

# **Saving behavior and risk taking of the Dutch: evidence from the Tax Reform of 2001**

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## ABSTRACT

We estimate the impact of the marginal tax rate on capital income on risk-bearing assets for the extensive and intensive margin. In contrast to the literature, we use instrumental variables for the marginal tax rates to correct for endogeneity. Moreover we use the exogenous variation in marginal tax rates from the Dutch Tax Reform of 2001. From the OLS and logit regressions we find that an increase of the marginal tax rate of 10 percent points results in a 3 percent point increase of the share of risky assets in total portfolio. That increase in marginal tax rate also enlarges the probability of having these assets with 2.5 percent.

Keywords: Household portfolio choice, Taxes, Tax Reform, Instrumental variables

*Thanks to Jacoba de Jong, Egbert Jongen, Mauro Mastrogiacono and Floris Zoutman*

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## 1. Introduction

After more than a decade since the introduction of the new taxation of capital income of 2001 in the Netherlands, there has still been just one study on the effects on portfolio choice. Although there is a more general report discussed in parliament, which foresees a significant reduction in arbitrage and a broadening of the tax base, until now we lack research on the economic effects of the marginal tax rate on portfolio choice. The only study on portfolio composition using the Tax Reform of 2001 is from Zoutman (2013). That paper differs from ours for we evaluate the choice between risky and riskless assets. In section 4 we discuss the paper of Zoutman.

The Tax Reform of 2001 meant the introduction of a system that was in contradiction with findings of the Mirrlees review. The review argues that the capital income tax distorts the decision to consume now or in the future and recommend a system where normal returns on savings are tax exempt. This is based on their assumption that a tax system should be neutral. Although this neutrality principle is also honored by the Dutch legislator, it resulted only in removing the possibility of arbitrage that was caused by the tax exemption of capital gains.

The economic literature agrees that marginal tax rates influence the savings behavior of individuals. There are a lot of studies suggesting that a capital income tax distorts more than a labor income tax. Summers (1981) found that if a tax on capital income is replaced by a consumption tax or a labor income tax, welfare would rise by 12% and 5% respectively. Bernheim (2002) finds lower estimates, but the effect of the marginal tax rate remains significant. This paper will go one step further than the savings rate, trying to fill the lack of relevant research for the Netherlands: we will review the effects of the marginal tax rate on the allocation of savings. We focus on the choice between risky and riskless assets.

This study uses the exogenous variation in the marginal tax rate on capital by the Dutch Tax Reform of 2001 in estimating the effects of capital taxation. We examine the effects of changes in the marginal tax rates for capital on the distributions of wealth over certain assets categories. In the years before 2001 risky assets were only taxed for their dividend payment and capital gains were untaxed in the Netherlands. Losing that advantage in 2001 should result in lower participation in risky assets and a smaller share of risky assets in the portfolio. This estimation is done by considering both the participation decision (the extensive margin) and the share of an asset in total portfolio (the intensive margin). As in previous research we focus on the choice whether or not to invest in risky assets (see Hochguertel et al, 1997 and Bernheim, 2002) and the size of these investments, but in contrast to the previous literature we are able to solve various endogeneity problems.

In addition, we discuss the so-called growth funds, as these funds are a clean example of tax arbitrage before 2001. These funds did not distribute profits or dividend, but just accumulated in value. Since these capital gains were untaxed, growth funds were in particular attractive.

These considerations lead to the following main questions, which can be divided into two sub-questions:

Main question: ***What is the effect of the marginal tax rate on the savings behavior of the Dutch?***

*1) How do marginal tax rates affect the participation decisions for particular assets?*

*2) How do marginal tax rates affect the share of investment in a particular asset?*

Theory provides two main channels in which the marginal tax rate can affect portfolio choice. The first advert that if some asset is taxed relatively less, this asset would be more attractive. In the years before 2001 risky assets were only taxed for their dividend payment and capital gains were untaxed. Losing that advantage in 2001 should result in lower participation in risky assets.

The second channel argues that a higher tax on capital income means that the governments shares more in the risks of risky investments. We present a theoretical model of Poterba (2001) to prove that. The elimination of the tax on capital income would both reduce the participation in risky assets and the share of risky assets in total portfolio.

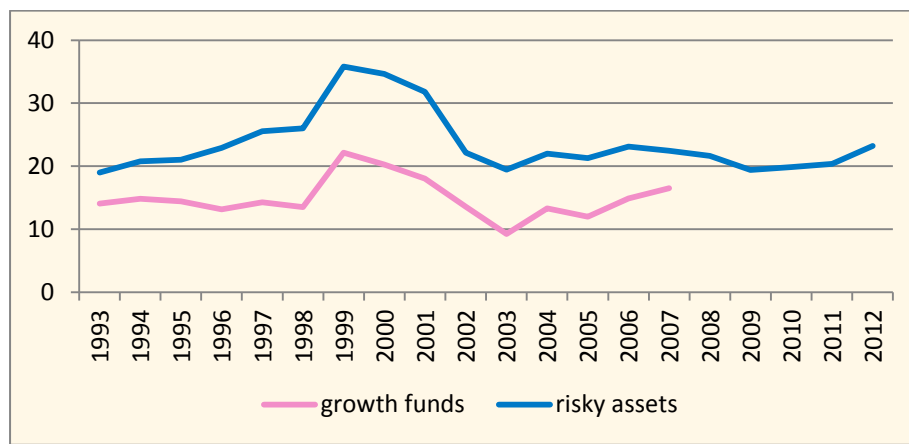
Previous research suffers from two main problems that we solve in this study. Both the marginal tax rate (1) and the variation in marginal tax rates (2) are endogenous, because these are determined by income and wealth (Alan, Atalay, Crossley, & Jeon, 2010). We identify the effect of marginal tax rates on allocation of assets with the exogenous change in tax rates that is created by the Tax Reform in the year 2001. Furthermore we create exogenous variation in the marginal tax rate by instrumenting it with birth cohorts and education level.

Using both solutions for the endogeneity we find that an increase of the marginal tax rate of 10 percent points results in a 3 percent point increase of the share of risky assets in total portfolio. It also raises the probability of having these assets with 2.5 percent. These results suggest that there is really a (substantial) effect of marginal tax rates on the decisions on portfolio allocation. We also find this result for participating in growth funds which are tax-deferred asset funds due to the lack of dividend payments. The results seem to be robust for various specifications. By comparing the predictions based on the old tax system with the data of the new system (see Saez et al (2009) for an application of this method) after 2001 we find similar results.

We use a panel dataset of the Dutch Household Survey covering 20 years of data. In this dataset individuals participate for a number of years and give information about wealth, income and (economic) preferences.

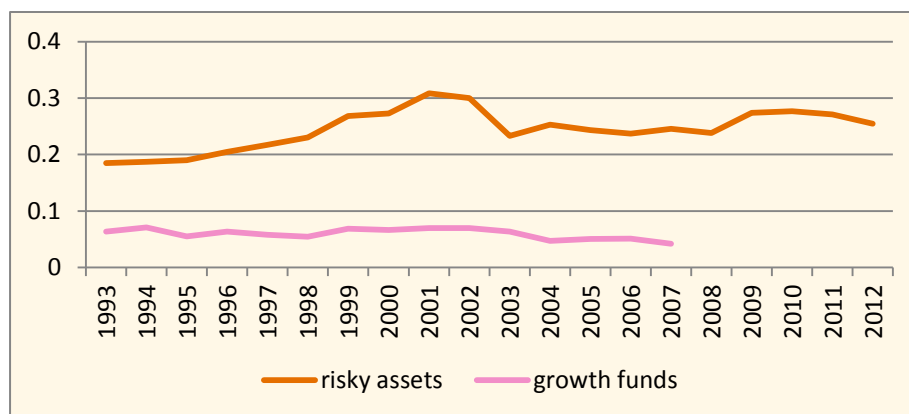
We observe from figure 1.1 that the attractiveness of risky assets decreases in 2001, and then remains fairly constant. That would be an indication of Tax Reform effect. Another possible explanation is the burst of the dotcom bubble and the corresponding decline of the (Dutch) stock market. We correct for this by adding the AEX as a control variable.

**Figure 1.1** - Share of risky assets and growth funds in total portfolio, given ownership of that asset (DNB Household Survey)



The reported ownership shares are shown in figure 1.2. For risky assets we observe a sharp drop in participation after the Tax Reform of 2001, indicating a certain level of causality. The effects on growth funds are less clear.

**Figure 1.2** - Ownership of risky assets and growth funds (DNB Household Survey)



These figures suggest that the Tax Reform of 2001 had an impact on the both the extensive and the intensive margin for risky assets, and to a lesser extent, growth funds.

## 2. Dutch tax system

The Dutch tax system is characterized by two principles: the ability-to-pay principle and the efficiency principle (Stevens, 2010). The government tries to steer the middle course between Scylla and Charybdis. This section describes this steersmanship before and after the large Tax Reform of 2001 (Wet Inkomstenbelasting 2001). We discuss both tax systems in general and focus on the taxation of capital income.

The first tax on income from 1892 can be considered a wealth tax and looked more or less like the current capital income tax. In the 19th century, it was culturally unacceptable to ask for someone's income, so the government fixed income at 4% of individuals' wealth. In 1914 this tax merged with the corporate tax to form the first real tax on income. Simultaneously, a separate wealth tax was introduced. The value of the income at the beginning of the year was determined as the tax base, which led to massive tax avoidance (Stevens, 2010).

