset category. This binary decision is estimated with probit models. We use the set of equations (4) and (5) to estimate the ownership decisions. Because the MTR is instrumented, it could be

[25] Although education itself is endogenous, we assume that it is exogenous with respect to the marginal tax rate. First, individuals are educated before they earn income. Education is, at least in countries as the Netherlands where schooling is accessible to everyone, determined by ability and less by income not earned yet. Second, education is heavily subsidized, such that actual income is not necessary.

[26] Lower education: primary education, secondary education and vocational education (MBO). Higher education: higher vocational education (HBO). University: academic education (WO).

necessary to correct the standard errors in the probit for a possible selection bias. Correction factors did only have a marginal effect on the standard errors, so we did not use them in the end. Moreover, we have clustered the observations by household in the pooled regressions which has a substantial effect on the size of the standard errors.

The set of regression equations is different if we also consider the intensive margin. Then we have also to take account of the possible self-selection. Because we only use the observations of those who actually participate in a particular asset in the intensive margin estimation, we lose information that is estimated in the participation equation. We solve this by inserting the inverse Mills' ratio, see Blundell et al. (1998) and Heckman (1979). To estimate the effect of the MTR on the intensive margin, we do not include it in the corresponding probit. Otherwise it would affect the intensive margin directly and indirectly via the participation decision. The probit becomes:

$$6. \qquad \Pr\left(O_{a,i,t} = 1\right) = \Phi(\eta_g + \eta_t + \eta_{gt} + \eta_1 X_{it})$$

The η's represent cohort-sex-education, time and cohort-sex-education-time dummies, respectively. We add the instrumental variables to create exogenous variation. The inverse Mills' ratio is $\hat{\lambda}_{i,t} = \frac{\phi(\hat{\eta}_g+\hat{\eta}_t+\hat{\eta}_{gt}+\hat{\eta}_{ot}+\hat{\eta}_1 X_{it})}{\Phi(\hat{\eta}_g+\hat{\eta}_t+\hat{\eta}_{gt}+\hat{\eta}_{ot}+\hat{\eta}_1 X_{it})}$. This variable is added in the OLS regression on the intensive margin. We also add the residuals from the first stage MTR equation (4) ($\hat{\varepsilon}_{i,t}$), in order to capture unobserved ability and preferences for portfolio allocation following the control function approach of Blundell et al. (1998). Besides we add the predicted marginal tax rate ($\hat{\tau}_{it}$, see equation 4) on the share of an asset ($S_{a,i,t}$) in the total portfolio. This leads to the following equation for the intensive margin:

$$7. \qquad S_{a,i,t} = \gamma_0 + \gamma_1 \hat{\tau}_{it} + \gamma_2 X_{it} + \gamma_3 \hat{\varepsilon}_{i,t} + \gamma_4 \hat{\lambda}_{i,t} + \omega_{it}$$

Also here we cluster the observations by household in the pooled regressions.

6. Results

6.1 Risky assets

In this section, we first present the results using the estimation methods in Hochguertel et al. (1997) and Poterba and Samwick (2002), among others. We replicate almost all of their results. Second, we use the instrumental variables and Heckman's selection model in order to eliminate present endogeneity and self selection problems if we identify the effects of the tax reform on the extensive and intensive margins.

Table 5 shows that we obtain similar results as other studies for the years before the tax reform, when the Netherlands levied a capital income tax.[27] The first model shows the marginal effects of a change in the difference in tax rates on asset participation. The second model presents the effect of the marginal tax rate on the share of risky capital in the total portfolio. This is done for each year between 1993 and 2000. We provide the results for more years than Hochguertel et al. (1997), who have only data for one year, and Poterba and Samwick (2002), who provide results for five years. The marginal tax rate has a significant positive effect on ownership in 4 of the 8 regressions and on the share of risk assets in all regressions. The estimations on the share of risky assets in the portfolio are based on fewer observations, as these equations are estimated only for those who participate in risky assets. The regressions for 1998 to 2000 suffer highly from many missing values and are probably less representative. The last row in Table 5 presents the results of the pooled regressions for 1993 to 2000. The regressions are estimated with the full set of control variables. The effects of the control variables are presented when discussing our preferred model.[28]

Table 5 - The effects of the MTR on ownership and share of risky assets by year

	(1) Ownership	Observations	(2) Share	Observations
1993	0.001	1791	0.195***	506
1994	0.002**	1943	0.133*	537
1995	0.001	1778	0.224***	519
1996	-0.001	1562	0.211**	479
1997	0.004**	1167	0.365***	370
1998	-0.000	676	0.513***	225
1999	0.005**	697	0.558***	273
2000	0.005*	499	0.547***	176
1993-2000	0.002***	10113	0.239***	3085

*** p<0.01, ** p<0.05, * p<0.1, s.e. clustered on household level in the last regression. (1): marginal effects of the probit regression of equation 5 without IV. (2): OLS regression of equation 7, without IV and lambda.