The German occupiers changed this to a so-called 'Realsystem' in 1941. Only the true income of individuals in a certain year was taxed. After World War Two, this system was maintained and finally legislated in IB 1964. This law created a synthetic income tax, with all income taxed at the same progressive rates. Until 2001 there were only minor changes on brackets and tariffs. The most important ones are the continuous rise of the length of the third tax bracket and the introduction of the second one. Especially the first change might give external variation. In the table below we provide the marginal tax rates (MTR) from 1993 until 2000.<sup>1</sup>

**Table 2.1 - Marginal tax rates and brackets (€) (Elsevier(s) Belasting Almanak)**

	1993	1994	1995	1996	1997	1998	1999	2000
<b>MTR1</b>	38.40%	38.25%	37.65%	37.50%	37.30%	36.35%	35.75%	33.90%
<i>bracket end</i>							6806.70	6922.42
<b>MTR2</b>							37.05%	37.95%
<i>bracket end</i>	19633.71	19633.71	20124.70	20567.59	20855.74	21411.17	21860.86	22232.51
<b>MTR3</b>	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%
<i>bracket end</i>	39266.51	39266.51	40248.49	42098.55	44208.18	47090.59	48079.83	48897.54
<b>MTR4</b>	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
<b>Tax deduction</b>	2617.86	2688.65	2756.26	3177.82	3222.75	3910.22	3992.81	4062.00

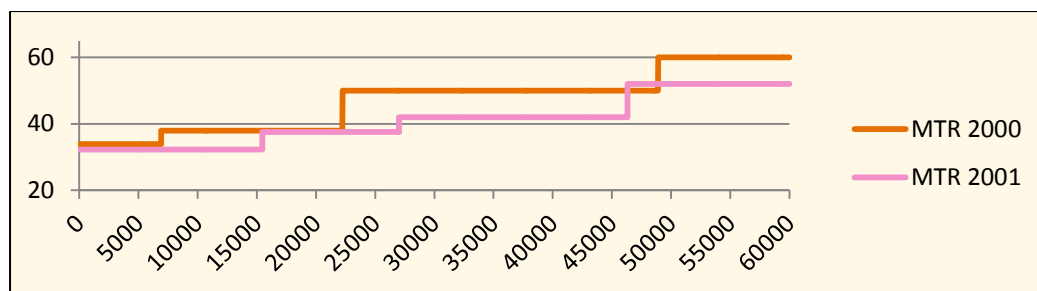
Basically, most income was taxed under the same progressive tax system, after a tax deduction that differed among individuals, depending on age and marital status. In addition to the income tax, wealth was taxed at a rate of 0.7% (0.8% up to 1997). This was true for almost all types of

<sup>1</sup> Since our data only regards those years, we limit the description of the changes to these years.

assets, excluding capital and life insurances, furniture, pensions and collections of art and science.<sup>2</sup>

After years of debate, the 2001 Tax Reform act was accepted by both chambers of parliament in 2000.<sup>3</sup> This new tax system was different from the previous system in two main ways: First, the so-called box system was introduced, which created three separated tax systems for respectively labor income (box 1), income from substantial shares in closely-held companies (box 2)<sup>4</sup> and capital income (box 3). This box system was intended to frame a ‘balanced tax system’ (Tweede Kamer, 2005). The first box is the most important one, for it captures 90% of the total tax base (Stevens, 2010, p. 88). The tax rates for the higher incomes decreased substantially from 60% to 52%. The tax deduction system was eliminated and replaced with a new system of tax credits. These credits depend on employment status, age, number of children, etc. Figure 2.1 gives an overview of the marginal tax rate given income for both the tax system of 2000 and 2001.

**Figure 2.1 - Marginal tax rates on income (euro) (Elsevier(s) Belasting Almanak)**



The second main change concerns the introduction of a new taxation of capital income in box 3. The old system had to be replaced, because the possibility of arbitrage in the previous system was huge. By participating in the so-called growth funds one could avoid the progressive rates of the income tax. Growth funds did not return any profit, but only raised in value.<sup>5</sup> This ‘capital gain’ was untaxed, making these funds extremely attractive (Bovenberg & Ter Rele, 1998). The aim of the Tax Reform was (1) to broaden the tax base, (2) to increase the balance of the system, (3) to make the system more simple and (4) to reduce the distortionary effects on economic behavior (Tweede Kamer, 2005).

From 2001 on the returns on savings and stocks are assumed to be 4%. This presumed return on capital is taxed at a rate of 30%. This major change in taxing capital income marked a switch from taxing the ex-post actual return towards taxing the ex-ante expected returns (Cnossen &

<sup>2</sup> See Elsevier Belasting Almanak, for the years 1993 to 2000.

<sup>3</sup> For a broader discussion on the creation of this Tax Reform, see Cnossen and Bovenberg (2000).

<sup>4</sup> Substantial shares in closely-held companies, in Dutch: *aanmerkelijk belang* (a.b.). See also Cnossen and Bovenberg (2000).

<sup>5</sup> Growth funds did not return any profit, but only raised in value.

Bovenberg, 2000). Where for the higher income, capital first was taxed at 60% in the higher bracket, this rate dropped substantially to 30% over the assumed 4% return.

In the present system, the aforementioned arbitrage has become impossible: *return* on capital is not actually taxed anymore, for the new system imposes a net wealth tax of 1.2% on financial wealth. It replaces the former progressive income tax for capital and labor, and the former wealth tax. In fact the wealth tax changed from 0.7% to 1.2% and the taxation of returns on capital was eliminated, for the taxation of capital was after 2001 unrelated to capital income.<sup>6</sup> This switch created a remarkable variation in marginal tax rates, as is shown in figure 2.2. Each line shows a different tax bracket. After 2001 all marginal tax rates on capital income decreased to 0%.<sup>7</sup>

**Figure 2.2 - Possible marginal tax rates on capital income (Elsevier(s) Belasting Almanak)**

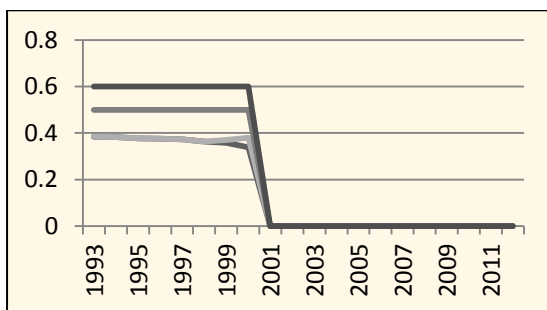
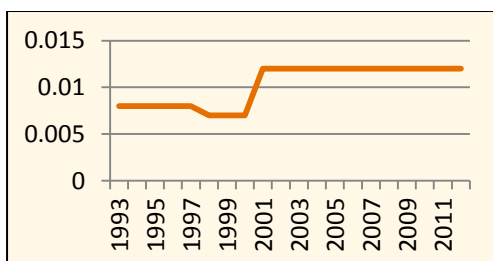


Figure 2.3 shows the evolution of the wealth tax over time. This tax rate is the same for all different assets, and therefore the behavior of agents in allocation there resources is assumed to be independent of this wealth tax. Furthermore, the tax exemption for capital tax decreased from about 90,000 euro to 20,000 euro, which increased the base of the tax. The tax base has remained almost unchanged for this wealth tax and therefore we do not expect any effects on the allocation of assets. For this reason, these data are irrelevant to our research and we can freely disregard it.

**Figure 2.3 - Marginal tax rates on wealth (Elsevier(s) Belasting Almanak)**



<sup>6</sup> The tax exemption of the wealth tax changed in 2001 from € 90756 to € 17600. Since this exemption was applied to all assets both before and after 2001, we can leave this aside.

<sup>7</sup> This does of course not hold for pension funds and houses, for these assets are not included in the regular taxation of capital (income).



The following table shows the various changes for all sorts of income and income on assets. This gives an idea of the tax treatment in both tax systems. We are especially interested in interest, dividends and capital gains. The latter were not taxed progressively until 2000, making them more attractive than dividends.

**Table 2.2 - Change in tax rates for different sorts of income and wealth (*Elsevier(s) Belasting Almanak*)**

	until 2000	from 2001
<b>Labor</b>	Progressive tax rates	Progressive tax rates <sup>8</sup>
<b>Housing income</b>	Progressive tax rates Wealth tax (0.7%) <sup>9</sup>	Progressive tax rate
<b>Interest (savings)</b>	Progressive tax rates Wealth tax (0.7%)	'Wealth tax' (1.2%) <sup>10</sup>
<b>Dividends (stocks)</b>	Progressive tax rates Wealth tax (0.7%)	'Wealth tax' (1.2%)
<b>Capital gains (growth funds)</b>	Wealth tax (0.7%)	'Wealth tax' (1.2%)
<b>Substantial shareholders</b>	Corporate tax & 25% (box 2) <sup>11</sup>	Corporate tax & 25% (box 2)
<b>Salary savings scheme</b>	Tax-deferred	Tax-deferred

### 3. Theoretical model

According to James Poterba, 'tax rules are a potentially important determinant of household portfolio structure' (Poterba, 2001, p. 1). Tax rules and tax rates influence the portfolio choice, for example decisions whether to hold stocks, bonds or just a savings account. The theory on this subject is based on the general theory of portfolio choice (see Feldstein (1976)). 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 common approach in the literature, see Hochguertel et al (1997), King and Leape (1998) and Poterba and Samwick (2002), among others.

According to Poterba (2001), the investor has to deal with several different tax rates in the capital asset pricing model (CAPM) in order to maximize return on investment and final wealth.

<sup>8</sup> See figure 2.1.

<sup>9</sup> Threshold around 90.000 euros.

<sup>10</sup> The 30% income tax over an assumed return of 4% is defined as a wealth tax of 1.2%. See also above. Threshold around 20.000 euros.

<sup>11</sup> Tax for substantial share holder, in Dutch: aanmerkelijk belang (a.b.). No threshold

This variation in tax rates might occur through different taxation of capital gains and dividend income. It can be summarized in the following simple model. All risk-free assets are taxed at rate  $\tau_{int}$  and all risky assets at another rate  $\tau_{eq}$ , including capital gains. The investor is assumed to maximize a utility function based on the mean and variance of final wealth  $W$ :  $U(W, \sigma_W^2)$ . The expected wealth of the investor in asset  $i$  is equal to the sum of the final value of both the risky and the risk-less assets:

$$1. \quad E(W) = [W_0 - \sum S_i] * (1 - \tau_{int})r_b + \sum S_i * (1 - \tau_{eq})\mu_i,$$

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

$$2. \quad V(W) = \sum \sum S_i * S_j * (1 - \tau_{eq})^2 * \sigma_{ij}$$

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

$$3. \quad S^* = \delta * \Omega^{-1} * [(1 - \tau_{eq})\mu - (1 - \tau_{int})r_b * 1]$$

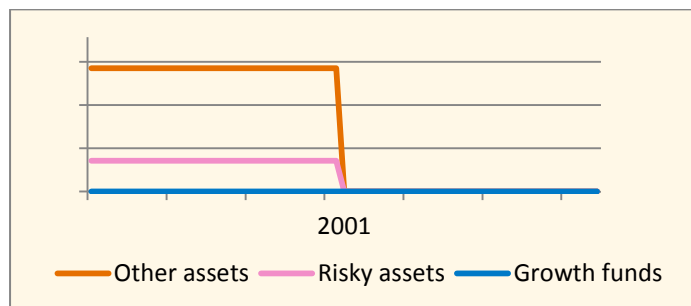
where  $1$  denotes a column vector of ones and  $\delta$  is related to the investor's risk aversion ( $\delta = U_W / [2U_{\sigma^2} * (1 - \tau_{eq})^2]$ ). The  $\Omega$  denotes a covariance matrix with risky returns. When taxes are equal to zero, the normal outcome of the CAPM model would occur. Formula (3) shows that a different fiscal treatment of risky and risk-free assets affects the optimal share of particular assets.