The regressions in Table 5 do not adequately identify the effect of a change in the marginal tax rate because of the endogeneity problems. First, the variation in the marginal tax rate is not exogenous, because it is determined by individual choices to work and to save more or less. Second, the marginal tax rate itself is determined by labor and capital income. Furthermore there might be self selection into asset participation. We solve these problems by applying the method of Blundell et al. (1998) discussed in Section 5. The results are presented in Table 6. The ownership estimations provide only significant results for the coefficient of the marginal tax rate in 1998 and in the pooled regression. If there are fewer observations the F-test on testing a

[27] See for example Tables 7 (extensive margin) and 10 (intensive margin) in Poterba and Samwick (2002), and Table 3 in Hochguertel et al. (1997).

[28] The full set of regression results is available upon request.

zero value for the coefficients of the instruments points to weak instruments. Staiger and Stock (1997) suggest that the value of the F test has to be larger than 10 for considering the variables as a good instrument. For the pooled data (1993-2000), the effect is significant for the extensive and intensive margins. The coefficient of the MTR for the intensive margin is also only positive and significant in the pooled regression. The inverse of Mills' ratio is also significant at the 90 percent level suggesting that there is a selection bias. The coefficient for the inverse Mills' ratio is not significant in the year regressions.

Table 6 - The effects of the instrumented MTR on ownership and share of risky assets by year, with IV, lambda

	(1) Ownership	Obs.	F-value	(2) Share	Obs.	Lambda	F-value
1993	0.008	1791	1.265	0.289	506	-2.527	1.689
1994	0.001	1943	1.725	0.532	537	-8.184	1.338
1995	0.021	1778	1.290	-0.155	519	-9.653	1.071
1996	-0.002	1562	2.072	0.463	479	1.728	2.299
1997	0.024	1167	1.340	-0.238	370	1.809	1.017
1998	0.024*	676	1.465	1.474**	225	31.445	1.170
1999	0.000	697	1.468	0.358	273	-1.899	0.655
2000	0.011	499	0.855	0.567	176	-29.730	1.075
1993-2000	0.006***	10113	112.5	0.286*	3085	-8.734*	119.1

*** p<0.01, ** p<0.05, * p<0.1, s.e. clustered on household level in the pooled regression. (1): marginal effects of the probit regression of equation (5) with IV. (2): OLS regression of equation (7) with IV (for 1993-2000) and the inverse Mills' ratio (lambda). The F-value indicates whether the instrumental variables significantly differ from zero and act as a good instrument. According to Staiger and Stock (1997) the F-value has to exceed the critical value of 10.
Full regressions are available on request.

However, the regressions in Table 6 do not solve the second endogeneity problem. We do this by using the exogenous change in the marginal tax rate that is the result of the tax reform in 2001. As explained in Sections 2 and 5 this reform de facto removes the tax on capital income. Therefore, the relevant marginal tax rate from 2001 onwards is equal to zero.

Table 7 provides the estimates of the extensive margin in a pooled regression for the whole dataset (1993-2012). Equation (5) is estimated for the ownership of risky assets. All standard errors are clustered at the household level.

Model (1) estimates the probability of owning risky assets. The estimates are marginal effects of a change in the explanatory variable. We observe that the choice of holding risky assets is affected significantly by the marginal tax rate. This result does hold in model (2), when we add the control variables to the regression. Furthermore, we observe that individuals with more wealth and/or income take more risk. This finding confirms Carroll (2000) who argues that portfolios of the wealthy are skewed towards risky assets. The age (of the head of the household) appears to have no significant influence on the ownership of risky assets. Household that consist of partners take less risk. Those who are more educated have a significant greater

chance of owning risky assets. King and Leape (1998) hypothesize that this is related to the information sensitivity of shares, resulting in higher educated individuals having an advantage. Hochguertel et al. (1997) argue similarly. The number of children has a significant negative impact on the ownership choice. Having a permanent contract has no significant effect. Furthermore, the risk seeking variable influences the choice to invest in risky assets significantly. Being risk-seeking implies a rise of 6.9% in the probability of owning risky assets. The variable for the AEX index (including dividends) is highly significant and absorbs the cyclical state of the stock exchange.