A higher tax rate on a given asset category makes that category relatively less attractive. A low  $\tau_{eq}$  results in a higher  $S^*$  given the value of  $\delta$ . In addition,  $\delta$  plays an important role, as it states that an equal fiscal treatment of both assets influences the optimal portfolio choice through the channel of risk sharing. While investing in risky assets, the government bears part of the risk by smoothing returns. The government not only taxes gains, but also mitigates losses. With a higher expected return that is associated with these assets, they are able to limit their risk. Therefore, even given equal positive tax rates over risky and non-risky assets, the risky assets become relatively more attractive. The last mechanism is crucial in our model.

Because capital gains were not taxed before 2001, but only dividend and interest income, risky capital was only mildly taxed in the Netherlands. This means that  $\tau_{eq}$  was relatively small, while other assets were taxed more heavily. This implied an arbitration advantage for risky capital

(Bovenberg & Ter Rele, 1998). With the reform of the tax system, this advantage disappeared, as shown in figure 3.1. We would therefore expect that the share of risky assets in the total portfolio would decrease.

**Figure 3.1** - Possible marginal tax rates for risky assets, growth funds and other assets (such as savings)



The figure also shows that growth funds were not taxed at all, because their profit only consisted of capital gains. The loss of their advantage over other asset categories is therefore even greater. We therefore expect that the impact on growth funds is larger than for normal risky assets.

The 2001 Tax Reform reduced the marginal tax rate on both interest and returns on equity to zero, as is shown in figures 2.2 and 3.1. This has implications for the  $\delta$ -formula. When the tax level on equity falls to zero,  $\delta$  will decrease, and therefore the share of risky returns in the portfolio. The intuition is quite simple. When the government taxes equity, the government bears a proportion of the risk of owning equity. Reducing this tax rate lowers the risk-bearing behavior of the government and therefore increases the risk for the economic agent (see also above and Cnossen and Bovenberg, 2000, p. 11).

If losses are not perfectly deductible, we are not able to state that the government really participates in the risks of individuals. In the years before 2001 one can compensate negative income with positive income in the previous three years and the upcoming eight years. Consequently, sharing of the risk with the government is actually possible and in practice nearly perfect. We therefore expect a lower share of risky assets after the Tax Reform of 2001.

The argument above focuses on the intensive margin. However, the same reasoning is also applicable for the extensive margin. If the government bears part of the risk, individuals are more likely to participate in risky investments. Formally the reasoning for the extensive margin runs with 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 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 coefficients for the extensive margin, but we can be sure about the sign.

The new tax system with a assumed rate of return of 4% and a tax rate of 30% is actually a wealth tax (1.2%) and is comparable to the wealth tax (0,7%) of the years before 2001 (see section 2.2). Both wealth taxes do not influence the allocation of savings and are independent of capital income. Hence, they are not relevant for the choice of the individual between risky and risk-less assets.

We can conclude from the theory that a lower tax rate on capital income will probably result in a lower proportion of risky assets in total portfolio. The main reason for this is that risky assets lost their advantage of lower tax rate. Furthermore, the risk sharing behavior of the government is relevant when taxing capital income, under the condition of perfect loss offset.

Whereas growth funds are confronted with a larger loss in advantage over other forms of capital, we expect that these assets will lose their attractiveness after the Tax Reform, in both the extensive and the intensive margin.

Therefore we conclude with two main hypotheses, based on our two sub questions from the first section:

- 1. A higher marginal tax rate increases the participation in risky assets and raises the share of these assets in portfolio.*
- 2. A higher marginal tax rate decreases the participation in growth funds and reduces the share of growth funds in portfolio.*

#### **4. Empirical evidence from the literature**

Our research paper builds upon a series of findings developed in the economic literature since the paper of Feldstein (1976) on the theoretical aspects of portfolio choice in practice. 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. These authors find that taxes influence the decision whether or not to own a certain asset, but they do not find clear evidence that the share of a certain asset in a portfolio is affected by the tax system which differs from our results. Poterba and Samwick (2002) use data from the American Survey of Consumer Finances. They impute marginal tax rates with a nonlinear algorithm from all income-related variables from the dataset. They present estimates for 1983, 1989, 1992, 1995, and 1998. Their paper suggests that marginal tax rates affect asset allocation

decisions but not for all years. We find the same mixed outcomes, when we use similar cross section analysis (see section 7).

Hochguertel et al. (1997) is the only paper which focuses on the choice for risky and risk-free assets for Dutch households. They show that the level of financial wealth and the marginal tax rate are the main determinants of the allocation. The share of stocks and bonds increases by 2%, given a 1% rise in the marginal tax rate. However, their estimation suffers from a small number of observations (156 individuals own shares) and the endogeneity problem. Just as King and Leape (1998) they find more significant effects for the extensive margin than for the intensive margin.

A recent paper of Alan et al. (2010) signals the major problem in most of the cross-sectional research that is presented above that income is highly correlated with the marginal tax rate, 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 rate: 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 marginal tax rates 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 Survey of Consumer Finances but implement a difference-in-difference approach with a Tax Reform as identification. Scholz finds relatively small effects from 1983 to 1989. 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).

Zoutman (2013) studies the effect of the Tax Reform of 2001 on portfolio composition. He does not focus that much on risky assets and presents estimations of the effect on financial wealth and housing wealth. Furthermore, he estimates a two stages model, including the decision whether to save or to consume. He also notes that studies with tax rate enhance problems with endogeneity. He uses a technique that we also apply as a robustness check, see section 6.3. Zoutman finds modest results. The main problem with his research is that he does not split up financial wealth in to risky and riskless assets, suggesting that financial wealth is homogeneous.

The papers on the empirical implications of the taxation of capital on portfolio choice find in general that higher marginal taxes induce larger investment in risky assets. However, the effects

on the intensive margin are small and sometimes insignificant. We can be critical on the estimations in the literature, since endogeneity problems are signaled with respect to the marginal tax rates. Tax Reforms as an exogenous change in marginal tax rates are applied to identify the real effects on portfolio choice. We extend this literature by using instrumental variables to estimate the marginal tax rate.

## 5. 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). It is carried out annually since 1993. We use data from the 1993 until 2012. Every year, approximately 1500 households are questioned, resulting in more than 2500 individuals. The questionnaire contains questions on wealth, income, pensions, house ownership and economic behavior.<sup>12</sup>

We choose to evaluate the data on the individual level and not on the household level, for two reasons. First, the Dutch taxation system is based on individual taxation, so before 2001 everyone faces his own marginal tax rate. Of course do we control for household specific characteristics in our regressions and in the calculation of the marginal tax rate. Second, households are not completely interviewed, leading to the fact that total household wealth is often underestimated if we choose to combine those individuals<sup>13</sup>.

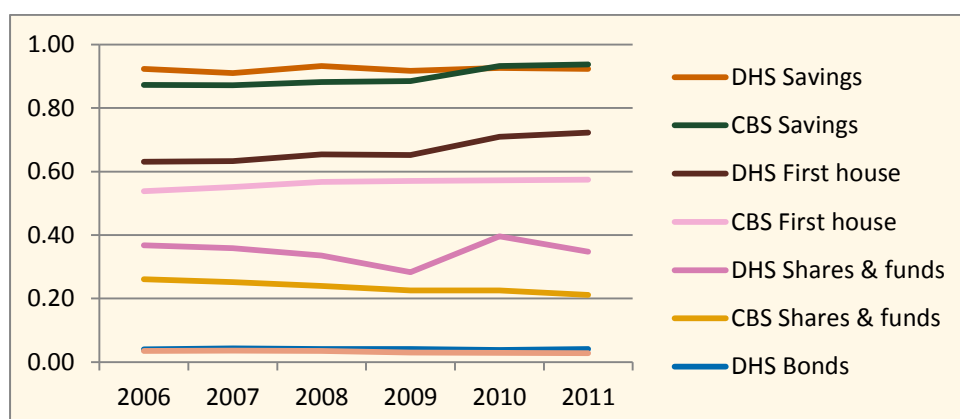
The data are somewhat biased towards older and wealthier households. The average age of individuals is 49, which is higher than the Dutch average for individuals older than 16 years old (approximately 46 according to the CBS). According to the European Central Bank (2013), the top 10% wealthiest households are overrepresented in the DNB Household Survey. A comparison with macro data from the CBS (2006-2011) shows that the sample and population differences are not that large. The differences that we observe might be explained to a large extent by a relatively high participation rate in risky assets and housing, which is shown in figure 5.1. The figure provides the participation rates for four assets groups in the CBS and the DNB Household Survey. Given that we actually want to derive conclusions on the individuals with a substantial level of wealth and risky assets, we do not consider this to be a problem

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<sup>12</sup> See <http://centerdata.nl/en/survey-research/dnb-household-survey-dhs>.

<sup>13</sup> Typically, only the main breadwinner is completely interviewed. Other family members just participated a few times and for a few questionnaires.

**Figure 5.1 - Participation in assets for DHS & CBS (DNB Household Survey & CBS)**



According to Teppa and Vis (2012) the DNB panel is representative along various dimension, but is biased towards higher educated and larger households and that singles are underrepresented in the survey. Teppa and Vis state that CentERdata constantly tries to correct these defects during the recruitment phase and by sing sample weights (Teppa & Vis, 2012).

As usual with panel data, we are confronted with missing values that distort the series, especially in reporting of income and wealth. Depending on the list of control variables, we remain with 500 to 2500 useful observations per year. Table 5.1 shows the number of observations for each year and for each relevant variable. Especially in 2000, the number of observations drops, mainly for income, wealth and risk seeking (figure 5.2). This is a pity, for we try to identify exogenous difference in marginal tax rates, where the years just before and after 2001, the year of the Tax Reform, are important.

**Table 5.1 - Descriptive statistics (DNB Household Survey)**

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
<b>Observations</b>	2781	3042	2743	2530	2200	1714	1515	1652	1864	1952
<b>Descriptive statistics after dropping the missing values</b>										
Observations	1737	1959	1740	1522	1172	654	364	192	727	819
Income (*1000)	41,2	41,5	41,0	39,6	35,4	33,0	33,1	32,8	35,2	31,3
Wealth (*1000)	106,6	101,3	89,7	93,4	141,1	99,3	84,0	133,2	131,9	155,3
Gender	0,2	0,2	0,2	0,2	0,2	0,2	0,3	0,2	0,2	0,3
Age	47,3	48,3	49,6	50,6	51,9	51,9	49,1	50,0	49,2	49,2
Partner	0,8	0,8	0,8	0,8	0,8	0,7	0,7	0,7	0,7	0,8
Education	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,2	0,5	0,4
# Children	0,8	0,8	0,8	0,9	0,9	0,7	0,7	0,5	0,7	0,7
House ownership	0,6	0,6	0,6	0,6	0,6	0,6	0,5	0,7	0,7	0,7
Risk-seeking	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
Unemployed	0,3	0,3	0,3	0,3	0,4	0,4	0,3	0,3	0,3	0,3
Perm, contract	0,8	0,8	0,8	0,8	0,8	0,8	0,9	0,7	0,8	0,8

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Observations</b>	1989	1906	1994	1948	1665	1462	1182	1865	1721	1749
<b>Descriptive statistics after dropping the missing values</b>										
Observations	887	1057	1164	1093	1058	841	760	1082	1137	1115
Income (*1000)	33,0	33,8	29,3	29,2	30,6	34,4	36,6	32,5	30,7	29,8
Wealth (*1000)	152,2	151,4	143,0	149,7	162,5	178,3	177,2	178,6	174,8	162,0
Gender	0,3	0,3	0,3	0,3	0,3	0,3	0,2	0,3	0,3	0,3
Age	49,9	51,4	50,1	51,8	53,4	56,7	58,5	55,8	57,3	58,9
Partner	0,7	0,7	0,7	0,7	0,7	0,7	0,4	0,7	0,7	0,7
Education	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
# Children	0,7	0,6	0,7	0,7	0,6	0,5	0,4	0,6	0,5	0,5
House ownership	0,7	0,7	0,7	0,7	0,6	0,7	0,7	0,7	0,7	0,7
Risk-seeking	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Unemployed	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Perm, contract	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,7	0,8

Figure 5.2 - Number of observations (DNB Household Survey)

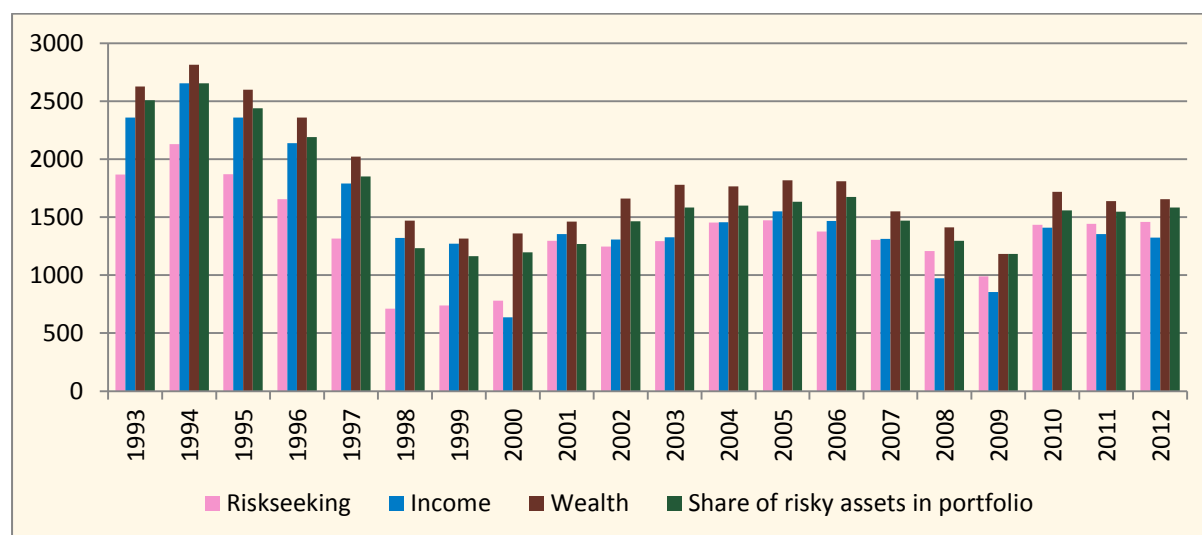
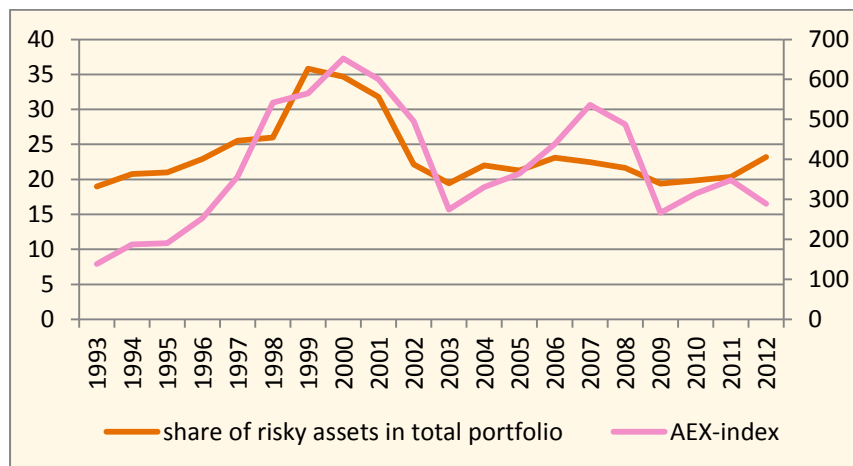


Table 5.1 also provides summary statistics over each year. *Gender* is a binary variable, taking the value of 1 if the individual is a woman. It is remarkable that approximately 75% of participating individuals are male. *Age* has a downward limit of 16, because only individuals older than 16 are permitted to participate in the DNB Household Survey. Over the duration of the survey the average age rises. *Partner* indicates whether someone has a partner or not. *Higher education* is a dummy for higher professional and academic education. *Unemployed* and *permanent* contract are dummies, respectively for those who are explicitly seeking for a job and for those who have a permanent contract. The variable for *risk-seeking* behavior is constructed using the response to the following statement: 'I am prepared to take the risk to lose money, when there is also a chance to gain money.' Respondents had 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.



The *AEX* (Amsterdam Exchange) variable is added in the regressions to capture the cyclical effects of stocks. It indicates the pattern of the main Dutch stock index. This variable is of great relevance, as is shown in figure 5.3. A lot of the variation in the share of risky assets, especially before 2001 might be explained by the AEX-index. If the price of stock rises, the share of risky assets in total portfolio will rise. This is not necessary associated with behavioral aspects. The addition of this variable is crucial, for in all of our regressions it is significant and explains lot of the variance in the risky assets.

**Figure 5.3 - Risky assets and AEX-index (DNB Household Survey & Datastream)**



To estimate the actual return on risky assets (see section 5.5) we obtained data on average returns on stocks, interest on long-term bonds and the refinancing rates of the central bank (DNB/ECB) from Thomson Datastream and CBS.

All data are corrected for inflation (2006=100) and are expressed in euros.

We used all data on wealth and generated aggregates for certain groups of assets. The main groups are *savings*, assumed to be risk-free or nearly risk-free, *funds, shares and bonds*,<sup>14</sup> assumed to be risk-bearing, *housing* and *tax-deferred assets* (see an overview in table 5.2). This separation into four groups is in line with the standard literature and is done to compare the data and the results with other papers, e.g., Hochguertel, Alessie and Van Soest (1997). Substantial shares<sup>15</sup> in companies are excluded, because of poor data on this subject before 2001. Investments in durables are also excluded because of poor data.

The last two subgroups require some clarification: home ownership is a stand-alone variable that earns its own category. It is influenced by many factors that are less relevant for ‘normal’ risky or risk-free assets. Moreover, the value of a house forms a big weight in the total portfolio

<sup>14</sup> Growth funds are excluded, because they are assumed to be completely tax-avoiding.

<sup>15</sup> In Dutch: *Aanmerkelijk belang*.

and can influence the results in the absence of any division. The fourth group can be considered as a bulk-category, as it is difficult to classify tax-deferred assets as risky or risky asset. For example, employee savings schemes allow for a limited share of income that can be contributed to a tax-deferred account. In this study we focus on the economic decisions on risky assets and growth funds.

**Table 5.2**

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

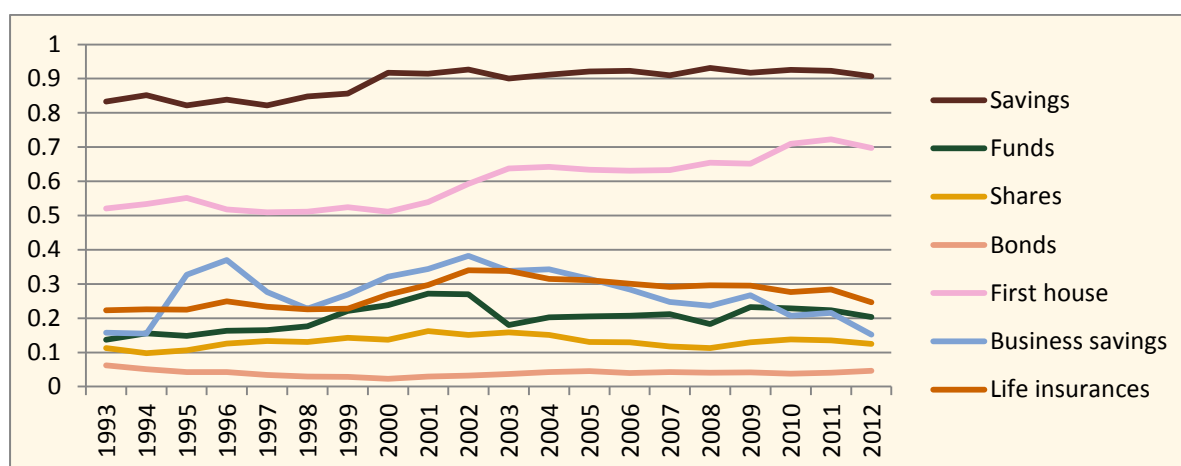
Obligatory savings for pensions are not included, for it is nearly impossible to construct the level of savings out of the available data. Furthermore, the tax system does not influence savings when these are obligatory. Mandatory pension savings might affect the optimal level of private savings (van Ewijk, 2005). However, since reliable data about mandatory pension savings is scarce, this question will not be addressed in this thesis<sup>16</sup>.