Table 7 - The effects of the MTR on ownership of risky assets

	(1)	(2)	(3)
IV	no	no	yes
MTR	0.0006***	0.0008***	0.0005**
income_2		-0.0152	-0.0095
income_3		0.0153	0.0226
income_4		0.0503***	0.0652***
income_5		0.1174***	0.1378***
wealth_2		0.1921***	0.1991***
wealth_3		0.3256***	0.3355***
wealth_4		0.3571***	0.3732***
wealth_5		0.5072***	0.5361***
partner		-0.0321**	-0.0337**
# children		-0.0133**	-0.0251***
perm. contract		-0.0133	-0.0162
risk seeking		0.0693***	0.0626***
aex		0.0002***	0.0001***
age		-0.0030	
age^2		0.0000	
education		0.0698***	
Observations	21974	21974	21974
Pseudo R^2	-13661	-12032	-12124
Log likelihood	0.001	0.120	0.113
F-test instruments			112.5

*** p<0.01, ** p<0.05, * p<0.1, s.e. clustered on household level. (1)-(2) probit regression of equation 5 without IV, (3) probit regression of equation 5 with IV.

By using instruments it is possible to eliminate the endogeneity of the MTR that is a concern before the tax reform. This allows us to provide a more accurate estimate of the actual effect of the reform. We first estimate the marginal tax rate based on equation (4), and subsequently equation (5). According to the F-test with a value of 112.5, the dummies are jointly significant[29] in the marginal tax rate equation, suggesting that these dummies are good instruments for the

[29] The value of the F test is larger than 10, see Staiger and Stock (1997).

marginal tax rate. We still find a significant positive effect of the marginal tax rate on the participation in risky assets in model (3) of Table 7. Because the instruments are education level and birth cohorts we do not include age and education in the control variables. The results suggest a robust positive relation between the marginal tax rate and the participation decision of risky assets. An increase of 10%-point in the marginal tax rate rises the probability of owning risky assets with 0.5%-point.

The literature suggests that there might be also a significant positive correlation between the marginal tax rate on capital income and the share of risky assets in the portfolio, given that someone participates in these assets. We present the estimates based on equation (7) in Table 8.

Table 8 - The effects of the MTR on the share of risky assets in total portfolio

	(1)	(2)	(3)
IV	no	yes	yes
MTR	0.044***	0.010	-0.004
income_2	-0.147	1.171	1.527
income_3	-1.274	-0.418	-1.028
income_4	0.740	1.061	-0.760
income_5	1.001	0.797	-2.857**
wealth_2	4.598**	4.541**	-1.890
wealth_3	0.602	1.079	-9.263**
wealth_4	-5.915***	-4.734**	-15.983***
wealth_5	-2.680	0.246	-15.376***
partner	-4.628***	-4.305***	-3.268**
# children	0.055	-1.545***	-0.816**
perm. contract	-0.989	-1.137	-0.628
risk seeking	4.498***	3.453***	1.702
aex	0.030***	0.028***	0.024***
age	-0.358		
age^2	0.006**		
education	1.567*		
lambda			-14.357***
constant	7.361	8.089***	35.794***
Observations	6887	6887	6887
Adj. R-squared	0.12	0.08	0.09
F-test instruments		119.1	119.1

*** p<0.01, ** p<0.05, * p<0.1, (1) & (2) s.e. clustered on household level. OLS regressions of share of risky assets. (3), with inverse Mills' ratio.