Figure 5.4 shows that nearly everybody in the sample owns a savings account. This is confirmed by observations from Hochguertel et al. (1997) and Poterba (2001). The probability of having shares or funds is roughly the same as shown in the U.S. estimates and in Hochguertel et al. (1997). The percentage of agents that own bonds is very low compared to the results of Poterba (2001). He estimated a probability of approximately 30% of having tax-exempt bonds. This might be due to the different pension system in the United States, which makes tax-exempt bonds rather popular. However, some of these differences could be caused by the limited representativeness of the DNB Household Survey we discussed above.<sup>17</sup>

<sup>16</sup> Since we have data on assets and the data on pensions is just about contributions and expected payment, we are not able to include pensions.

<sup>17</sup> Although these same problems are likely to be present in the U.S. dataset as well.

**Figure 5.4 - Probability of owning an asset (DNB Household Survey)**



We further observe a decrease in salary savings schemes in the last decade. This is mainly due to the possibility of free withdrawals in 2005 and 2010, and the definitive abolition of the salary savings schemes arrangements in 2011. The decrease of ownership of (growth) funds right after the Tax Reform is remarkable. This might be due to the elimination of the arbitrage opportunity for these funds we discussed in the previous section.

Table 5.3 shows the conditional probabilities of owning a certain asset (row), given the ownership of another asset (column) for the whole period of the dataset<sup>18</sup>. We note that ownerships of shares, bonds and funds are heavily correlated and significantly increase the probability of having such an asset. Ownership of second houses is excluded from our analysis, as the corresponding data are rather poor.<sup>19</sup>

**Table 5.3 - Pair wise correlations of ownership (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	

We construct an estimate of the marginal tax rate for capital income. Calculating the rate for the years after the Tax Reform of 2001 is pretty simple, because it is zero by definition (see figure

<sup>18</sup> In the appendix separate tables can be found for the years 1993, 1998, 2003, 2008.

<sup>19</sup> The observed ownership probability of a first house conditional on the second should logically be 100%, the data shows a probability of 92%. Furthermore, and more important, the number of second houses is very low and the reported values include a lot of missing values.

2.2). However, doing so for the years 1993 to 2000 is not that easy, because we have data on the gross total labor income and its composition but lack the data on capital income, such as dividend or interest income. Thus, the only way to incorporate marginal tax rates on total income is to assume a fixed average return per year on the actual value of wealth. Several proxies are possible for estimating the average return: interest rates on government bonds, indices of stocks, interest rates of the central bank. We have constructed returns on investment for returns on savings and bonds and for returns on risky investments, such as stocks and mutual funds<sup>20</sup>, both with the 10-years interest rate on Dutch government bonds.

Figure 5.5 - Interest, dividend and AEX-index (Tweede Kamer)

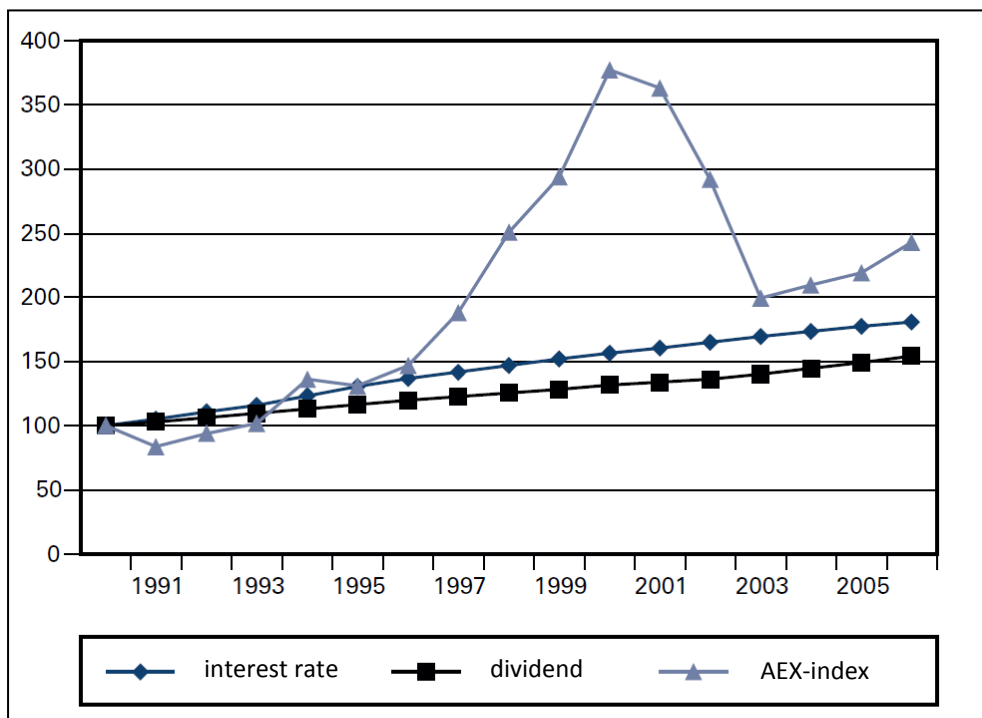


Figure 5.5 shows that even the aggregated taxed returns on risky capital (dividends) follow the pattern of the long run interest rate (Tweede Kamer, 2005), which makes it plausible to use the same proxy for estimating the income on financial assets before 2001. This estimation resulted in less than 500 changes in marginal tax rate for the year 1993 up to 2000, with approximately 12000 observations remaining constant. The assumed rates of return are presented in table 5.4.

Table 5.4

	1993	1994	1995	1996	1997	1998	1999	2000
10-year interest rate	0,07	0,07	0,07	0,07	0,06	0,05	0,05	0,05

<sup>20</sup> Growth funds are excluded, for their marginal tax rate is assumed to be zero.

## 6. Methodology

Our main purpose is to estimate the effect of the marginal tax rate on the savings behavior of the Dutch citizens and to test the presented hypotheses. 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. We solve the endogeneity problem by using instruments for the marginal tax rate.

### 6.1 Endogeneity problem

Regular estimation of the effect of the marginal tax rate on asset ownership with OLS and logit has one specific problem: the endogeneity problem, which is signaled by several authors (Scholz, 1994; Samwick, 2000; Alan et al, 2010, among others). We will show that we are able to replicate the results in the literature if we do not correct for it. The problem is that the explanatory variable, marginal tax rate, might not only determine the share (or the ownership) of an asset, but might itself be explained by wealth or income. And since *wealth* is part of one of our control variables, this would yield reverse causality. According to Alan et al., pooled estimates ‘suggest much more significant results, but plausible concerns can be raised about the sources of variation, i.e. cross-sectional variation in tax rate and variation by Tax Reforms’ (2010, p. 814).

The marginal tax rate is logically dependent on total *income* of an agent, for the Dutch tax system is progressive. Higher income yields higher marginal tax rates, limited by four tax brackets. Furthermore, it is possible that the marginal tax rate causes changes in income, for individuals are expected to react on their after-tax rate of return on labor. Because the taxable income for 2001 was partly determined by capital income (which depends on wealth), here the endogeneity problem plays a role too.

Studies on the effects of marginal tax rates on the behavior of individuals usually observe two distinct endogeneity problems. First, the main issue concerns the endogeneity of change in the marginal tax rates. 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 of 2001. This reform creates exogenous variation in the marginal tax rates that therefore are not affected by choices about income and wealth. Studying effects of marginal tax rate by using Tax Reforms is usual, see Auerbach, Kotlikoff and Skinner (1983) and Poterba (2002).

Second, the marginal tax rates before and after the reform might be endogenous, because of progressive tax systems. In the present tax system, the marginal tax rate for capital income is not allowed to vary. For the years before 2001, however, this problem should be addressed, both for wealth and for income. For wealth it means that the probability of owning particular

assets, which we want to explain, is not only influenced by the marginal tax rate, but also determines the marginal tax rate. As stated above, only for 500 of 12.500 individuals in the sample the inclusion of assets in the taxable income meant an increase in marginal tax rate. But, for this group the endogeneity towards wealth still applied. This is even more true for labor income, as this income is the main factor in determining the marginal tax rate in the Netherlands. Table 6.1 shows the correlation of the main control variables and the marginal tax rate. It is clear that especially income is highly correlated with the marginal tax rate (MTR).

**Table 6.1 - Correlation of the marginal tax rate (MTR) and main control variables (DNB Household Survey)**

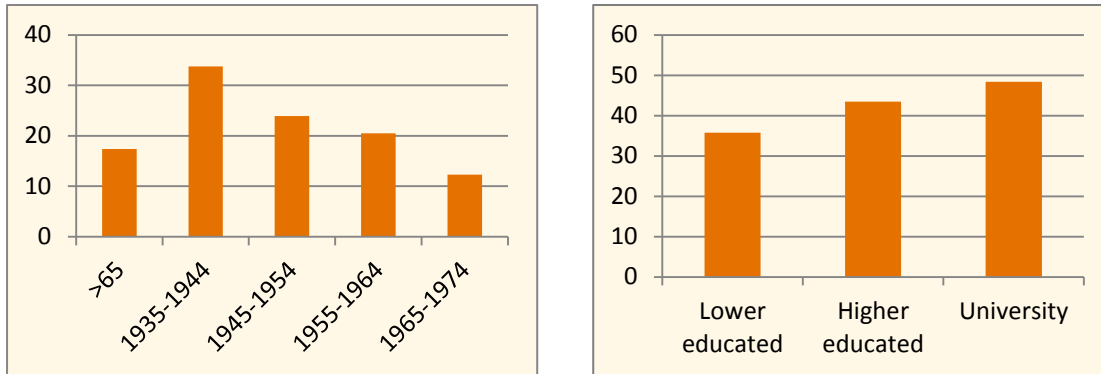
	MTR	Income	Wealth	Age	Education	Cohort
<b>MTR</b>	1					
<b>Income</b>	0,7262	1				
<b>Wealth</b>	0,0576	0,0895	1			
<b>Age</b>	0,0648	0,0297	0,0683	1		
<b>Education</b>	0,2853	0,3532	0,0536	-0,0286	1	
<b>Cohort</b>	-0,0869	-0,1461	-0,0435	-0,4096	0,0064	1

We solve this endogeneity by creating exogenous variation in the marginal tax rates. We instrument this exogenous variation in a two stage system to the marginal tax rate (Angrist & Pischke, 2009). The two available and useful instruments are birth cohorts and education (Blundell, 1998). The data show that the older cohorts have higher wealth and that cohorts are largely correlated with income. Exogenous variation in year of birth generates therefore exogenous variation in marginal tax rates. We determine four cohorts of 10 year, including 95% of all participating individuals: 1935-1944, 1945-1954, 1955-1964, 1965-1974. We create an extra cohort for those who are older than 65, for they face lower tax rates, because of their exemption of paying for pensions.<sup>21</sup> The exogeneity of the cohorts is clear: influencing your birth date is difficult. Figure 6.1 shows the decrease of the marginal tax rate over the cohorts.

<sup>21</sup> Generally the tax rates of elderly people (>65) are 15-20% lower in the first two tax brackets, see section 2.

**Figure 6.1 - Marginal tax rate (%) over cohorts (DNB Household Survey)**

**Figure 6.2 - Marginal tax rate (%) over education (DNB Household Survey)**



The same reasoning applies to education (figure 6.2). 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.<sup>22</sup> The other 7% would be dropped as well in normal regressions, due to missing values. The correlation between education and income is reasonable large, see table 6.2.

The exogeneity of education can be questioned. Is it possible that a higher marginal tax rate results in higher education? This is not the case, for a few reasons. First, individuals are normally educated before they will earn income. Education is, especially in the Netherlands where schooling is accessible to everyone, caused by ability and not by income they have not earned yet. Furthermore, education is heavily subsidized, and income is actually not necessary.

## 6.2 Estimation

We estimate the following regression (Blundell, 1998) for estimating the marginal tax rate in the first stage:

$$1. \quad \hat{\tau}_{it} = \alpha_g + \alpha_t + \alpha_{gt} + \alpha_{ot} + \alpha_2 X_{it} + \varepsilon_{it}$$

where  $\hat{\tau}_{it}$  is the prediction of the marginal tax rate,  $\alpha_g$  is a cohort-education dummy,  $\alpha_t$  is a period dummy,  $\alpha_{gt}$  is a cohort-education-period dummy and  $\alpha_o$  is a dummy indicating whether someone is older than 65.  $X_{it}$  is a set of control variables (see section 5.2). In the results section we test whether our instruments have explanatory power with respect to the marginal tax rate.

<sup>22</sup> Lower education: primary education, secondary education and vocational education (MBO). Higher education: higher vocational education (HBO). University: academic education (WO).

Based on our theory and our main questions we estimate two categories of equations. The first considers the extensive margin and has the following form:

$$2. \quad O_{ait} = \beta_0 + \beta_1 \hat{\tau}_{it} + \beta_2 X_{it} + \varepsilon_{it}$$

where  $O_{ait}$  denotes the ownership of a particular asset category,  $\hat{\tau}_{it}$  is the (predicted) marginal tax rate and  $X_{it}$  is a vector of socioeconomic control variables. The ownership decision is estimated with logit models.

The third equation describes the intensive margin, i.e., the effect of the (predicted) marginal tax rate ( $\hat{\tau}_{it}$ ) on the share of an asset ( $S_{ait}$ ) in the total portfolio. We only evaluate the individuals that actually own that asset ( $S_{ait} > 0$ ), in order to distinguish between the extensive and the intensive margin and to avoid problems with fixed purchasing costs. See also Poterba and Samwick (2002).

$$3. \quad S_{ait} = \gamma_0 + \gamma_1 \hat{\tau}_{it} + \gamma_2 X_{it} + \varepsilon_{it}$$

The covariate vector  $X_{it}$  is identical to the previous specification. This equation is estimated with Ordinary Least Squares. Besides estimation on the share of an asset in total wealth we estimate other shares, such as the share of risky asset in the sum of risky and riskless assets.

We do not present estimations with household fixed effects, for we have to drop a lot of observation in that case. Although it is able that this biases our results, exemption makes our finding more robust.

### 6.3 Differences after prediction

Saez, Slemrod and Giertz (2009) provide another way to identify the effect of the Tax Reform and to solve the previously described endogeneity problem. They use the data before a Tax Reform to predict data after the reform. This makes it possible to compare a treatment group (actual values) with a control group (predicted values). The main advantage of this approach is that we can compare individuals directly, and control for changes over time. But it is clear that predicting variables over time has the disadvantage to become unstable on the long run. We therefore limit our estimations to the first years after the Tax Reform.

In the following equation, the difference in share of a particular asset is explained by the difference in the marginal tax rate and some control variables:

$$4. \quad \Delta S_{ait} = \beta_0 + \beta_1 \Delta \tau_{it} + \beta_2 X_{it} + \varepsilon_{it}$$



We expect from theory that the  $\beta_1$  is positive, so that the negative difference in marginal tax rates (new minus old) result in a negative difference in the share of risky assets in total portfolio.

## 7. Results

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 nearly all of their results. Second, we use the instrumental variables to identify the effects of the Tax Reform, in order to eliminate present endogeneity problems.

### 7.1 Replication

Table 7.1 shows that we generate similar results as previous studies for the years before the Tax Reform, when the Netherlands had a capital income tax.<sup>23</sup> The first model shows the marginal effects of a change in the marginal tax rate on the participation choice for these assets. 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 overall a significant positive influence on ownership and the share of risk assets, albeit the coefficients are not always significant. The estimations for the share of risky assets in total portfolio does not have much observations, as not many individuals do have these assets. The ownership regressions for 1998, 1999 and 2000 suffer from many missing values. Therefore these estimations are probably less reliable. The last regressions in Table 7.1 give the pooled effect for 1993-2000. This longer period has more observations and gives more robust results. The regressions are estimated with the full set of control variables. The effects of the control variables are presented when discussing our preferred model.<sup>24</sup>

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<sup>23</sup> See for example table 7 (extensive margin) and 10 (intensive margin) in Poterba and Samwick (2002), and table 3 in Hochguertel et al. (1997).

<sup>24</sup> The full set of regression results is available upon request by the author.

**Table 7.1 - The effects of the MTR on ownership and share of risky assets by year**

	(1) Ownership	Observations	(2) Share	Observations
1993	0.002	2273	0.25109	251
1994	0.002*	2550	0.84737***	267
1995	-0.000	2258	0.53922**	253
1996	0.003**	1929	0.33712	238
1997	0.006***	1398	0.22859	327
1998	0.007***	777	-0.12359	206
1999	0.003	828	0.62227***	201
2000	0.010**	240	-0.95427*	62
1993-2000	0.003***	12253	0.556***	1805

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1, s.e. clustered on household level. (1): logit regression of equation 5, without IV. (2): OLS regression of equation 6, without IV.

The model in Table 7.1 does not adequately identify the effect of a change in the marginal tax rate because of the two endogeneity problems. First, the variation in the marginal tax rate is not exogenous, because it is determined by individual choices to work more or work less. Second, the marginal tax rate itself is determined by labor and capital income. We solve the latter problem by applying the IV method of Blundell (1998) discussed in section 5. The results are presented in table 7.2. What is notable is that the statistical significance of the marginal tax rate on ownership and on the share of risky assets is smaller than in Table 7.1. This can be explained by low numbers of observation. For the pooled data (1993-2000), the effect is still significant when we consider the intensive margin. The dummies in the first stage regression are jointly significant (p<0,000) in the marginal tax rate equation, suggesting that these dummies are a good instruments.<sup>25</sup>

**Table 7.2 - The effects of the instrumented MTR on ownership and share of risky assets by year, with IV**

	(1) Ownership	Observations	(2) Share	Observations
1993	0.007	2273	0.22536	251
1994	0.015**	2550	-1.35795	267
1995	-0.000	2258	-0.65249	253
1996	-0.005	1929	2.86575***	238
1997	0.009	1398	-0.05191	327
1998	0.013	777	0.11930	206
1999	-0.008	828	0.61213	201
2000	-0.004	240	0.75927	62
1993-2000	0.006*	12253	0.52897**	1805

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1, s.e. clustered on household level. (1): logit regression of equation 5, with IV. (2): OLS regression of equation 6, with IV.

However, the former endogeneity problem is not solved so far. We do this by using the exogenous change in the marginal tax rate that is the result of the Tax Reform of 2001. As

<sup>25</sup> See table A2 in the appendix.

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.

## 7.2 Extensive margin

Table 7.3 provides the estimates of the extensive margin in a cross-sectional setting for the whole dataset (1993-2012). Whereas the results are virtually identical whether we use a logit or probit specification, AIC and BIC criteria indicate that the former model performs slightly better. Equation 5 is estimated for the ownership of risky assets. All standard errors are clustered at the household level.

**Table 7.3** - The effects of the MTR on ownership of risky assets

	(1)	(2)	(3)	(4)	(5)
<i>IV</i>					yes
$\tau/\hat{\tau}$ (mtr)	0.00050***	0.00031	0.00046*	0.00071***	0.0025**
income_2		-0.03216**	-0.01292	-0.02316	-0.038**
income_3		-0.01078	0.00952	0.00252	-0.037**
income_4		0.01530	0.03273*	0.02808	-0.060***
income_5		0.10369***	0.10286***	0.10973***	-0.030**
wealth_2		-0.08021***	-0.09931***	-0.09753***	-0.091***
wealth_3		0.01492	-0.00012	-0.00260	-0.005
wealth_4		0.17330***	0.15812***	0.16093***	0.150***
wealth_5		0.28897***	0.26961***	0.27747***	0.261***
sex		0.06693***	0.10459***	0.07938***	0.116***
age		-0.01065***	-0.00132	-0.00316	-0.00
age <sup>2</sup>		0.00011***	0.00004	0.00005	0.000
partner		0.03489***	0.02579*	0.02278	0.038***
education		0.05845***	0.06382***	0.06490***	0.065***
# children		-0.00980	-0.01243*	-0.01351**	-0.010
unemployed		0.01699	0.01346	0.01677	0.016
perm. contract		-0.02577**	-0.01329	-0.01739	-0.024
risk seeking			0.26487***		0.263***
aex		0.00022***	0.00024***	0.00027***	0.0002***
Observations	48304	31280	24901	24901	24901
Pseudo R <sup>2</sup>	0.000	0.0843	0.1155	0.0878	0.1126
Loglikelihood	-28081.87	-17132.044	-13472.981	-13894.766	-13517.537

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1, s.e. clustered on household level. (1)-(4) logit regression of equation 5, without IV, (5) probit regression of equation 5, with IV.

Model (1) estimates the probabilities 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 not hold in model (2), when we add the control variables to the regression. When we add risk seeking to the regression the results remain almost the same, although the coefficient of the marginal tax rate becomes

significant. The risk seeking variable explains a substantial part of the variance of the ownership of risky assets, as is shown in model (4), where the second model is replicated with the same observations as in the third one, risk seeking matter for the significance of the MTR and not the set of observations.