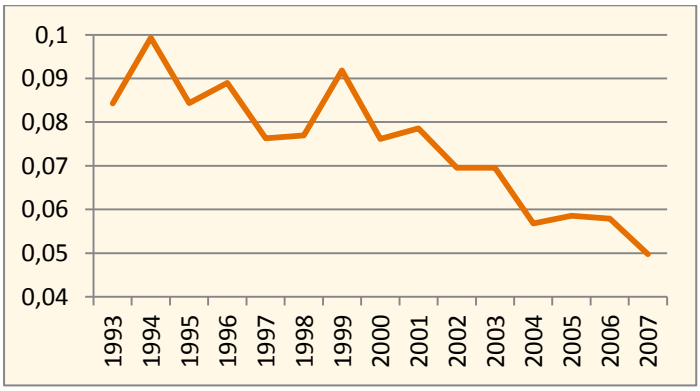
All models in Table 8 include the marginal tax rate and the full set of control variables. The first model uses the data on the observed MTR and models (2) and (3) the instrumented MTR. Model (2) is an OLS regression and model (3) a two-stage Heckman model. The effect of the

marginal tax rate on the share of risk in portfolio is positive and significant in model (1). Risk seeking and the AEX take the expected, positive sign. If the MTR is instrumented the coefficient becomes insignificant. This result pinpoints the necessity of using instrumented variables for the MTR in order to correct for endogeneity. Age and education are dropped, because these variables are already used as instrumental variables. Using the Heckman selection model shows the lambda is significant in (3), but this does not change the insignificance effect of the MTR on the intensive margin.

6.2 Growth funds

Figure 8 shows the ownership of growth funds over time. The probability of owning such funds decreases from 2001. After 2007 questions about growth funds are not included in the survey. Before 2001 growth funds were attractive because of their tax exemption. With the disappearance of this advantage, the attractiveness of growth funds has vanished, which led to substantial lower interest for these funds.

Figure 8 - Ownership probability of growth funds (*DNB Household Survey*)



To see whether the change of the marginal tax rates is a major driver for the changes in ownership we estimate equation (5) for growth funds. The results suggest in particular that a higher marginal tax rate indeed has a positive effect on the ownership probabilities of growth funds. The elimination of the marginal tax rate with the tax reform in 2001 explains to large extent the disappearance of growth funds. If the marginal tax rate was 60 percent before 2001, the elimination of the tax rates implies a reduction of 6 percent in ownership according to the estimated coefficient. Note that the ownership share was 7 percent in 2001. If we instrument the marginal tax rate in model (2) with dummies for education, sex and cohort, the coefficient remains the same. A higher marginal tax rate enlarges the probability of participating in growth funds. This result is analogue with what our findings for risky assets.[30] Moreover, households with more wealth tend to have higher ownership shares in growth funds.

[30] Due to a limited number of observations for the intensive margin, we are not able to estimate the impact of the MTR.

Table 9 – Effect of the marginal tax rate on the ownership of growth funds

	(1)	(2)
IV	no	yes
MTR	0.0006***	0.0006***
income_2	-0.0139**	-0.0139**
income_3	-0.0165**	-0.0170**
income_4	-0.0146**	-0.0131*
income_5	-0.0080	-0.0065
wealth_2	0.0620***	0.0649***
wealth_3	0.1038***	0.1064***
wealth_4	0.1128***	0.1162***
wealth_5	0.2197***	0.2314***
partner	-0.0098	-0.0116
# children	-0.0032	-0.0059*
perm. contract	-0.0174**	-0.0186**
risk seeking	0.0138**	0.0128*
aex	-0.0000	-0.0000
age	-0.0033**	
age^2	0.0000**	
education	0.0176***	
Observations	16763	16763
Pseudo R-squared	-4202	-4224
Log likelihood	0.0789	0.0742
F-test instruments		112.5

*** p<0.01. ** p<0.05. * p<0.1. s.e. clustered on household level. All probit-regressions. (2): with IV.

6.3 Riskless assets

If the allocation towards risky assets changes, it is likely that the allocation towards risk-free assets is also affected because of substitution. To check the consistency of our results we estimate the effects of the MTR on the amount of savings in the portfolio on the basis of equation (7), with both IV and Heckman's selection model. It makes no sense estimating the ownership decision: almost everyone has a savings or checking account.

The marginal tax rate has significant negative impact on savings if we use the data directly. This corresponds to the positive impact on the share of risky assets in Table 8. These results are biased because of the endogeneity of the MTR. If the MTR is instrumented with education, birth cohorts and sex the coefficient is positive and significant. We observe that a higher marginal tax rate lowers the attractiveness of riskless assets. However, the coefficient becomes negative and insignificant if we correct for selection (see model (3)). Selection thus matters even if nearly all households have risk free assets. The MTR has thus no significant impact on the share of risk

free and risky (Table 8) assets. We also find that higher incomes and wealth have a negative impact on the share of risk free assets.