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. Sex, as defined being female, influences risk taking positively. This suggests that women are more likely to invest in risky assets. Age appears to have no significant influence on the ownership of risky assets. Individuals with a partner take more risk. Those who are more educated have a significant greater chance of owning private equity. King and Leape (1987) hypothesized that the reason for this lies with the information sensitivity of shares, resulting in higher educated individuals having an advantage. Hochguertel et al. (1997) agree with this rationale. The number of children has no consistent significant impact on the ownership choice, but is inclined to have a negative coefficient. Being unemployed and having a permanent contract has no significant effect if risk seeking and the AEX are included. Furthermore, the risk seeking variable influences the choice to invest in risky assets significantly. Being risk-seeking implies a rise of 26.5% in the probability of owning risky assets, which is expected, but still quite large. The variable for the AEX index is highly significant and absorbs the cyclical state of the stock exchange.

By the use of instruments for MTR it is possible to eliminate the endogeneity that plays a role before the Tax Reform. This allows us to provide a more accurate estimate of the actual effect of the Tax Reform. We first estimate the marginal tax rate based on equation 4, then we predict equation 5. According to the F-test, the dummies in the first stage regression are jointly significant ( $p < 0.000$ ) in the marginal tax rate equation, suggesting that these dummies are a good instrument to reduce endogeneity. We find a significant positive effect for the marginal tax rate on the participation in risky assets (5), which is in line with our theoretical predictions. An increase of 10 percent points in the marginal tax rate increases the probability of having a risky asset with 2.5 percent.

### **7.3 Intensive margin**

The literature suggests that there might be a significant positive correlation between the level of the marginal tax rate on capital income and the share of risky assets in the portfolio, given that someone participates in these assets (intensive margin). We present estimates based on equation 6 in table 7.4. We extend this with a model where we instrument the marginal tax rate by cohort and level of education.

**Table 7.4 - The effects of the MTR on the share of risky assets in total portfolio**

	(1)	(2)	(3)
<i>IV</i>	no	no	yes
$\tau / \hat{\tau}$ (mtr)	-0.001	0.099***	0.334***
income_2		-6.328***	4.892*
income_3		-3.752**	0.221
income_4		-3.186*	-2.968
income_5		-0.596	-2.020
wealth_2		-10.263***	-11.083***
wealth_3		-22.715***	-22.409***
wealth_4		-26.858***	-28.261***
wealth_5		-21.377***	-24.552***
sex		2.629*	5.612***
age		-0.119	-0.267
age <sup>2</sup>		0.004	0.006*
partner		-1.766	-0.117
education		0.779	-0.169
# children		-0.106	0.040
unemployed		0.999	2.417*
perm. contract		-0.423	-2.588*
risk seeking		4.947***	5.062***
aex		0.018***	0.012***
constant	22.451***	24.128***	15.784*
Observations	6469	4959	4959
Adj. R-squared	-0.00	0.19	0.19

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1, s.e. clustered on household level. All OLS regressions of equation 6: share of risky assets in total portfolio. (1), (2): without IV. (3): with IV.

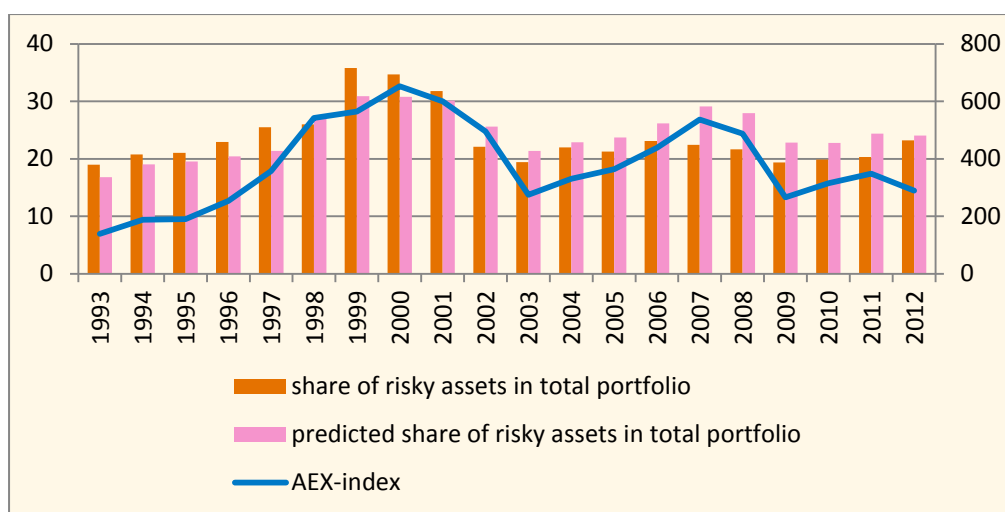
Model (1) of table 7.4 presents the primary link between the marginal rate and the proportion of equity in total assets. This regression is expanded in model (2) with the set of control variables. Including these variables, the effect of the marginal tax rate on the share of risk in portfolio is positive and significant. Decreasing the marginal tax rate with 10 percent point yields a reduction of the share of risky assets in total portfolio of 1 percent point. Furthermore, lower incomes are associated with lower shares of risky assets in total portfolio. It's remarkable that this does not hold for wealth. Risk seeking and the AEX take the expected sign.

Also at the intensive margin, we extend the model to a two stage least square estimation, thereby solving the discussed endogeneity problem for the marginal tax rate before 2001 (model (3)). IF MTR is instrumented the coefficient is also positive and significant. The effect of the marginal tax rate has tripled. A decrease of 10 percent point in the marginal tax rates yield an reduction of 3.3 percent point in the share of risky assets in the total portfolio. The variables for income are no longer significant, which can be explained by the use of instruments: cohorts

and education also create exogenous variation in income. Being a female has a significant positive effect on the level of risk taking in portfolio, even if we include risk seeking.

We apply the approach of Saez, Slemrod and Giertz (2009) as a robustness analysis. We did the usual estimates (equation 3) for the years 1993 to 2000, without IV. Those estimates are used for predicting the share of risky assets in the total portfolio for the whole period (assuming that the old tax system holds) and shown in figure 7.1. Also the AEX stock index average is presented. The individual tax rates for the years after the Tax Reform are calculated with the tax system of 2000.

**Figure 7.1 - Comparison of predicted and actual share of risky assets in total portfolio (own calculations)**



We observe that the prediction is rather good. In table 7.5 the results are presented for equation 8 using OLS regressions. In regression (2) the data are limited until 2005, because of the unreliability of the predictions in the long run.

Both regressions show that the difference between predicted and actual marginal tax rates explain to some extent the difference between the expected and the actual share of risky assets in total portfolio. The coefficient is positive, suggesting that a lower MTR on capital income reduces the share of risky assets in the portfolio. This corresponds to our previous results in table 7.5 and suggests that our estimates from the IV-approach are robust to specification issues. The effect is larger in the years up to 2005, which is expected, because of the higher accuracy of these observations.

**Table 7.5 - The differences between the predicted and actual data for the share of risky assets in total portfolio**

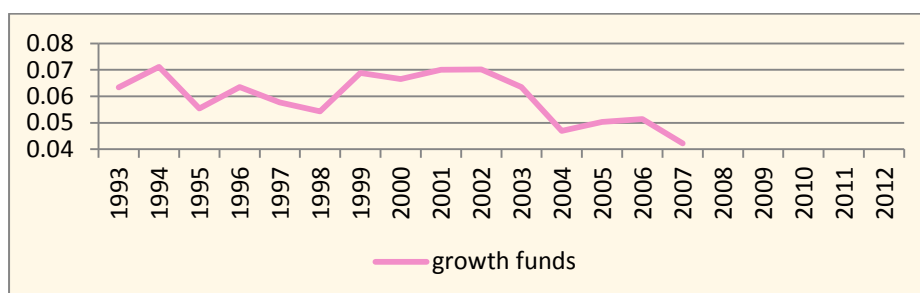
	(1)	(2)
$\Delta\tau$ (mtr)	0.085*	0.255***
income_2	-6.847***	-5.176**
income_3	-0.261	2.193
income_4	-3.548**	-1.379
income_5	-3.694*	-0.685
wealth_2	-2.906**	-2.738
wealth_3	-2.789**	-5.912**
wealth_4	-6.101***	-6.514***
wealth_5	-10.296***	-9.185***
sex	-4.947***	-8.422***
age	0.753***	0.662*
age <sup>2</sup>	-0.006***	-0.006*
partner	1.897**	-0.299
education	0.316	-1.272
# children	-0.382	-0.477
unemployed	-5.162***	-2.741
perm. contract	2.801***	3.120
risk seeking	1.834**	1.886
aex	-0.010***	-0.008
Constant	-12.467**	1.522
Observations	3154	984
Period	2001-2012	2001-2005
R-squared	0.06	0.07

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1, s.e. clustered on household level. All regressions are estimates of equation 8. (2): data limited to 1993-2005.

## 7.4 An extension - Growth funds

Figure 7.2 shows the ownership of growth funds. Their probabilities of having such funds decreases from 2001, until 2005. After 2007 the questions about growth funds were not included in the DNB Household 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 rates for these funds.

**Figure 7.2 - ownership probability of growth funds (DNB Household Survey)**



To see which variables form the main explanation for the ownership of funds in the total portfolio risk new estimate equation 5 for growth funds. Model (1) uses the pooled logit estimation. These results suggest in particular that a higher marginal tax rate indeed has a positive effect on the ownership probabilities of growth funds. This is in line with our expiations: when the added value of the growth funds diminishes it is clear that their attractiveness has to decrease. When we instrument the marginal tax rate in model (3) with dummies for education and cohort, the significance remains, suggesting that there is actually an effect of the marginal tax rate on the ownership of growth funds. Due to lots of missing values in the data for the *intensive margin*, we are not able to derive conclusions from these estimations.