Table 10 - The effects of the MTR on the share of riskless assets in total portfolio

	(1)	(2)	(3)
IV	no	yes	yes
MTR	0.000***	0.001***	-0.000
income_2	0.134***	0.134***	0.148***
income_3	0.101***	0.101***	0.157***
income_4	0.078***	0.072***	0.137***
income_5	0.053***	0.044***	0.125***
wealth_2	0.285***	0.282***	0.475***
wealth_3	0.209***	0.206***	0.364***
wealth_4	0.173***	0.170***	0.323***
wealth_5	0.108***	0.095***	0.254***
partner	-0.009	-0.007	0.001
# children	-0.006	0.001	-0.016***
perm. contract	0.077***	0.081***	0.061***
risk seeking	-0.042***	-0.039***	-0.087***
aex	-0.000***	-0.000***	-0.000***
age	0.006***		
age^2	-0.000***		
education	-0.049***		
lambda			1.572***
constant	0.558***	0.655***	0.405***
Observations	23492	23492	23492
R-squared	0.16	0.16	0.17
F-test instruments		18.15	18.15

*** p<0.01, ** p<0.05, * p<0.1, (1) & (2) s.e. clustered on household level. OLS regressions of share of risky assets. (3) with inverse Mills' ratio.

7. Conclusion

In this paper we investigate the effects of the marginal tax rate on the risk-taking savings behavior of the Dutch. Many papers suffer from endogeneity problems and/or selection biases. We solve these issues by applying three methods. First, we have instrumented the marginal tax rate by sex, birth cohorts and education, following Blundell et al. (1998). It turns out that these are all appropriate as instruments. Second, we have used a Heckman selection model for estimating the share of risky assets in order to correct for the selection bias. Third, we use the exogenous variation in marginal tax rate resulting from the Dutch tax reform of 2001 for tackling the possible endogeneity of the change in the marginal tax rate. Tax reforms are more often used in this literature. However, to our knowledge, the combination of these techniques

has never been applied in this area. By applying these solutions, we extend the existing literature on this field of research.

First, we have replicated the cross section results of the literature, see among others Hochguertel et al. (1997) and Poterba and Samwick (2002), that a higher difference in marginal tax rates could result in a higher ownership of risky assets in the portfolio, although this heavily depends on the number of observations and the endogeneity of the marginal tax rate. If the tax rate is not instrumented we find more often positive significant effects compared to the preferred case that the tax rate is instrumented. Correcting for endogeneity thus matters. This is also the case for selection if the shares of risky assets are estimated. Taking account of endogeneity and selection often results in insignificant coefficients for the tax rate.

Using the Dutch tax reform in a pooled regression and applying these three techniques we find significant effects of the marginal tax rate on the participation decision of both risky assets and growth funds. These latter funds were not taxed before 2001. An increase of the marginal tax rate with 10%-point rises the probability of owning risky assets with respectively 0.5 and 0.6%-point. These estimations are robust for several specifications. The decline of the marginal tax rate on capital income from 60 to nil percent implied a 6 percentage point decline of the ownership of growth funds. However, for the share of risky and riskless assets in total portfolio we do not find significant results. This is mostly driven by our identification strategy. We eliminate both selection and endogeneity problems by applying IV-methods and the Heckman-approach.

Bibliography

Alan, S., Atalay, K., Crossley, T. F., & Jeon, S.-H. (2010). New evidence on taxes and portfolio choice. *Journal of Public Economics 94* , 813-823.

Alessie R, Hochguertel S. & van Soest A. (2001). Household portfolios in the Netherlands. In *Householdportfolios*, Guiso L, Haliassos M, Jappelli T (eds). MIT press: Cambridge, MA.

Alessie, R., S. Hochguertel & .A. van Soest (2004). Ownership of Stocks and Mutual Funds: A Panel Data Analysis, *The Review of Economics and Statistics* vol. 86(3), 783-796.

Angrist, J., & Pischke, J.-S. (2009). *Mostly Harmless Econometrics.* Princeton: Princeton University Press.

Auerbach, A., Kotlikoff, L., & Skinner, J. (1983). The efficiency gains from dynamic tax reform. *International Economic Review 24* , 81-100.

Bernheim, B. D. (2002). Taxation and Savings. In A. Auerbach, & M. Feldstein, *Handbook of Pulic Economics, Volume 3,* 1174-1240.

Blundell, R. D., A. Ducan & C. Meghir (1998). Estimating labor supply responses using tax reforms. *Econometrica* , 66:827-861.

Bovenberg, L., & Ter Rele, H. (1998). *Reforming Dutch capital taxation: an analysis of incentives to save and invest.* The Hague: CPB.

Federal Reserve. (2013, August 2). *About Survey of Consumer Finances*. Retrieved August 5, 2013, from Research Sources: http://www.federalreserve.gov/econresdata/scf/aboutscf.htm

Feldstein, M. (1976). Personal Taxation and Portfolio composition: an econometric analysis. *Econometrica 44* , 631-650.

Feldstein, M. (1978). The welfare costs of capital income taxation. *Journal of Political Economy 86* , 29-51.

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

Hochgürtel, S., Alessie, R., & van Soest, A. (1997). Saving accounts versus stocks and bonds in household portfolio allocation. *Scandinavian Journal of Economics 99 (1)* , 81-97.

Jongen E.L.W. & M. Stoel (2013). Estimating the Elasticity of Taxable Labour Income in the Netherlands, CPB Background Document, 29 May 2013.

King, M. A., & Leape, J. I. (1998). Wealth and portfolio composition: Theory and evidence. *Journal of Public Economics* , 155-193.

Moonen, L., Otten, F., & Pleijers, A. (2011). *Inkomens en positie op de arbeidsmarkt - Sociaal-economischetrends,* Centraal Bureau voor de Statistiek.

Poterba. (2001). Taxation and Portfolio Structure: Issues and Implications. *NBER Working Paper No. 8223* .

Poterba, J. M., & Samwick, A. (2002). Taxation and household portfolio composition: US evidence from the 1980s and 1990s. *Journal of Public Economics 87* , 5-38.

Poterba, J., Venti, S., & Wise, D. (1995). Do 401(k) contributions crowd out other personal saving? *Journal of Public Economics* , 1:1-32.

Salanié, B. (2003). *The economics of Taxation.* MIT Press.

Samwick, A. (2000). Portfolio responses to taxation: evidence from the end of the rainbow. In J. Slemrod, *Does Atlas Shrug? The economic consequences of taxing the rich* (pp. 289-323). Cambridge: Harvard University Press.

Sandmo, A. (1985). The effects of Taxation on Savings and Risk Taking. In A. Auerbach, & M. Feldstein, *Handbook of Public Economics* (pp. 265-311).

Scholz, J. (1994). Tax progressivity and household portfolios: descriptive evidence from the surveys of consumer finances. In J. Slemrod, *Tax Progressivity and Income Inequality* (pp. 219-267).

Staiger, D., & Stock, J. (1997). Instrumental variables regression with weak. *Econometrica 65(3)* , 557-586.

Tweede Kamer. (2005). *Breder, lager, eenvoudiger? Een evaluatie van de belastingherziening 2001.* Den Haag: Tweede Kamer der Staten-Generaal.

Zoutman, F. T. (2013). *The effect of capital taxes on Household´s Portfolio Composition and Intertemporal Choice: Evidence from the Dutch 2001 Capital Income Tax Reform.* Rotterdam.

Appendix

Table A1 - Pair wise correlations of ownership 1993-2012 (*own calculations, DHS Household Survey*)

	Savings	Funds	Shares	Bonds	First house	Salary savings schemes	Life insurances
Savings		0.97	0.96	0.98	0.92	0.93	0.95
Funds	0.22		0.54	0.56	0.25	0.26	0.34
Shares	0.14	0.36		0.60	0.18	0.17	0.22
Bonds	0.05	0.12	0.19		0.06	0.04	0.06
First house	0.62	0.75	0.81	0.82		0.71	0.75
Salary savings schemes	0.29	0.42	0.41	0.30	0.33		0.50
Life insurances	0.29	0.47	0.45	0.41	0.34	0.43	

Note: these are conditional correlations. Given that a household has savings (first column) the correlation having funds is 0.22 while it is 0.97 the other way around.

Publisher:

CPB Netherlands Bureau for Economic Policy Analysis
P.O. Box 80510 | 2508 GM The Hague
T (070) 3383 380

April 2014 | ISBN 978-90-5833-639-2