**Table 7.6 – effect of the marginal tax rate on the ownership of risky assets**

	(1)	(2)
IV	no	yes
$\tau$ (mtr)	0.001***	0.002***
income_2	-0.004	-0.005
income_3	-0.008	-0.006
income_4	-0.014*	0.001
income_5	0.005	0.004
wealth_2	-0.018**	-0.015*
wealth_3	0.003	-0.001
wealth_4	0.038***	0.031***
wealth_5	0.082***	0.064***
sex	0.016**	0.041***
age	-0.002	-0.003**
age <sup>2</sup>	0.00002*	0.00003**
partner	0.0005	0.010
education	0.017***	0.008
# children	-0.004	-0.001
unemployed	0.002	0.014
perm. contract	-0.014**	-0.036***
risk seeking	0.043***	0.046***
aex	0	-0.00001
Observations	19496	19496
Pseudo R-squared	0.05	0.071
Loglikelihood	-4447.7838	-4477.9994

\*\*\* p<0.01. \*\* p<0.05. \* p<0.1. s.e. clustered on household level. All logit-regression of equation 5. (2): with IV.

## 8. Conclusion

In the previous sections we investigated the effects of the marginal tax rate on the savings behavior of the Dutch. According to our theoretical model, a higher marginal tax rate should result in a higher proportion of risky assets. This would also lead to larger participation in these



assets. Other research has confirmed these considerations empirically. Furthermore, Alan et al. (2010) already indicate that the largest effects are found in pooled estimates that suffer from the endogeneity problem.

We were able to replicate the results of Hochguertel et al. (1997) and Poterba and Samwick (2002). However, both papers suffer from an endogeneity problem. We solve this issue by applying two methods. First, we use the exogenous variation in marginal tax rate resulting from the Tax Reform of 2001. Second, we have instrumented the marginal tax rate by birth cohorts and education. It turns out that they are both applicable as instruments. By applying these solutions, we extend the existing literature on this field of research. This has, as far as we know, never been applied in this area and thus provides new results. By creating exogenous variation in the marginal tax rate we avoid the endogeneity problem and we identify the real effects.

With the addition of both solutions for the endogeneity we still find significant results. The increase of the marginal tax rate of 10 percent points results in a 3 percent point increase of the share of risky assets in total portfolio. That increase in marginal tax rate also enlarges the probability of having these assets with 2.5 percent. These results suggest that there is really a (substantial) effect of marginal tax rates on the decisions on portfolio allocation.

We also find these results for growth funds, although the intensive margin cannot be studied due to a lack of observations. Combining both results suggest that the abolition of the tax exemption of capital gains substantially affected the choice of individuals, both in their decision to participate and in their decision on the level of investment.

In another specification based on the work of Saez et al. (2009) we find almost the same results, suggesting that our findings are robust against specification issues.

This research extends the literature in two ways. First, we solve the endogeneity issues of the marginal tax rate in a satisfactory way by applying instrumental variables to our regressions. Education level and birth cohort create exogenous variation in income, wealth and marginal tax rate. As far as we know, this technique has never been applied in this field of research. Second, we study the major Tax Reform of 2001 in the Netherlands, which has strong effects on the marginal tax rate of individuals. We observe differences in the marginal tax rates from 60% towards zero. By exogeneity of these differences we are more able to investigate the actual impact on asset allocation. Moreover, the Tax Reform of 2001 has never been studied in this way, although the introduction of the new tax system with taxes on the assumed return on wealth in a different box from labor taxation was a unique change. This study attempts to fill this gap.

There are some issues that might challenge the sign or the magnitude of our findings, although our results are highly significant and occur in almost all of our specifications. First, in this study we find a relatively high number of missing values, particularly around the years of 1999/2000. This problem applies to most of the recent studies in this field. See for example Hochguertel et al (1997), they present their results with less than 200 observations. We are able to strengthen our findings by enlarging the sample over time, but the lack of observations did not permit us to focus only on those individuals with interview data before and after the reform.

Second, there may be mixed effects on risky assets. From the theoretical model, we expect that after the review of 2001, the share of equity decreases, because it is less attractive to bear risk. In addition, the growth funds were abolished and thus lost their attractiveness compared with ordinary risky assets. These are two opposite effects on risk-bearing wealth, resulting in possibility that the combined effect on risky assets might be even larger.

Third, the period of our study coincides with the rises and downturns in the equity markets in the end of the 20th century. The so-called dot.com bubble created a run on the market. However, the popularity of shares decreased rapidly after 2001. As shown in figure 5.3 the AEX and the share of risky assets in total portfolio follow somewhat the same pattern. This means that a large part of the increase in the share of risky assets is caused by increases in the prices of shares. Moreover, it is likely that higher prices are attractive and encourage people to invest in shares, which might lead to herd behavior. We believe this to be sufficiently corrected by adding the AEX as explanatory variable, for its high significance.

Fourth, the question arises as to what extent people let themselves be influenced by a reduction in the marginal tax rate. There was still an income tax, even though it was not dependent on income. It is conceivable that the Dutch individual is not a *homo economicus* and has no knowledge of risk participation in an income tax on capital. According to Mullainathan and Thaler there are three main ways in which humans deviate from economic theory (2000). First, they argue that individuals have limited cognitive abilities and are not always able to solve their optimization problems. Second, bounded willpower suggest that agents sometimes make choices that are not in their interest in the long-run. Third, sometimes people do not only act in their own interest, but also care for others. We think that in this case the first way is explaining most of the lack of consistent effects. Especially the risk-sharing with the government might be unknown to the public. However, we believe that our results are so strong that the effect must be attributable to changes in behavior of individuals.

The literature review showed that the existing economic theory assumes that people respond to the marginal tax rate. Our empirical results indicate that this is indeed the case in the

Netherlands. The abolition of the preferential treatment of capital gains seems to have gotten its effect. The arbitrage that appears before 2001 seems to be eliminated. The share of risky assets in total portfolio of the Dutch has been significantly reduced. These results imply that policy makers should be aware of the behavioral effects of individuals. Considerations to tax capital income again should be influenced by our findings. By taxing assets differently, the government distorts the market equilibrium and creates a Harberger triangle. However, it might be possible that the government wants to stimulate risk taking. This for example enlarges the growth possibilities of firms, which investments are specifically more risky. The larger amount of capital available boosts the economy in that way. The government needs to evaluate both the distortionary effects and the positive effects of taxing some goods differently.

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## 10. Appendix

Table 10.1

VARIABLES	(1) marginal tax rate
perdum1993	19,05091***
perdum1994	18,63769***
perdum1995	16,78513***
perdum1996	13,34231***
perdum1997	8,34851**
perdum1998	1,00499
perdum1999	1,57179
edu1_coh2	3,58546
edu3_coh2	-0,12732
edu4_coh2	7,60067**
edu1_coh3	2,44849
edu3_coh3	0,30158
edu4_coh3	3,4635
edu1_coh4	10,40749***
edu3_coh4	1,78231
edu4_coh4	-3,20433
edu1_coh2_per1993	-8,63701**
edu3_coh2_per1993	-0,84457
edu4_coh2_per1993	-4,97273
edu1_coh3_per1993	-0,69676
edu3_coh3_per1993	-0,72378
edu4_coh3_per1993	-6,77151
edu1_coh4_per1993	-0,03949
edu3_coh4_per1993	13,13968
edu1_coh2_per1994	-5,03907
edu4_coh2_per1994	-6,20416*
edu1_coh3_per1994	-0,65475
edu3_coh3_per1994	0,35343

edu4_coh3_per1994	-0,027
edu3_coh4_per1994	3,44747
edu1_coh2_per1995	-9,35092**
edu3_coh2_per1995	-0,90403
edu4_coh2_per1995	-5,94002
edu1_coh3_per1995	-2,64536
edu3_coh3_per1995	1,49186
edu4_coh3_per1995	0,66961
edu1_coh4_per1995	-4,44655
edu4_coh4_per1995	8,13994
edu1_coh2_per1996	-2,45893
edu3_coh2_per1996	-2,02717
edu4_coh2_per1996	-8,78029*
edu1_coh3_per1996	-6,18904
edu3_coh3_per1996	1,10945
edu4_coh3_per1996	-4,47179
edu1_coh4_per1996	-15,09363**
edu3_coh4_per1996	-5,82924
edu4_coh4_per1996	5,82595*
edu1_coh2_per1997	-5,36092
edu3_coh2_per1997	0,94955
edu4_coh2_per1997	-4,11426
edu1_coh3_per1997	-0,2111
edu3_coh3_per1997	2,86358
edu4_coh3_per1997	-2,01397
edu1_coh4_per1997	-5,68765
edu3_coh4_per1997	1,23572
edu4_coh4_per1997	9,35322***
edu1_coh2_per1998	-7,12956
edu3_coh2_per1998	4,82738*
edu4_coh2_per1998	-4,73832
edu1_coh3_per1998	1,74741
edu3_coh3_per1998	-1,73474
edu1_coh4_per1998	-3,26432
edu3_coh4_per1998	6,80694
edu4_coh4_per1998	19,62403***
edu1_coh2_per1999	-4,44187
edu3_coh2_per1999	-0,72723
edu3_coh3_per1999	1,71139
edu4_coh3_per1999	-2,2408
edu1_coh4_per1999	-15,23871***
edu3_coh4_per1999	2,86512
edu4_coh4_per1999	13,27592***
edu3_coh2_per2000	-2,18651
edu4_coh2_per2000	3,47267
edu1_coh3_per2000	-4,51691
edu1_coh4_per2000	-1,98935
edu1_old	-0,93031
edu3_old	-6,64491***
edu4_old	6,36116**
edu1_old_per1993	-0,41016
edu3_old_per1993	3,45844
edu4_old_per1993	-4,54476*
edu1_old_per1994	0,97065
edu3_old_per1994	3,6691
edu4_old_per1994	-7,90585***

edu3_old_per1995	6,13141**
edu4_old_per1995	-5,31425**
edu1_old_per1996	-1,49477
edu3_old_per1996	5,98838**
edu4_old_per1996	-2,24464
edu1_old_per1997	1,22462
edu3_old_per1997	7,58550***
edu4_old_per1997	-0,7942
edu1_old_per1998	-2,49999
edu3_old_per1998	8,36292***
edu4_old_per1998	-3,34846
edu1_old_per1999	2,43358
edu3_old_per1999	7,96030**
edu1_old_per2000	-0,07088
income_2	-5,76666***
income_3	-7,68056***
income_4	-2,48407**
income_5	-0,66813
wealth_2	0,38641
wealth_3	2,04535*
wealth_4	3,20137**
wealth_5	7,43429***
sex	-10,58489***
age	0,85807***
age <sup>2</sup>	-0,00651***
partner	-3,85721***
education	2,35337**
number of children	-0,35893
unemployed	-4,34024***
permanent contract	6,76634***
riskseeking	0,0443
aex	0,02757**
F-test of joint significance ov IVs	12,15***
Observations	1805
Adjusted R-squared	0,96

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